THEOPHRASTUS

DE LAPIDIBUS

EDITED WITH INTRODUCTION,
TRANSLATION AND COMMENTARY
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TRANSLATION

ON STONES

I. 1. Of the things that are formed within the earth, some are of water and some of earth. Of water are metals, like silver, gold, and the rest; while of earth are stone, including the more unusual kinds, and those varieties of earth that are at all peculiar in colour, smoothness, solidity, or some other quality. Metals, however, have been considered elsewhere, and it is the latter that we have now to discuss. 2. Generally speaking, we must suppose that all these latter things are formed of a pure and uniform matter, this matter being produced as a result either of a 'conflux' or of 'filtering' or, as has been explained above, of some other process of separation: some of this matter may possibly be produced by the one process, some by the other, and some in yet a different way. It is from this matter, to be sure, that stones and earths derive smoothness, solidity, lustre, transparency, and other qualities of this kind, qualities which are present in a varying degree according to the purity and uniformity of the matter of which each of the stones or earths is composed. For in general it is the perfection, greater or less, of the matter subjected to composition or solidification that directly determines the qualities derived from that matter. 3. This solidification is due in some cases to heat and in others to cold, for there may be nothing to prevent certain kinds of stone from being formed either by heat or by cold; although it would seem that the earths at any rate are all formed by fire, since the process whereby a thing is solidified and the process whereby it suffers dissolution belong to contrary *genera*. As for peculiarities, these are more numerous in stones than in the earths. Indeed, so far as the earths are concerned, most of the characteristic differences are in respect of colour, viscidity, smoothness, solidity, and the like: differences in other respects are rare. 4. Stones, however, while possessing these same differences, have, in addition to such differences, others in respect of their capacity (*a*) to act on other substances, or (*b*) to react to them, and to fail so to react. For instance, (*b*) some stones can be melted while others cannot be, some are combustible while others are not, and so forth. Moreover, in the

very process of combustion or, rather, of exposure to fire stones exhibit many differences. Again, (*a*) some stones, the *smaragdus* for example, have the power of communicating their colour to water, and others that of completely petrifying objects placed in them. Some have a power of attraction, and others that of testing gold and silver, like the so-called 'Heraclean' and 'Lydian' stones. 5. But the greatest and most remarkable power, if this is true, is that possessed by the stones which bring forth other stones. What is more familiar than these capacities and more frequent in its occurrence is that which concerns the working of stones. For some can be carved or turned on a lathe or sawn, while on others an iron tool makes only a poor and slight impression, and on others no impression whatsoever. There are many other differences in regard to the working of stones. 6. Numerous stones, then, possess characteristic differences in respect of colour, hardness, softness, smoothness, and other such qualities which cause them to be exceptional. Moreover, in some cases at least, these differences belong to the stone of a whole region. As instances, there are of course the celebrated quarries of Paros, Pentelicus, Chios, and the Thebaid; there is the *alabastrites*, which likewise is hewn in large pieces, being found near the Egyptian Thebes, and a stone like ivory known as the 'chernites', in a coffin of which Darius is said to be buried. 7. Again, there is the (Egyptian) *poros*, which is similar to Parian marble in colour and compactness, and possesses merely the lightness of ordinary *poros*: hence the Egyptians use it for courses in their fine buildings. There is found in Egypt, moreover, a black stone, transparent like that of Chios, and many others elsewhere. Numerous stones, then, partake of characteristic differences such as these, as was stated above. On the other hand, those differences previously described which stones possess in virtue of the capacity to act or react do not similarly belong (*a*) to a whole region, or (*b*) to continuous masses of stone, or (*c*) to stones of great size. 8. In fact, some of the stones to which they belong are (*a*) very rare and (*c*) small, for example the *smaragdus*, the 'sard', the *anthrax*, the *sapphirus*, and indeed almost all the stones that rank among those carved into signets. And some are (*b*) actually found inside other stones when these are split. The stones which have to do with burning and combustion also are few in number; and it is the characteristic differences of these stones that we should perhaps first describe and enumerate.

τοῖς ὅλοις (ἄλλοις M) *codd.* 8 ἔνιοι FLM: ἐνίοις *ceteri.* σπάνιοι] σπανίοις CE. οἱ ἐν λόγῳ τῶν *ego*: *lacunam ante* λόγον *codd., Wimmer.* σφραγίδια] σφραγίδα F.

II. 9. Burning causes some stones to melt and become fluid. Take, for instance, those found in mines. When silver and copper and iron become fluid, the stone from them becomes fluid at the same time, possibly owing to the moist character of its constituents or possibly indeed through the agency of the metals. Similarly *pyromachi* and millstones become fluid along with the material heaped upon them by those who burn it. Some people even assert outright that all stones melt with the exception of limestone, which is calcined and turns into lime. 10. But this appears to be entirely an exaggeration, because there are many stones that break and burst asunder more violently even than earthenware in their struggle to resist the action of fire. This is actually what is to be expected of stones that have lost their moisture, since whatever is capable of being melted must be humid and contain much moisture. 11. It is said that some stones that are exposed to the sun dry up so completely that they are useless unless they are wetted and moistened again, while others are in consequence softer and more friable. It is clear that both kinds of stone are deprived of their moisture by the sun, but that the compact stones happen to harden as they dry, while the porous stones or rather those of porous consistency are rendered friable and brittle. 12. Some of these friable stones, when they are burnt, glow like charcoal and last a long time, as for instance those found in the mine near Binae which are washed down by the river there. When these are covered with charcoal, they burn and continue to do so as long as anyone blows upon them. After this they die down and are kindled again, and thus retain their use for a considerable time. Their smell, however, is very strong and disagreeable. 13. The stone known as 'spinos', which used to exist in these mines, burns when it is placed in the sun if it has been previously split up and arranged in a heap; and it burns all the more fiercely when water has been sprayed and sprinkled on and around it. 14. The Lipara stone, which before burning is black, smooth and dense, is not only rendered porous by combustion, but also assumes the appearance of pumice, so that its colour changes along with its density. This stone does not occur as a continuous mass, but is found in separate 'cups' here and there amid the pumice, just as in Melos the pumice is said to be found within another stone. Thus

περιρράνῃ] *περιράνῃ codd., edd.* 14 *ἐκποροῦται ego*: *ἐκπωροῦται coni. Salmasius*: *ἐκφοροῦται codd.* *τε om.* E. *δ' οὗτος*] *δὲ οὗτος Schneider, &c.* *χυτριδίῳ* (*pro quo in archetypo scriptum esse videtur κυθριδίῳ*) *ego*: *κυθρισμῷ* ADFGKLMN: *κυθρρισμῷ* C: *κυθερισμῷ* E: *κυττάρῳ Schneider, &c.*: *κυτταρείῳ Furlanus.* *εἴη ἂν ego*: *εἰ μὲν* FK²: *lacunam post εἰ* E: *εἰ μαν ceteri codd.*: *ἐκεῖνος μὲν Furlanus.* *τούτῳ*] *τοῦτο* K².

there exists, so to speak, an inverse relationship between the Lipara stone and this Melian stone, except that the Melian stone is dissimilar to that of Lipara. 15. The stone found in Sicily at Tetras, which is opposite Lipara, is also rendered porous, while the stone which is burnt in large quantities on Cape Erineas in the same manner as that of Binac gives off the odour of asphalt, and the residue left by its combustion is like calcined earth. 16. Those stones which on account of their use are dug under the simple title of 'anthrakes' are earthy, but are ignited and burnt like charcoal. They are found in Liguria, where amber also exists, and in the territory of Elis on the mountain track leading to Olympia, and are used by smiths. 17. A stone which was found in the mines of Scaptehyle was similar in appearance to rotten wood, and would burn if olive oil was poured on it. When the oil had burnt away, the stone itself also would stop burning just as though it were unaffected by fire. These, then, are substantially the characteristic differences of stones that are burnt.

III. 18. There is another kind of stone known as 'anthrax' which is quite incombustible, just as though it were formed of matter contrary in nature. Signets are carved of it. It is of a red hue and when placed towards the sun produces the colour of live charcoal. This stone, which is imported from Carthage and Massilia, is virtually the most valuable, an extremely small specimen fetching forty gold staters. 19. Again, the stone from the neighbourhood of Miletus, which is angular and contains hexagons, does not burn. This too is called 'anthrax'. What is also surprising (and incidentally the properties of the *adamas* are in a manner similar) is that it does not seem in any way to be the absence of moisture that makes the *anthrax* incombustible, as is the case with pumice and cinders. These indeed are unaffected by fire and are incombustible precisely because their moisture has been removed. For pumice in general is held by some to be produced through a process of combustion, except for the kind that is formed of sea-foam. 20. Their belief is derived from their observation of the pumice found near volcanic craters and also of the 'corroded' stone, which gives off flames and becomes just like pumice. The regions in which the formation of pumice occurs do in fact seem to support this conclusion, since it is mostly in those which are volcanic

ceteri. δόξειεν *Turnebus*: δόξειε δ' *codd.* ἐξῃρῆσθαι] ἐξηρεῖσθαι FKL *Aldus.* ἐπεί] ἐπὶ N. 20 γενομένων *codd.*: γινομένων *Schneider.* διαβόρου *Liddell & Scott*[9] (*s.v.* διάβαρος): διαβάρου *codd.* ἢ κισσηροῦται EK *Turnebus, Caley & Richards*: οὐ κισσηροῦται F *Aldus, Wimmer*: ἡ κισσηροῦται M: ἢ κ. *ceteri*: ἢ καὶ κ. *Furlanus, Schneider.*

that pumice exists. 21. But it is possible that, while some pumice is formed under such conditions, some is formed differently, and that there are several ways in which it is generated. For instance, the pumice of Nisyros appears to consist of a kind of sand. Evidence for this is derived from the fact that, when they are handled, some of the pumice-stones found there crumble into a kind of sand because they are not yet completely formed and solidified. Numerous pumice-stones are found clustered together in small pieces when the top soil is scraped away, the stones being approximately large enough to fill the hand or a little larger. Even the sand is of extremely light weight. On the other hand, all the pumice of Melos is heavy (?), and some of it is found within another stone, as was said before. 22. Pumices differ from each other in colour, solidity, and weight. They differ in colour inasmuch as the pumice from the Sicilian lava-flow is black, while in solidity and weight it is quite like a millstone. For pumice of this kind does indeed exist, weighty and solid and more valuable in use than the other kind. This pumice from the lava-flow is a better abrasive than the kind which is light in weight and white in colour, although that which comes actually from the sea is the best abrasive of all. So much for pumice. As for the stones from which we digressed to this subject, namely the stones that are affected and unaffected by fire, the causes of their behaviour must be considered elsewhere.

IV. 23. Other stones, of which signets are carved, are also found to be unusual. Some of these, the 'sard' and the *iaspis* for example and the *sapphirus*, which is speckled as if with gold, are unusual only in their appearance. The *smaragdus*, on the other hand, possesses also certain powers. For, as we have mentioned, it imparts its colour to water, the largest size affecting the whole volume of water, an average stone a smaller volume, and the poorest kind only the water adjacent to it. 24. Moreover, it is good for the eyes, and signets carved of it are worn to be looked at. It is, however, rare and of no great size, unless we are to trust the records relating to the kings of Egypt, according to which there was once brought to them, among other gifts from the king of

τῆς κισσήριδος] *τῆς om. Wimmer.* 23 *ἄλλαι* ⟨*περιτταὶ*⟩ *ego*: *ἄλλαι* ⟨*διάφοροι*⟩ *Wimmer, Caley & Richards*: *lacunam post ἄλλαι codd.* *ἡ ἴασπις* FKM (*ἡ om.* M): *ἡ ἄσπις ceteri.* *μὲν*] *μὲν οὖν* BDHJ. *παντός Turnebus*: *πάντων* E: *πάντως ceteri.* 24 *σφραγίδια φοροῦσιν* F *edd.*: *σφραγίδια διαφοροῦσιν codd.* *ἐκείνοις Turnebus* (*in versione*), *Wimmer, Caley & Richards*: *σμαράγδους* B^2H: *lacunam ante νους ceteri codd.*: *ἔνιοι Furlanus, Schneider.* *κομισθῆναι* EF: *κομησθῆναι* K^2LM: *κοσμηθῆναι* ACDGK^{1}N.

Babylon, a *smaragdus* which was four cubits long and three cubits broad. It is also stated that at the temple of Zeus there stand four obelisks of *smaragdus*, forty cubits in height with a breadth of four cubits at one extremity and two at the other. These, then, are the facts according to the records of the kings of Egypt. 25. As for the stones known to many as Laconian *smaragdi*, the largest is the one at Tyre, where a great block stands in the temple of Heracles, unless indeed this is a false *smaragdus*, of which a kind also exists. There are two accessible and well-known places where the *smaragdus* is especially to be found, namely the copper mines of Cyprus and those of the island opposite Chalcedon. It is in this island that it comes to light in the more remarkable way. For here this kind of stone, which in Cyprus extends independently in numerous veins, is mined under the same conditions as the rest of the minerals. 26. But only a few of the stones found attain the size of a signet. The majority are smaller and are consequently used for soldering gold, which the *smaragdus* solders as effectively as does chrysocolla. Some people, indeed, assume that the two are identical in nature. Incidentally, they are identical in colour, but chrysocolla is abundant in gold-mines and still more so in copper-mines, as in those of these regions, (27) whereas the *smaragdus*, as has been said, is rare; and this is because it is apparently formed from the *iaspis*. It is stated that in Cyprus a stone was once found one half of which was a *smaragdus* and the other half an *iaspis*, as though the transformation of the stone from water were not yet complete. There is a method of working the *smaragdus* so as to achieve brilliance. If it is unworked, it is dull.

V. 28. Like the *smaragdus*, the *lyngurium*, which is carved into signets and is as hard as any stone, has an unusual power. For it attracts other objects just as amber does, and some people claim that it acts not only on straws and leaves, but also on thin pieces of copper and iron, as Diocles maintained. The *lyngurium* is cold and very clear. A wild lynx produces better stones than a tame animal, and a male better ones than a female, there being

κύθρῳ ceteri. *ἀργὴ Schneider*: *ἀρχὴ codd.* 28 *αὕτη Turnebus (in versione), de Laet*: *αὐτὴ codd.* *φύλλα coni. Wimmer*: *ξύλον codd. An ξύσματα?* *ἔστι δὲ Schneider*: *ἔτι* F *Aldus*: *ἔτι δὲ ceteri codd.* *διαφανῆ codd.*: *διαφανές Schneider, &c.* *σφόδρα καὶ*] *καὶ σφόδρα καὶ* C¹E¹. *ψυχρά codd.*: *ψυχρόν Schneider, &c.*: *πυρρά Furlanus.* *βελτίω de Laet*: *βέλτιον codd.* *τὰ τῶν (quater) codd.*: *τὸ τῶν Schneider, &c.*

a difference in diet, in the exercise taken or not taken, and, in general, in the natural constitution of the body, inasmuch as the body is drier in the case of the former and more moist in the case of the latter. The stone is discovered only when experienced searchers dig it up, for when the lynx has passed its urine, it conceals it and scrapes soil over it. Moreover, the *lyngurium* needs considerable working. 29. Similarly amber is a stone (for the amber of Liguria is dug from the earth), and of this likewise a power of attraction is an attribute. However, the stone with the strongest and most conspicuous power of attraction is clearly that which draws iron, but this stone too is rare and is found only in a few places. It should of course be included in our list as possessing such a power. 30. There are many other stones, too, of which signets are made, such as the *hyaloides*, which reflects images as well as being transparent, the *anthrakion* and the *omphax*. Again, we have the rock-crystal and the amethyst, both of which are transparent and are found, like the 'sard', by splitting certain rocks. Then there are some which, as we mentioned before, differ from each other although they share the same name. For instance, there is the 'sard', of which the transparent, ruddier kind is known as the 'female', while the transparent but darker variety is known as the 'male'. 31. The same is true of the *lyngurium*, the 'female' being the more transparent and the paler. *Cyanus* also is termed 'male' and 'female', the 'male' variety being the darker. The onyx is a mixture of white and grey arranged in parallel layers, while the amethyst has the colour of red wine. A handsome stone which fetches a high price is the agate from the river Achates in Sicily. 32. In the gold-mines at Lampsacus a remarkable stone was once found. This was taken to Astyra (?), where a signet was carved from it and sent to the Persian king because it was so unusual.

VI. 33. These stones are rare as well as beautiful, but those of Greece are of course less valuable. We may take as examples the *anthrakion* of Orchomenos in Arcadia, which is darker than the Chian stone and is made into mirrors, and the stone of Troezen, which is variegated dark-red and white. The Corinthian stone is similarly variegated, except that the white has a yellow tinge. 34. In general, there are many stones of this kind to be met with,

Τίραν Turnebus: *ἡμέραν Rossbach.* *γλυφθὲν Turnebus*: *γλυφερὸν codd.* *βασιλεῖ*] *⟨Ἀλεξάνδρῳ⟩ βασιλεῖ Schneider, Wimmer (Ἀλεξάνδρῳ βασιλεῖ Turnebus).* 33 *ἐξ Ὀρχομενοῦ Turnebus; cf. Plinium* 37. 97: *ἐξορχομενου* B^2H^2: *ἐξερχόμενον* (*δ' ἐξερχόμενον* K) *ceteri.* *κάτοπτρα Turnebus; cf. Plinium* 37. 97: *κάθοπτρα* B^2: *καθὸ* B^1DFJN: *κάθοπτος καθὸ* H: *κα** E: *καθοὶ* ACGKLM. *τὸ λευκὸν χλωροειδέστερον* B^2H: *λευκὸν om. cum lacuna ceteri codd.* (*τὸ om.* E): *ὅτι χλωροειδέστερος Schneider, &c.*

but the remarkable ones are rare and come from only a few places, from Carthage for example, from the districts near Massalia, from Egypt around the Cataract and Syene near the city of Elephantine, and from the region known as Psepho. 35. And in Cyprus there is the *smaragdus* and the *iaspis*. Those stones used in inlay work come from the neighbourhood of the Bactrian Desert and are collected by expeditions of men on horseback in the season of the Etesians, when the high winds shift the sand and expose them to view. The stones are small, or rather, not large. 36. The so-called 'pearl', which is transparent in nature and is made into costly necklaces, also ranks as a precious stone. It grows in an oyster which is comparable to the *pinna*, but smaller. The dimensions of the pearl are those of a fish's eye of large size, and it is produced off the coast of India and certain islands in the Red Sea. These, then, are substantially the stones which possess an unusual character. 37. There are also others, for example fossil ivory, which has black and white markings, the stone known as *sapphirus*, which is dark and does not differ greatly from the 'male' kind of *cyanus*, and the *prasitis*, which has the colour of verdigris. A solid stone is the *haematitis*, which has a dull appearance and, as its name implies, looks like congealed blood. Another stone is the so-called 'xanthe', which is not so much yellow in colour as whitish, 'xanthos' being the term used for this colour in the Dorian dialect. 38. Incidentally, the coral, which is just like a stone, is red in colour and rounded like a root, and grows in the sea. In some respects the Indian reed, when it has turned to stone, is not so very different from coral in nature. These, however, call for separate consideration.

VII. 39. There are also many kinds of stone extracted from mines. Of these, some contain gold as well as silver, but only the silver is clearly perceptible. Their weight is rather heavy and their smell rather offensive. There is also a natural *cyanus* which contains chrysocolla, and another stone which is like charcoal in colour, but heavy. 40. One could find quite a number of peculiarities belonging to such stones. 41. However, certain stones have also powers of the kind mentioned earlier, in that they do not react to extraneous forces: for example, they cannot be carved

ego. καὶ κατὰ *Turnebus (in versione), Schneider*: ἡ κατὰ *codd.* δ' ἡ καλουμένη ξανθή K² *Turnebus (in versione), Schneider* (δὲ ἡ) : δὴ καλουμένη (δὴ A, δὲ EJ) *codd.* δὲ μᾶλλον ὃ *Turnebus (in versione), Schneider*: δ' ὃ μᾶλλον *codd.* Δωριεῖς E: δωρεῖς *ceteri.* 38 ὡς ἂν] ἂν *om. Wimmer.* 39 ἔνιαι *Furlanus*: ἔνια *codd.*: ἔνιοι *Turnebus.* δ' ἔχουσα *Schneider*: δ' ἔχουσι *codd.* (δὲ *Wimmer*). 40 τὸ ὅλον . . . ὅμοια τούτοις *ex initio huius sectionis in* § 50 *transtuli; vide commentarium ad loc.*

by iron tools, but only by other stones. Generally speaking, even the larger stones differ greatly in the methods of working that they admit. For, as we stated earlier, some can be sawn, and others carved or turned on a lathe, like this 'magnetis', which indeed has an unusual appearance and is admired by some for its likeness to silver, although it is in no way akin to it. 42. There are fairly numerous stones, however, that admit of every method of working. For example, a stone of this kind which is dug in the island of Siphnos about three furlongs from the sea is round, clod-like, and soft enough to be both turned on the lathe and carved. But when it is dipped in oil and fired, it becomes extremely dark and hard. Tableware is made of it. 43. All stones of this kind submit to the force of iron, but certain others, as we have said, cannot be carved by iron tools, but only by other stones. Some again may be carved by iron tools, but only if they are rather blunt. There are also other differences of this kind (?). It is almost equally strange that some stones are not quarried by iron (?). And yet in general the more recalcitrant substances are cut more strongly by iron, which is harder than stone (?). 44. It is also strange that, while whetstones erode iron, iron in its turn should be able to split and shape whetstones and yet be powerless similarly to affect stones of which signets are made. Moreover, the whetstone and the stone by means of which signets are carved are of similar, if not identical, material. The best whetstones come from Armenia. 45. The character of the stone that tests gold is remarkable in that it appears to have the same power as fire, which also tests gold. Consequently some people question the truth of this, but their objections are not very relevant because the methods of testing are different, involving a change and alteration of colour in the case of fire, and a comparison of marks made by friction in the case of the stone, which seems to have the power of abstracting the essential quality of each sample. 46. It is said that a stone has now been discovered which is far superior to the kind previously known, and detects the quality not only of refined gold, but also of copper alloyed with gold or with silver

Schneider: τὴν τοιαύτην *codd.* ἔχειν τῷ πυρὶ δύναμιν FKLM *edd.*: δ. ἔ. τ. π. *ceteri.* ἐκεῖνο FK²LM: ἐκεῖ *ceteri.* διὸ καὶ. . .δοκιμάζει *om.* E. τῷ τὰ F *Aldus*: τὸ τὰ *ceteri.* ἀλλοιοῦν E *Turnebus*: ἀξιοῦν (ἀξοιῦν F *Aldus*) *ceteri codd.* 46 φασι νῦν A: φασιν νῦν *ceteri.* τὸν κατάχαλκον χρυσὸν *Schneider*: τὸν χαλκὸν κατὰ χρυσὸν (καταχρυσὸν C) *codd.*

together with the amount of precious metal contained in a stater of the alloy. Those concerned use streaks, starting with that which indicates the smallest amount of baser metal, this amount being [a krithe, then a kollybos, then] a quarter-obol or a half-obol. Thus the proportion of precious metal is detected from these streaks. 47. All stones of this kind are found in the river Tmolus. They are smooth in character, rather like counters, flat, but not circular: they are approximately twice the size of the largest counter. In testing the metal, the upper surface of the stone, which is exposed to the sun, differs from the lower surface and is superior to it in this respect. This is because the upper surface is also the drier, for moisture hinders the abstracting of the metal. Indeed in great heat the test is less satisfactory since the stone gives off moisture which renders it slippery. The same thing happens also to other stones, including those of which divine images are made; and this is taken to be an omen, as though the statue were sweating.

VIII. 48. These, then, are substantially the characteristic differences and powers of stones. Those belonging to earth are less numerous, but more peculiar. For earth indeed may undergo processes of (*a*) melting, (*b*) softening, and (*c*) hardening again. Thus (*a*) it melts, like stone, along with ores that are smelted, but (*b*) it is softened and (*c*) stones are made of it, for example the parti-coloured and the other kinds that are produced artificially. All of these are made by softening and firing earth. 49. And if, as some maintain, glass is made from vitreous earth, so too it is firing that causes this earth to become glass. A most peculiar earth is that which is mixed with copper, for it not merely melts and mingles with the metal, but also has a remarkable power of enhancing the beauty of its colour. In Cilicia there exists an earth which is heated and becomes viscous, and is used in place of birdlime for dressing vines as a protection against grubs. 50. One might try to find those distinctive qualities which render earth apt to harden to the consistency of stone. And yet those which give earths a distinctive flavour have a peculiar nature of their own no less than those which give a distinctive flavour to plants. It will be better, however, to enumerate the

CE *Turnebus*: ἔχειν *ceteri codd.* 50 εἴη *Turnebus*; ἦ ΛCDEFGKL: ἦ MN. τοὺς τούτων *codd.*: τοὺς τῶν τόπων *Turnebus* (*in versione*), *coni. Schneider*: τῶν τόπων *Wimmer, Caley & Richards.* ⟨ἰδίαν⟩ τιν' ἔχουσι *Turnebus* (*in versione*), *Schneider*: τιν' (τινὰ DN) ἔχουσαι *codd.*

distinctive qualities of the earths with reference to the colours used in painting pictures. (40.) In general, it is in mines that we find the most numerous and most peculiar varieties of such earths. Some of them, like ochre and ruddle, are composed of earth, some, like chrysocolla and *cyanus*, of a kind of sand, and some, like realgar and orpiment and so forth, of powder. 50. Their formation, incidentally, is due either to a 'conflux' or to 'filtering', as we stated at the beginning. Some of them at least have obviously undergone exposure to fire and some process of complete combustion, as for example realgar, orpiment and the like; but it may be stated generally that all are products of the dry and smoky exhalation. 51. All these earths are found in silver-mines and gold-mines, and some, like orpiment, realgar, chrysocolla, ruddle, ochre and *cyanus*, in copper-mines also. *Cyanus* is the least plentiful and is distributed in the smallest quantities. Of the rest, some occur in veins, while we are told that ochre is found in masses, and ruddle in every variety of shade: hence painters use it for flesh-tints. Moreover, ochre is said to be a substitute for orpiment since its colour is in no way different, but only appears to be. 52. To proceed, there are some regions, Cappadocia for instance, where ochre and ruddle are even mined in the same place, and large quantities are dug. The miners, however, are said to be hampered by the danger of suffocation, which may be brought about rapidly or at any rate in a short time. The best ruddle, for there are many varieties, appears to be that of Ceos, some of which comes from the mines there, for iron-mines also contain ruddle. (53) In the Little Mine, however, it is mined by itself. 52. But there are also the Lemnian and the so-called Sinopic, the latter being merely the Cappadocian, which is brought down to Sinope. 53. There are three kinds of ruddle, one deep-red, one pale, and one medium, the last being termed 'self-sufficient', because, unlike the others, it does not need to be mixed with anything. Ruddle of inferior quality is produced by burning ochre. The invention belongs to Cydias, who is said to have grasped it through noticing that, when a general store was destroyed by fire, half-burnt ochre had turned crimson. 54. New

addito; vide commentarium ad loc. τῷ μικρῷ] τῇ *Λήμνῳ Furlanus (in versione), Hill.* 52 *Λημνία Turnebus (in versione), Heinsius*: λιμνία *codd.* καὶ ἣν καλοῦσι *Σινωπικήν Turnebus (in versione), Furlanus*: ἣν καλοῦσιν ὠπτικὴν (ὀπτικὴν E) *codd.* 53 ἔστι δὲ] δὲ *om.* F. γένη EFK²M: γεννή *ceteri.* μιγνύουσι FK²: μισθοῦσι *ceteri.* δὲ καὶ ἐκ *Schneider, &c.*: τ' ἐκ *codd.* ὤχρας FK²M: χώρας *ceteri* κατακαυθέντος CEFKLM: κα‖καυθέντος A: κα καυθέντος G: καὶ καυθέντος D: κατὰ καυθέντος N. παντοπωλίου *Turnebus*: παντωλίου ACDEFGK¹LMN: πανδοχείου K² *Furlanus, Wimmer, Caley & Richards.* πεφοινιγμένην] φοινιγμένην DJ.

pots luted with clay are placed in a furnace. When the pots are thoroughly exposed to the fire, they cause the ochre to be baked, and the more they are burnt, the darker and more glowing the ochre becomes. The process of generation testifies to the truth of this. For fire would appear to be the agent responsible for all these transformations if we are to suppose the process employed here to be similar to, or comparable with, the natural process of generation. 55. Just as there is a natural and an artificial ruddle, so too there is a natural and a prepared *cyanus*, such as is made in Egypt. There are three kinds of *cyanus*, the Egyptian, the Scythian, and lastly the Cyprian, the Egyptian being best for undiluted pigment-powders and the Scythian for the diluted. The Egyptian is a preparation; and the records relating to the kings include the name of the first king to produce fused 'cyanus' in imitation of the natural kind, together with the information that along with gifts tribute came from Phoenicia and elsewhere in the form of *cyanus*, some of which had been fired and some not. Grinders of paints assert that four shades can be produced from the Scythian *cyanus* by itself, the first shade, which is also the palest, being made from the finest particles, while the second, which is the darkest, is prepared from the coarsest. Besides these, white lead also is produced artificially. 56. A piece of lead as big as a brick is placed above some vinegar in a cask. When after about ten days the lead has acquired thickness, the cask is opened and a kind of mildew scraped from the lead, which is repeatedly placed in this way until it is used up. The scrapings are pounded in a mortar and continually strained away; and the white lead is the matter finally left deposited. 57. Verdigris is produced in a comparable manner. Copper is placed above wine-lees, and the substance that forms on it is scraped away, for the verdigris, as it forms, appears on the surface of the copper. 58. There is also natural and manufactured cinnabar. Spanish cinnabar, which is extremely hard and stony, is natural, and so too is that of Colchis, which is said to be found on precipices and shot down by arrows. The manufactured variety comes from one place only, which is a little above Ephesus (in the territory of the Cilbians?). Here a sand which glows like the scarlet kermes-berry is collected

58 κατ' ἐργασίαν F *Aldus; cf.* § 58 *infra*: κατ' ἐργασίας ACDGJKLMN: μετ' ἐργασίας E. Κόλχοις] κολύχοις F *Aldus*. ⟨ἐπὶ⟩ κρημνῶν *Schneider*. ὃ F *Aldus*: ὃν *ceteri*. ὑπὲρ Ἐφέσου μικρὸν ⟨ἐν Κιλβιανοῖς?⟩ *coni. Leaf; vide commentarium et cf. infra* μικρὸν ἐν καλοῖς. μόνον. ἔστι δ' ἄμμος *Turnebus (in versione), Schneider, &c.*: μόνον δ' ἐστὶν ἄμμος *codd.* λαμπυρίζουσαν FK²M: λαμπυρίζουσι ACDGK¹LN: *αμπυρίζουσι E.

and thoroughly pounded to a very fine powder in stone vessels. It is then washed in copper vessels, and the sediment is taken and pounded and washed again. There is a knack in doing this, for from an equal quantity of material some workers secure a great amount of cinnabar, and others little or none. However, use is made of the washings floating above, particularly as a wall-paint. The sediment which forms below turns out to be cinnabar, while all that is above, which is the greater part, is merely washings. 59. The process is said to have been invented and introduced by Callias, an Athenian from the silver-mines, who collected and studied the sand, thinking that it contained gold owing to its glowing appearance. But when he found that it contained no gold, he still admired its fine colour and so came to discover the process, which is by no means an old one, but dates back only some ninety years before the archonship of Praxibulus at Athens. 60. From these examples it is clear that Art imitates Nature, and yet produces its own peculiar substances, some for their utility, some merely for their appearance, like wall-paint, and some for both purposes, like quicksilver; for even this has its uses. It is made by pounding cinnabar with vinegar in a copper mortar with a copper pestle. And perhaps one could find several things of this kind.

IX. 61. However, among earths which are mined there still remain those that are found in earth-pits. These are generated, as was said at the beginning, from a 'conflux' or 'secretion' of exceptional purity and uniformity. Colours of every kind are derived from them owing to the nature of the substances themselves, and also to differences in their manufacture (?). These stones that are brought from Asia are composed of such earths, some of these earths being softened for the purpose and others ground and melted. 62. There are, roughly speaking, three or four natural earths which are useful as well as unusual, namely the Melian, the Cimolian, the Samian, and finally besides these the Tymphaic, otherwise known as 'gypsum'. Only the Melian is used in painting pictures, no use being made of Samian in spite of its beautiful appearance, because it is greasy, dense, and smooth. Moderate roughness and an absence of grease are more suitable

τῆς μίας codd. *ἠρέμα τραχῶδες ego*: *ἀραῖον καὶ ἠρέμα τραχῶδες coni. Salmasius*: *ἤρεμον καὶ *δες codd.* *ἀλιπὲς*] *ἐλλιπὲς* C: *ἐλλειπὲς* E.

in painting, and these, together with a loose texture, are the qualities possessed by Melian earth. 63. The earths of Melos and Samos differ in many more respects. A worker in the Samian pits cannot stand upright while digging, but is forced to lie on his back or side. The vein there stretches a considerable distance and is only about two feet in height, although its depth is much greater. On either side the earth is enclosed by rocks, from which it is extracted. The vein has running through the middle of it a seam, which is superior in quality to the outer parts, and again a second seam like the first, and a third and a fourth, the last, which is known as 'the Star', being the best. 64. The earth is used mainly, if not entirely, for treating cloaks. The same use is made of Tymphaic earth, which is called 'gypsum' by the people of Thessaly and the neighbourhood. Gypsum is most plentiful and most easily discerned in Cyprus, for only a little soil need be removed when it is dug there. In Phoenicia and Syria it is produced by the burning of stones, and again at Thurii, where large quantities are forthcoming. Thirdly there is the gypsum of Tymphaea, Perrhaebia and other places. 65. The nature of the varieties of gypsum is peculiar in that it is stony rather than earthy, the stone being similar to *alabastrites*, except that it is nodular and so cannot be hewn in large pieces. The viscidity and heat of gypsum, when it is moistened, are remarkable. It is used in building, being poured round the stones themselves, and is also applied to any similar material which requires bonding. 66. The workmen break it up, and then pour water over it and stir it with sticks, for they cannot do so by hand owing to the heat. It is moistened immediately before use, for if it is prepared even a little beforehand, it hardens rapidly and cannot be split up. Its strength too is remarkable, so much so that when the stones of a building break and come apart, the gypsum does not in any way relax its hold upon them. Indeed, often parts of a building have collapsed and have been taken away, while the upper portions remain suspended, being held together by the bonding of the gypsum. 67. Gypsum, moreover, can be removed, and so be rebaked and

Turnebus: ἐρεχθῇ ACDFGKLMN: ὀρυχθῇ E. αὐτῷ τῷ λίθῳ *ego*: τοῦτον τὸν λίθον *codd., edd.* (τοῦτον *in uncis posuit Schneider, om. Wimmer*). περιχέοντες *Turnebus* (*in versione*), *Schneider, &c.*: περιέχοντες *codd.* τοιοῦτο] τοιοῦτον *Schneider, Wimmer.* 66 ἐὰν γὰρ E: ἐὰν *ceteri; an recte?* ἐὰν ⟨δὲ⟩ *Schneider, &c.* διελεῖν *Schneider*: διελθεῖν *codd.* θαυμαστὴ δὲ E *Schneider* (*in suppl.*), *Wimmer, Caley & Richards*: θαῦμά ἐστι δὲ *ceteri.* ἡ ἰσχύς EF: ἰσχύς *ceteri.*: ⟨ἡ⟩ ἰσχύς *Schneider, &c.* ὅτε γὰρ] ὅτε τε F *Aldus.* καὶ διαφέρονται] ἢ διαφέρονται *Schneider* (*in suppl.*), *Wimmer, Caley & Richards.* ἡ δὲ οὐδαμῶς *ego*: ἡ δὲ o*μος A: ἡ δὲ *μος CDFGKLMN: ἡ δὲ E: ἡ δεσμὸς *Turnebus*: ἡ γύψος *Schneider* (*in suppl.*), *Wimmer, Caley & Richards.* μένει *Coraës*: καὶ *codd.* 67 δύναται] δύνανται FKLM.

used again and again. In Cyprus and Phoenicia it is employed mainly for this purpose, but in Italy for preserving wine as well. Furthermore, it is used by painters for certain features of their art and by fullers for sprinkling on cloaks. In viscidity and smoothness it seems to be unequalled for taking the impressions of seals and this is the purpose for which it is largely, if not mainly, used in Greece. 68. It is in these and similar uses that the effectiveness of gypsum is shown. Its nature is such that it seems in some way to combine the qualities of lime and of earth, namely heat and viscidity; or rather, it possesses each in a superior degree, being hotter than lime and much more viscous than earth. That it contains fire is shown by the fact that on occasion a ship has been laden with cloaks which, becoming soaked, have caught fire, thus causing a conflagration which has destroyed the ship itself as well. 69. Both in Phoenicia and in Syria gypsum is made by being burnt in a furnace. For the most part 'marble', and moreover the hardest 'marble' available, is burnt, ox-dung being placed by it to make it burn more quickly and thoroughly. For once it has been kindled, ox-dung seems to be extremely hot and lasts for a very long time. When the material has been baked, it is broken up like lime. From these facts it seems clear that gypsum as a whole is generated by fire.