

TRANSLATION

ON STONES

Of the substances formed in the ground, some are made of water and some of earth. The metals obtained by mining, such as silver, gold, and so on, come from water; from earth come stones, including the more precious kinds, and also the types of earth that are unusual because of their color, smoothness, density, or any other quality. As the metals have been discussed in another place, let us now speak about the stones. 1

In general we must consider that all of them are formed from some pure and homogeneous matter as a result of a conflux or percolation, or because the matter has been separated in some other way, as has been explained above. For perhaps some are produced in one of these ways, and some in the other way, and others in a different manner. Hence they gain their smoothness, density, brightness, transparency, and other such qualities, and the more uniform and pure each of them is, the more do these qualities appear. In general, the qualities are produced according to the accuracy with which the stones are formed and solidified. 2

Some things are solidified through heat, others through cold. And probably there is nothing to prevent some kinds of stones being formed by either of these two methods, although it would seem that all the types of earth are produced by fire, since things become solid or melt as a result of opposite forces. There are more peculiarities in stones; for most of the differences in the types of earth concern color, tenacity, smoothness, density, and so on, but in other respects the differences are rare. 3

Stones, however, have these differences and in addition there are others that depend on their power of acting on other substances, or of being subject or not subject to such action. For some can be melted and others cannot, some can be burnt and others cannot, and there are other differences of this kind. And some show a number of differences in the actual process of being set on fire and burnt, and some, like the *smaragdus*,¹ can make the 4

¹ A green stone, mentioned again in secs. 8, 23, 24, 25, 26, 27, 35. The usual English translation is "emerald," but this is not the exact meaning of the word. For the identification of this stone, see Commentary, secs. 23 and 24.

color of water the same as their own, whereas others can turn what is placed on them entirely into stone; some have the power of attraction and others can test gold and silver, such as the stone called the Heracleian and the one called the Lydian.

5 But the greatest and most wonderful power, if this is true, is that of stones which give birth to young. But the power of those used in manual work is better known and is found in more varieties. For some can be carved, or turned on a lathe, or sawn; there are some on which an iron tool cannot operate at all, and others on which it works badly and with difficulty. And there are several other differences in addition to these.

6 The differences that are due to color, hardness, softness, smoothness, and other such qualities, through which stones gain their special excellence,² are found in many varieties, and in some they occur in the whole of a district. And among such stones there are the Parian, the Pentelic, the Chian, and the Theban, and these stone quarries have become widely known. There is also the *alabastrites*,³ found at Thebes in Egypt—this, too, can be worked in large blocks—and the stone resembling ivory which is called *cher-nites*;⁴ and they say that Darius was buried in a sarcophagus of this material. And there is the (variety of) *poros*,⁵ which is like Parian marble in color and density, but has only the lightness of (ordinary) *poros*; for this reason the Egyptians use it as a frieze in their elaborate buildings. And a dark stone is also found in the same place, which is translucent like the Chian stone, and there are several other kinds in other places. Such differences are common to many stones, as we have already said, but those that are due to the powers mentioned above are not found now in whole districts or in continuous or large masses of stone.

8 Some stones are quite rare and small, such as the *smaragdos*, the *sardion*,⁶ the *anthrax*,⁷ and the *sappheiros*,⁸ and almost all those

² See Commentary.

³ In all probability, onyx marble.

⁴ Apparently a variety of onyx marble.

⁵ This could be travertine, but here it is probably a special kind of *poros* found in Egypt.

⁶ A red stone mentioned again in sec. 23 and described briefly in sec. 30. See Commentary, sec. 30, for its identification.

⁷ Another red stone which is described in secs. 18 and 19. See Commentary, secs. 18 and 19.

⁸ A blue stone which is described briefly in secs. 23 and 37. For its identification, see Commentary, sec. 37.

that can reasonably be cut and used as seals.⁹ And some are discovered in other stones when these are cut up. There are a few which can be set on fire and burnt, and perhaps we should first explain the nature and extent of their differences.

Some of them melt and become fluid when subjected to fire, 9
such as those which come from mines. For when silver, copper, and iron become fluid, so does their stony matrix, either because of the moisture in the matter it contains or because of the nature of such stones. In this way, too, fire-resisting stones and millstones become fluid along with the material placed on them by those who are burning it. And some go so far as to say that all of them melt except marble and that this burns up and lime is formed from it.

But it would seem that it is going too far to say this; for there 10
are many which break and fly into pieces as if they are fighting against being burnt, like pottery, for example. And this is natural since they have lost their moisture; for whatever can be melted must be moist and have a good deal of humidity.

And they say that some stones that are exposed to the sun be- 11
come completely dry, so that they are useless unless they are soaked and wetted again, and others become softer and are more easily broken. It is clear that both kinds are robbed of their moisture by the sun, but it happens that stones of solid texture become hard when they are dry, whereas those that are loose in texture, and those whose formation is of this kind, are easily broken and melted.

Some of those that can be broken are like hot coals when they 12
burn, and remain like this for some time, such as those found in the mine at Binai¹⁰ which are brought down by the river; for when they are covered with charcoal they burn as long as air is blown onto them, then they die down and afterwards can be kindled again, so that they can be used for a long time, but their odor is very harsh and disagreeable.

There is a stone called *spinós*,¹¹ which was found in mines. If 13
this is cut up and the pieces are piled in a heap, it burns when

⁹ The emendation (*πάρες τῶν κατὰ*) has been added to the text.

¹⁰ The text uses the plural form (Binai), but the place was usually known as Bina.

¹¹ Probably some sort of asphaltic bitumen.

exposed to the sun, and it does this all the more if it is moistened and sprinkled with water.

- 14 But the Liparean stone¹² is made porous when it is burnt, and becomes like pumice, so that both its color and density are altered; for before it has been burnt it is black, smooth, and compact. This stone is found in pumice, appearing separately in various places and not continuously, as if it were in a cell of a honeycomb. In the same way it is said that in Melos pumice is found in another kind of stone, and so the Liparean stone corresponds to this in the opposite way, as it were, except that this stone is not the same as the Liparean stone.
- 15 The stone which is found at Tetras in Sicily also becomes porous. This place is in the neighborhood of Lipara, and the stone is plentiful in the promontory called Erineas. Like the stone found at Binai, it releases a bituminous odor when it is burnt, and what remains after the burning is similar to burnt earth.
- 16 Among the substances that are dug up because they are useful, those known simply as coals are made of earth, and they are set on fire and burnt like charcoal. They are found in Liguria, where amber also occurs, and in Elis as one goes by the mountain road to Olympia; and they are actually used by workers in metals.
- 17 In the mines at Scaptē Hylē a stone was once found which was like rotten wood in appearance. Whenever oil was poured on it, it burnt, but when the oil had been used up, the stone stopped burning, as if it were itself unaffected. These are roughly the differences in the stones that burn.
- 18 But there is another kind of stone which seems to be of an exactly opposite nature, since it cannot be burnt. It is called *anthrax*, and seals are cut from it; it is red in color, and when it is held towards the sun it has the color of a burning coal. One might say that it has great value; for a very small one costs forty pieces of gold. It is brought from Carthage and Massalia.
- 19 The stone found near Miletus does not burn; it is angular and there are hexagonal shapes on it. It is also called *anthrax*, and this is remarkable, for in a way the nature of *adamas*¹³ is similar.

This power of resisting fire does not seem to be due to the

¹² Obsidian.

¹³ Probably corundum. See Commentary, secs. 19 and 44.

absence of moisture, as is true of pumice and ashes. For these cannot be set on fire and burnt, because the moisture has been removed, and some think that pumice is formed entirely as a result of burning, with the exception of the kind that is produced from the foam of the sea. Their belief is due to observation and is based on what is produced in craters of volcanoes and also on the porous stone¹⁴ which changes¹⁵ to pumice when it is fired. And the places where it is produced seem to prove this, for pumice is found especially in places that¹⁶ 20

But perhaps one kind is made in this way, and others in another way, and there are many methods of producing it; for the pumice found in Nisyros seems to consist of a kind of sand. And it is regarded as proof of this that some of the stones which are found break into pieces in one's hands and crumble into sand, as it were, because they have not yet become compact and solid. People find them in groups but in small amounts,¹⁷ mostly about a handful in size or a little larger, whenever they scrape off the surface covering them. And the sand is very light. The kind found in Melos is all¹⁸ but some are produced in a stone of a different sort, as has been mentioned before. 21

They differ from one another in color, density, and weight. They differ in color because the kind that comes from the lava stream in Sicily is black, and this stone and the *malodes*¹⁹ differ in density and weight; for a pumice of this kind, having both weight and density, is also produced, and this is more valuable than the other in its practical use. The one that comes from the lava stream can cut better than the white kind, which is light in weight, but the kind that comes from the sea itself cuts best of all. So much for pumice. But we must consider elsewhere the causes 22

¹⁴ *diaberos*, perhaps *diaboros*.

¹⁵ The Aldine text has *ob* (i.e., "which does not change"). Wimmer accepts this, but ϕ is found in the manuscripts (i.e., "which changes").

¹⁶ The emendation *καιομένοις* would mean "places that are burning"; *πυρκαϊστοίς* would mean "places that have been subjected to burning."

¹⁷ *κατὰ μικρά* is used sometimes by Aristotle in this sense. Cf. *Meteorologica*, 370B, 5.

¹⁸ The emendation *σχεδὸν ὡς ἐν Νισύρῳ* would mean "almost like the kind in Nisyros," but *εὐθραυστος, ἐν λίθῳ δέ* . . . would mean "easily broken, but is produced in a stone."

¹⁹ *Malodes* is unknown; *mélodes* would suggest a pale-yellow stone, and *mylodes* would be a millstone.

of the difference between stones that either burn or do not burn, from which we moved into this discussion.

- 23 There are also other stones from which seals are cut that are (remarkable), some of them only for their appearance,²⁰ such as the *sardion*, the *iaspis*,²¹ and the *sappheiros*, and the last of these seems to be spotted with gold. But the *smaragdos* also has certain powers, for it makes the color of water just like its own, as we have said before; a stone of moderate size affects a small amount of the water in which it is placed, the largest kind the whole of the water, and the worst kind only the part close to it. It is also good for the eyes, and for this reason people carry seals made of it, so as to see better.²² But it is rare and of small size, unless we are to believe the records about the Egyptian kings; for it is said that among the gifts from the king of the Babylonians a *smaragdos* was once sent to them which was six feet²³ in length and four and a half in width, and that four such stones are deposited as an offering in the obelisk of Zeus. These were sixty feet long, and their width was six feet at one end and three at the other. But these statements depend entirely on their writings.
- 25 The largest of the stones which many call *tanos*²⁴ is the one at Tyre. For there is a large slab in the temple of Herakles, unless this is a false *smaragdos*, for a species of that kind does exist. The stone occurs in places that are well known and easy to reach, especially in two of them, the copper mines of Cyprus and the island lying off Chalcedon. In the latter, exceptional stones are found. This kind is obtained by mining, like the others, and nature has produced it separately in many veins in Cyprus.
- 26 They are not often found large enough for a seal, but most of them are smaller in size; for this reason the stone is used for soldering gold, since it solders like *chrysokolla*.²⁵ And some people even suppose that its nature is the same, for they both happen

²⁰ Schneider thinks that something is missing here; the meaning should be "some of them differ in their appearance but have the same name." Cf. sec. 30.

²¹ Not our modern jasper. For its identification, see Commentary, sec. 27.

²² Perhaps εὖ βλέπειν ("to see well," "to improve their sight").

²³ A cubit was about one and a half feet; thus four cubits means six feet.

²⁴ For a possible identification, see Commentary. Wimmer reads βακτριανῶν ("Bactrian stones") instead of τανῶν.

²⁵ A name applied to certain green copper minerals. It probably included malachite as well as the modern chrysocolla.

to be similar in color. But *chrysoḱolla* is found in large quantities in gold mines and even more in copper mines, as in the ones near the . . . districts.

But *smaragdos* is rare, as we have mentioned, for it seems to be formed from *iaspis*. It is said that a stone was once found in Cyprus half of which was *smaragdos* and half *iaspis*, as if it had not yet been entirely changed from the watery state. It takes some work to make it shine, for in its natural condition it is not bright. 27

It is remarkable in its powers, and so is the *lyngourion*;²⁸ for seals are cut from this too, and it is very hard, like real stone. It has the power of attraction, just as amber has, and some say that it not only attracts straws and bits of wood, but also copper and iron, if the pieces are thin, as Diokles used to explain. It is cold and very transparent, and it is better when it comes from wild animals rather than tame ones and from males rather than females; for there is a difference in their food, in the exercise they take or fail to take, and in general in the nature of their bodies, so that one is drier and the other more moist. Those who are experienced find the stone by digging it up; for when the animal makes water, it conceals this by heaping earth on top. This stone needs working even more than the other kind. 28

And since amber is also a stone—for the kind that is dug up is found in Liguria—the power of attraction would belong to this too. The stone that attracts iron is the most remarkable and conspicuous example. This also is rare and occurs in few places. This stone too should be listed as having a similar power. 29

There are several other stones from which seals are cut, such as the *hyalocides*,²⁷ which reflects images and is also transparent, and the *anthrakion*²⁸ and the *omphax*.²⁹ There is also rock crystal, and the amethyst, and both of them are transparent; and these two and the *sardion* are found when certain rocks are cut through. And there are others, as has been mentioned before, which differ from one another, though they have the same name. For one type 30

²⁶ Lynx-urine stone. Probably a variety of amber.

²⁷ Glasslike stone. Its identification is uncertain, but some possibilities are discussed in the Commentary.

²⁸ Mentioned again in sec. 33. For possible identification, see Commentary, sec. 33.

²⁹ Apparently a green stone of some sort. The problem of its identification is discussed in the Commentary.

of *sardion*, which is translucent and of a redder color, is called the female, and the other, which is translucent and darker, is called
 31 the male. And it is the same with the varieties of the *lyngourion*, for the female is more transparent and yellow than the other. Also, one kind of *kyanos*³⁰ is called male and the other female, and the male is the darker of the two. The *onychion*³¹ is mixed in color, with white and dark alternating; the amethyst is wine-colored. The *achates*³² is also a beautiful stone; it comes from the river Achates in Sicily and is sold at a high price.

32 In the gold mines at Lampsakos a wonderful stone was once found, from which a seal was cut after it had been taken up to Astyra,³³ and this was then sent to the King because of its unusual nature.

33 These stones are rare as well as beautiful, but those that come from Greece are of less value, such as the *anthrakion* from Orchomenos in Arcadia. This is darker than the stone from Chios, and mirrors are made from it. There is also the stone from Troezen, and this is variegated with purple and white. The Corinthian stone is also variegated with the same colors, except that it is paler.

34 In general there are many stones of this kind, but the remarkable ones are rare and come from a few places only, such as Carthage, the country around Massalia, Egypt near the First Cataract, Syene
 35 near the city of Elephantine, and the region called Psepho.³⁴ In addition, the *smaragdus* and the *iaspis* are found in Cyprus.

The stones which are used for mosaics come from Bactriana near the desert. They are collected by horsemen who go out at the time of the etesian winds; for they are visible then, since the violence of the winds disturbs the sand. But they are small in size and not large.

36 Among choice stones there is also the one called the pearl; this is translucent by nature, and valuable necklaces are made from it. It is produced in an oyster, which is similar to the *pinna* [except

³⁰ A variety of lapis lazuli. This same word also denoted certain blue pigments. See Commentary, secs. 31 and 55.

³¹ A broader term than onyx. See Commentary.

³² A name given to certain variegated stones, including some varieties of agate.

³³ This translates *Ἀστύρα* instead of *στύρα*. If Pliny is right, the king was Alexander the Great.

³⁴ Possibly Psebo.

that it is smaller. In size the pearl is as big as a large fisheye],³⁵ and it is produced in India and certain islands in the Red Sea.³⁶ These are approximately the stones that are of unusual excellence.

But there are some others, such as the fossil ivory which is 37
variegated with white and dark markings. And there is also the stone called *sappheiros*, which is dark and not very different from the male *kyanos*, and there is the *prasitis*,³⁷ which has the color of verdigris. And the *haimatitis*³⁸ also is of solid texture; it is dull in color, and in accordance with its name seems to be made of blood that has become firm and dry. The stone called *xanthe*³⁹ is another variety, not really yellow in color but rather of a whitish tint, a color which the Dorians call *xanthos*.

Coral, which is like a stone, is red in color and rounded like a 38
root, and it grows in the sea. And in a way the petrified Indian reed is not very different in its nature from coral. But this is a subject for another inquiry.

There are also many varieties of stones which are obtained by 39
mining. Some of these contain gold and silver at the same time, but only the silver can be seen clearly. They are rather heavy in weight and have a strong odor. There is also natural *kyanos*, which contains *chrysokolla*, and there is another stone which is like glowing coals in color; and these stones are heavy.

In general a great many unusual types of such stones are found 40
in mines; some of them are of an earthy nature, such as yellow ochre and red ochre, and some are sandy, like *chrysokolla* and *kyanos*, and others are powdery, such as realgar and orpiment and others that are like them. One could mention a number of peculiarities in such stones.

Some stones also have the power of not submitting to treatment, 41
as we have mentioned before; for example, they cannot be cut with iron tools, but only with other stones. In general there is a great difference in the methods of working the larger stones; for some can be sawn, others can be carved, as has been stated, and others turned on a lathe, like the Magnesian stone. This is un-

³⁵ The words in brackets come from Athenaeus (III, 93).

³⁶ Probably the present Persian Gulf.

³⁷ An opaque green stone. For possible identification, see Commentary.

³⁸ Probably red jasper.

³⁹ Probably yellow jasper.

usual in its appearance, and some people are astonished at its resemblance to silver, though it is not related to it at all.

- 42 And there are a larger number of stones which submit to every method of treatment. In Siphnos there is a stone of this kind which is dug up about three furlongs from the sea; it is round and has the qualities of a lump of earth, and because it is soft it can be turned on a lathe and carved. When it is heated in the fire and dipped in oil, it becomes very black and hard; and dishes for the table are made out of it.

- 43 All such stones submit to the power of iron, but some stones, as we have mentioned before, can be carved with other stones, but not with iron instruments. And others can be carved with iron, but only with rather blunt tools. And . . . are . . . In much the same way . . . cannot be cut with iron, and yet iron, which is harder than stone, cuts substances that are . . . stronger.⁴⁰

- 44 That seems peculiar also, because whetstone wears away iron, although iron can divide the whetstone and shape it but cannot do this to the kind of stone from which seals are made. And again, the stone with which seals are carved consists of the material from which whetstones are formed, or something like it. And the (best) whetstone comes from Armenia.

- 45 The nature of the stone which tests gold is remarkable, for it seems to have the same power as fire, which can test gold too. On that account some people are puzzled about this, but without good reason, for the stone does not test in the same way. Fire works by changing and altering the colors, and the stone works by friction, for it seems to have the power of picking out the essential nature of each metal.

- 46 They say that a much better stone has now been found than the one used before; for this not only detects purified gold, but also gold and silver that are alloyed with copper, and it shows how much is mixed in each stater. And indications are obtained from the smallest possible weight. The smallest is the *krishē*, and after

⁴⁰ If certain emendations were adopted, this difficult passage might be translated as follows: "And such stones are harder. In much the same way it is peculiar that a stone cannot be cut at all with iron, and yet iron too, which is harder than stone, cuts substances which are firmer and stronger." (*καὶ εἰσὶν οἱ τοιοῦτοι σκληρότεροι. παραπλησίως δὲ ἄτοπον τὸ ἴσως μὴ τέμνεσθαι λίθον θυδήρῳ· καίτοι καὶ στερεώτερα καὶ ισχυρότερα τέμνει καὶ σίδηρος λίθου σκληρότερος ὢν.*)

that there is the *kollybos*, and then the quarter-obol, or the half-obol;⁴¹ and from these weights the precise proportion is determined.

All such stones are found in the river Tmolos. They are smooth 47
in nature and like pebbles, flat and not round, and in size they are twice as big as the largest pebble. The top part, which has faced the sun, differs from the lower surface in its testing power and tests better than the other. This is because the upper surface is drier, for moisture prevents it from picking out the metal. Even in hot weather the stone does not test so well, for then it gives out moisture which causes slipping. This happens also to other stones, including those from which statues are made, and this is supposed to be a peculiarity of the statue.

Of such kinds are the special qualities and powers found in 48
stones. Earth has fewer of these, though they are more peculiar; for it is also possible for earth to be melted and softened and then hardened again. It melts (along with)⁴² substances which are dug up and which can be liquefied, just as stone also does. It is softened, and stones are made from it. These include the variegated ones and other composite stones . . . ;⁴³ for all of these are made 49
artificially when they are fired and softened. And if glass is also formed, as some say, from vitreous earth, this too is made by thickening.

The most unusual earth is the one mixed with copper; for in addition to melting and mixing, it also has the remarkable power of improving the beauty of the color. And in Cilicia there is a kind of earth which becomes sticky when it is boiled, and vines are smeared with this instead of birdlime to protect them from woodworms.

It would also be possible to determine the differences that are 50
naturally adapted for causing earth to turn into stone; for those that are due to locality, which cause different kinds of savors, have their own peculiar nature, like those which affect the savors

⁴¹ See Commentary for a discussion of the absolute and relative values of these weights. They were probably equivalent to .06, .09, .18, and .36 of a gram.

⁴² Some word is understood here, such as *ἄμα* ("along with"); cf. *ἄμα* in sec. 9. Schneider suggested *ὁμοίως* ("in the same way as").

⁴³ If *ἐκ τῆς Ἀσίας ἀγούσης* were read, the meaning would be that "they bring them from Asia."

of plants. But it would be best to list them according to their colors, which painters also use.

These substances, as we said in the beginning, are produced either by some conflux or by percolation. Moreover, some seem to have been set on fire and burnt, such as realgar and orpiment and others of the same kind. To put it plainly, all of these result from a dry and smoky exhalation.

- 51 They are all found in silver and gold mines, and some of them in copper mines, such as orpiment, realgar, *chrysokolla*, red ochre, yellow ochre, and *kyanos*, but the last of these is seldom found and only in small quantities, whereas there are veins of some of the others, and yellow ochre is said to be found in masses. But there are all kinds of red ochre, so that painters can use it for flesh-colored pigments. And yellow ochre can take the place of orpiment, since there is no real difference in their color, though there seems to be.

- 52 But in some places there are mines that even contain both red ochre and yellow ochre together, as for example in Cappadocia, and large quantities are dug up. But they say that the risk of suffocation is a serious matter for the miners, since this can happen to them quickly and takes a very short time.

- The best red ochre seems to be that of Ceos; for there are several kinds. One of them comes from mines, since iron mines also contain red ochre. But there is also the Lemnian kind and the one called Sinopic; this is really Cappadocian red ochre, but it is
53 brought down to Sinope. It is dug up by itself in . . .⁴⁴ And there are three varieties of it, one very red, one light-colored, and a third whose color is midway between the others. We call this a self-sufficient kind because it does not have to be mixed, whereas the others do.

It is also made by burning yellow ochre, but this is an inferior kind and is a discovery of Kydias; for it is said that he became aware of it when an inn burnt down, as he noticed that some yellow ochre was half-burnt and had become red in color.

- 54 New earthen vessels are covered with clay and placed in ovens; for when the vessels become red-hot, they heat the ochre, and as they become hotter in the fire, they make its color darker and more

⁴⁴ ἐν τῇ μικρῇ is difficult; ἐν τῇ Λήμνῳ ("in Lemnos") is a possible alternative.

like glowing charcoal. And its origin is itself a proof of this; for it would seem that all these substances change under the influence of fire, if it is right to consider that the red ochre made in this process is the same as the one made by nature or very similar to it.

Just as there is a natural and an artificial red ochre, so there is a native *kyanos* and a manufactured kind, such as the one in Egypt. There are three kinds of *kyanos*, the Egyptian, the Scythian, and the Cyprian. The Egyptian is the best for making pure pigments, the Scythian for those that are more dilute. The Egyptian variety is manufactured, and those who write the history of the kings of Egypt state which king it was who first made fused *kyanos* in imitation of the natural kind; and they add that *kyanos* was sent as tribute from Phoenicia and as gifts from other quarters, and some of it was natural and some had been produced by fire. Those who grind coloring materials say that *kyanos* itself makes four colors; the first is formed of the finest particles and is very pale,⁴⁶ and the second consists of the largest ones and is very dark. These are prepared artificially, and so is white lead.

Lead about the size of a brick is placed in jars over vinegar, and when this acquires a thick mass, which it generally does in ten days, then the jars are opened and a kind of mold is scraped off the lead, and this is done again until it is all used up. The part that is scraped off is ground in a mortar and decanted frequently, and what is finally left at the bottom is white lead.

Verdigris is made in much the same way. Red copper is placed over grape-residues⁴⁷ and the matter that collects on it is scraped off; for it is verdigris that appears there.

There is also a natural and a prepared kind of cinnabar. The cinnabar in Iberia, which is very hard and stony, is natural, and so is the kind found in Colchis. They say that this is found on cliffs and is brought down by arrows that are shot at it. The prepared kind comes from one place only, a little above Ephesos. It is a sand that shines brightly and resembles scarlet dye; this is collected and ground in stone vessels until it is as fine as possible; then it is washed in copper ones . . . ,⁴⁸ and what remains is taken

⁴⁶ This translates *λευκότατον*, which has been accepted as an emendation in the text.

⁴⁷ The literal translation of *τρώξ* would be "wine-lees," but see Commentary.

⁴⁸ The words *ἐν καλοῖς* (after *μικρὸν*) may simply be a repetition of *ἐν χαλκοῖς*. Schneider thinks they belong above, after *ὑπὲρ Ἐφέσου μικρὸν* ("a little above Ephesos") and should really be *ἐν ἀγροῖς Κιλιβιανοῖς* ("in the Cilbian district").

and ground again and then washed. Skill is needed for this process; for some people make a great deal and others little or nothing out of an equal amount of sand. The washing is done from the top, and separate portions are wetted one after the other; what is left at the bottom is cinnabar, and the washings are what remains above in larger quantities.

59 They say that Kallias, an Athenian from the silver mines, discovered and demonstrated the method of preparation; for thinking that the sand contained gold because it shone brightly, he collected it and worked on it. But when he saw that it did not contain any gold, he admired the beauty of the sand because of its color and so discovered this method of preparation. This did not happen long ago, but about ninety years before Praxiboulos was archon at Athens.

60 It is clear from these facts that art imitates nature and creates its own peculiar products, some of them for use, and some only for show, such as paints,⁴⁸ and others for both purposes equally, such as quicksilver; for this has its use too. It is made when cinnabar mixed with vinegar is ground in a copper vessel with a pestle made of copper. And perhaps several other things of this kind could be discovered.

61 Among the substances obtained by mining there still remain those that are found in earth-pits; these are caused, as we said in the beginning, from some conflux and separation of matter which is purer and more uniform than that of the other kinds. And all sorts of colors are obtained from them owing to the differences of the matter they contain . . . ;⁴⁹ some of them are softened and others are ground and melted, and in this way the stones that are brought from Asia are constructed.

62 The natural kinds of earth, which are useful as well as superior in quality, are three or four in number, the Melian, the Kimolian, the Samian, and a fourth in addition to these, the Tymphaic or *gypsos*.⁵⁰ Painters use only the Melian kind; they do not use the

⁴⁸ This translates ἀλιφάς; ἀλκρεῖς is unknown. The emendation ἀλκρεῖς (lit., "without fat") must refer to the type of earth mentioned in sec. 62; this was not greasy and was suitable for painting.

⁴⁹ If καὶ διὰ τὴν τῶν διεθούρων were read, the meaning would be "and of the matter that percolates."

⁵⁰ A much broader term than the English word *gypsum*. It included not only the

Samian, even though it is beautiful, because it is greasy, dense, and smooth. For the kind which is . . . and . . . ,⁶¹ and is not greasy is more suitable for painting, and the Melian kind has this quality⁶²

In Melos and Samos there are additional differences in the earth. 63
It is not possible to stand upright while digging in the pits of Samos, but a man has to lie on his back or his side. The vein stretches for a long way and is about two feet in height, though much greater in depth. It is surrounded on both sides by stones and is taken out from the space between them. It has a stratum right through the middle, and this is better than the parts on the outside; and then it has another stratum, and still another, up to 64
four The innermost earth is called "the star." This earth is used mainly or solely for clothes.⁶³

The Tymphaic earth is also used for clothes and is called *gypros* by the people who live near Mt. Athos and those districts. *Gypsos* occurs in large quantities in Cyprus and can easily be seen; for only a little soil is removed when it is dug up. In Phoenicia and Syria it is made by burning stones, and this also happens in Thourioi; for a large amount is produced there. And thirdly, it occurs in Tymphaia and in Perrhaibia and in other places.

Its nature is peculiar; for it is more like stone than earth, and 65
the stone resembles *alabastrites*. It is not cut out in a large mass but in small pieces. Its stickiness and heat, when it is wet, are remarkable; for it is used on buildings and is poured around the stone or anything else of this kind that one wishes to fasten.

After it has been pulverized and water has been poured on it, 66
it is stirred with wooden sticks; for this cannot be done by hand

mineral now called gypsum but also the roasted mineral. Lime and lime mortar also appear to have been included under this term. For a discussion of the various identifications, see Commentary, secs. 62, 64-69.

⁶¹ The literal meaning of *ἡρεμον* is "quiet," but what it means here is not certain. The emendations *δραιόν* and *τραχύδες* mean "of loose texture" and "rough." The first of these is very appropriate, since it indicates low density and is the opposite of *πυκρόν*. Furlanus reads *ἡρεμον* in addition to *δραιόν*, but the adverb *ἡρέμα* ("gently," "slightly") would be better.

⁶² The emendation *ἐν τῷ φάριδι* assumes that this is the name of a place. Schneider suggests *ἐν τῷ ψαφαρῷ* or *σὺν τῇ ψαφαρότητι*, implying that the earth is "liable to crumble." If the adjective *διάφορον* is concealed here, it would mean that the earth has a certain quality "in a marked degree."

⁶³ For cleaning or whitening clothes. See sec. 67.

because of the heat. And it is wetted immediately before it is used; for if this is done a short time before, it quickly hardens and it is impossible to divide it. Its strength, too, is remarkable; for when the stones are broken or pulled apart, the *gypsos* does not become loose, and often part of a structure falls down and is taken away, while the part hanging up above remains there, held together by
 67 the binding force. And it can even be removed and calcined and made fit for use again and again.

In Cyprus and in Phoenicia it is used mainly for these purposes, but in Italy it is also used for treating wine. And painters employ it for some parts of their art, and so do fullers, who sprinkle it on clothes. It seems to be far superior to other earths for taking impressions, and is generally used for this purpose, especially in Greece, owing to its stickiness and smoothness.

68 Its powers are seen in these and similar uses, but its nature is such that it seems, as it were, to contain the qualities both of lime and of earth, namely, heat and stickiness, or rather each of these in a marked degree. It is also clear from the following example that it has a fiery nature; for once a ship loaded with clothes was itself burnt when the clothes became wet and caught fire.

69 *Gypsos* is also burnt in Phoenicia and in Syria, where it is fired in a furnace. Marbles especially are burnt, and also the more ordinary kinds of stones, while cow-manure is placed alongside the hardest ones⁵⁴ to make them burn better and more quickly. It seems to become extremely hot when it has been set on fire, and stays hot for a very long time. And when it has been calcined, it is pulverized like ashes. From this it seems clear that its nature is entirely due to fire.

⁵⁴ If καὶ ἀπλῶς τοὺς στερεωτάτους, παρατιθέντες βόλινον were read, the meaning would be "and in general the hardest kinds of stones, while cow-manure is placed alongside them." Eichholz translates ἀπλῶς as "absolutely."