

PLINY ON MINING

BOOK XXXIV CHAP. 49.--BLACK LEAD.

Black lead is used in the form of pipes and sheets: it is extracted with great labour in Spain, and throughout all the Gallic provinces; but in **Britannia** it is found in the upper stratum of the earth, in such abundance, that a law has been spontaneously made, prohibiting any one from working more than a certain quantity of it. The various kinds of black lead are known by the following names--the Ovetanian, the Caprariensian, and the Oleastrensian. There is no difference whatever in them, when the scoria has been carefully removed by calcination. It is a marvellous fact, that these mines, and these only, when they have been abandoned for some time, become replenished, and are more prolific than before. This would appear to be effected by the air, infusing itself at liberty through the open orifices, just as some women become more prolific after abortion. This was lately found to be the case with the Santarensian mine in Bætica; which, after being farmed at an annual rental of two hundred thousand denarii, and then abandoned, is now rented at two hundred and fifty- five thousand per annum. In the same manner, the Antonian mine in the same province has had the rent raised to four hundred thousand sesterces per annum.

It is a remarkable fact, that if we pour water into a vessel of lead, it will not melt; but that if we throw into the water a pebble or a copper quadrans, the vessel will be penetrated by the fire.

BOOK XXXIV CHAP. 42.--THE METAL CALLED LIVE IRON.

The nature of lead next comes to be considered. There are two kinds of it, the black and the white. The white is the most valuable: it was called by the Greeks "cassiteros," and there is a fabulous story told of their going in quest of it to the islands of the Atlantic, and of its being brought in barks made of osiers, covered with hides. It is now known that it is a production of Lusitania and Gallæcia. It is a sand found on the surface of the earth, and of a black colour, and is only to be detected by its weight. It is mingled with small pebbles, particularly in the dried beds of rivers. The miners wash this sand, and calcine the deposit in the furnace. It is also found in the gold mines that are known as "alutiæ," the stream of water which is passed through them detaching certain black pebbles, mottled with small white spots and of the same weight as gold. Hence it is that they remain with the gold in the baskets in which it is collected; and being separated in the furnace, are then melted, and become converted into white lead.

Black lead is not procured in Gallæcia, although it is so greatly abundant in the neighbouring province of Cantabria; nor is silver procured from white lead, although it is from black. Pieces of black lead cannot be soldered without the intervention of white lead, nor can this be done without employing oil; nor can white lead, on the other hand, be united without the aid of black lead. White lead was held in estimation in the days even of the Trojan War, a fact that is attested by Homer, who calls it "cassiteros." There are two different sources of black lead: it being procured either from its own native ore, where it is produced without the intermixture of any other substance, or else from an ore which contains it in common with silver, the two metals being fused together. The metal which first becomes liquid in the furnace, is called "stannum;" the next that melts is silver; and the metal that remains behind is galena, the third constituent part of the mineral. On this last being again submitted to fusion black lead is produced, with a deduction of two-ninths.

BOOK XXXIV CHAP. 54.--PSIMITHIUM, OR CERUSE; SIX REMEDIES.

Psimithium, which is also known as ceruse, is another production of the lead-works. The most esteemed comes from Rhodes. It is made from very fine shavings of lead, placed over a vessel filled with the strongest vinegar; by which means the shavings become dissolved. That which falls into the vinegar is first dried, and then pounded and sifted, after which it is again mixed with vinegar, and is then divided into tablets and dried in the sun, during summer. It is also made in another way; the lead is thrown into jars filled with vinegar, which are kept closed for ten days; the sort of mould that forms upon the surface is then scraped off, and the lead is again put into the vinegar, until the whole of the metal is consumed. The part that has been scraped off is triturated and sifted, and then melted in shallow vessels, being stirred with ladles, until the substance becomes red, and assumes the appearance of sandarach. It is then washed with fresh water, until all the cloudy impurities have disappeared, after which it is dried as before, and divided into tablets.

Its properties are the same as those of the substances above mentioned. It is, however, the mildest of all the preparations of lead; in addition to which, it is also used by females to whiten the complexion. It is, however, like scum of silver, a deadly poison. Melted a second time, ceruse becomes red.

BOOK XXXIII CHAP. 21. HOW GOLD IS FOUND.

Gold is found in our own part of the world; not to mention the gold extracted from the earth in India by the ants, and in Scythia by the Griffins. Among us it is procured in three different ways; the first of which is, in the shape of dust, found in running streams, the Tagus in Spain, for instance, the Padus in Italy, the Hebrus in Thracia, the Pactolus in Asia, and the Ganges in India; indeed, there is no gold found in a more perfect state than this, thoroughly polished as it is by the continual attrition of the current.

A second mode of obtaining gold is by sinking shafts or seeking it among the debris of mountains; both of which methods it will be as well to describe. The persons in search of gold in the first place remove the "segutilum," such being the name of the earth which gives indication of the presence of gold. This done, a bed is made, the sand of which is washed, and, according to the residue found after washing, a conjecture is formed as to the richness of the vein. Sometimes, indeed, gold is found at once in the surface earth, a success, however, but rarely experienced. Recently, for instance, in the reign of Nero, a vein was discovered in Dalmatia, which yielded daily as much as fifty pounds' weight of gold. The gold that is thus found in the surface crust is known as "talutium," in cases where there is auriferous earth beneath. The mountains of Spain, in other respects arid and sterile, and productive of nothing whatever, are thus constrained by man to be fertile, in supplying him with this precious commodity.

The gold that is extracted from shafts is known by some persons as "canalicium," and by others as "canaliense;" it is found adhering to the gritty crust of marble, and, altogether different from the form in which it sparkles in the sapphirus of the East, and in the stone of Thebais and other gems, it is seen interlaced with the molecules of the marble. The channels of these veins are found running in various directions along the sides of the shafts, and hence the name of the gold they yield--"canalicium." In these shafts, too, the superincumbent earth is kept from falling in by means of wooden pillars. The substance that is extracted is first broken up, and then washed; after which it is subjected to the action of fire, and ground to a fine powder. This powder is known as "apitascudes," while the silver which becomes disengaged in the furnace has the name of "sudor" given to it. The impurities that escape by the chimney, as in the case of all other metals, are known by the name of "scoria." In the case of gold,

this scoria is broken up a second time, and melted over again. The crucibles used for this purpose are made of "tasconium," a white earth similar to potter's clay in appearance; there being no other substance capable of with-standing the strong current of air, the action of the fire, and the intense heat of the melted metal.

The third method of obtaining gold surpasses the labours of the Giants even: by the aid of galleries driven to a long distance, mountains are excavated by the light of torches, the duration of which forms the set times for work, the workmen never seeing the light of day for many months together. These mines are known as "arrugiæ;" and not unfrequently clefts are formed on a sudden, the earth sinks in, and the workmen are crushed beneath; so that it would really appear less rash to go in search of pearls and purples at the bottom of the sea, so much more dangerous to ourselves have we made the earth than the water! Hence it is, that in this kind of mining, arches are left at frequent intervals for the purpose of supporting the weight of the mountain above. In mining either by shaft or by gallery, barriers of silex are met with, which have to be driven asunder by the aid of fire and vinegar; or more frequently, as this method fills the galleries with suffocating vapours and smoke, to be broken to pieces with bruising- machines shod with pieces of iron weighing one hundred and fifty pounds: which done, the fragments are carried out on the workmen's shoulders, night and day, each man passing them on to his neighbour in the dark, it being only those at the pit's mouth that ever see the light. In cases where the bed of silex appears too thick to admit of being penetrated, the miner traces along the sides of it, and so turns it. And yet, after all, the labour entailed by this silex is looked upon as comparatively easy, there being an earth--a kind of potter's clay mixed with gravel, "gangadia" by name, which it is almost impossible to overcome. This earth has to be attacked with iron wedges and hammers like those previously mentioned, and it is generally considered that there is nothing more stubborn in existence--except indeed the greed for gold, which is the most stubborn of all things.

When these operations are all completed, beginning at the last, they cut away the wooden pillars at the point where they support the roof: the coming downfall gives warning, which is instantly perceived by the sentinel, and by him only, who is set to watch upon a peak of the same mountain. By voice as well as by signals, he orders the workmen to be immediately summoned from their labours, and at the same moment takes to flight himself. The mountain, rent to pieces, is cleft asunder, hurling its debris to a distance with a crash which it is impossible for the human imagination to conceive; and from the midst of a cloud of dust, of a density quite incredible, the victorious miners gaze upon this downfall of Nature. Nor yet even then are they sure of gold, nor indeed were they by any means certain that there was any to be found when they first began to excavate, it being quite sufficient, as an inducement to undergo such perils and to incur such vast expense, to entertain the hope that they shall obtain what they so eagerly desire.

Another labour, too, quite equal to this, and one which entails even greater expense, is that of bringing rivers from the more elevated mountain heights, a distance in many instances of one hundred miles perhaps, for the purpose of washing these debris. The channels thus formed are called "corrugi," from our word "corrivatio," I suppose; and even when these are once made, they entail a thousand fresh labours. The fall, for instance, must be steep, that the water may be precipitated, so to say, rather than flow; and it is in this manner that it is brought from the most elevated points. Then, too, vallies and crevasses have to be united by the aid of aqueducts, and in another place impassable rocks have to be hewn away, and forced to make room for hollowed troughs of wood; the person hewing them hanging suspended all the time with ropes, so that to a spectator who views the operations from a distance, the workmen have all the appearance, not so much of wild beasts, as of birds upon the

wing. Hanging thus suspended in most instances, they take the levels, and trace with lines the course the water is to take; and thus, where there is no room even for man to plant a footstep, are rivers traced out by the hand of man. The water, too, is considered in an unfit state for washing, if the current of the river carries any mud along with it. The kind of earth that yields this mud is known as "urium;" and hence it is that in tracing out these channels, they carry the water over beds of silex or pebbles, and carefully avoid this urium. When they have reached the head of the fall, at the very brow of the mountain, reservoirs are hollowed out, a couple of hundred feet in length and breadth, and some ten feet in depth. In these reservoirs there are generally five sluices left, about three feet square; so that, the moment the reservoir is filled, the floodgates are struck away, and the torrent bursts forth with such a degree of violence as to roll onwards any fragments of rock which may obstruct its passage.

When they have reached the level ground, too, there is still another labour that awaits them. Trenches--known as "agogæ" --have to be dug for the passage of the water; and these, at regular intervals, have a layer of ulex placed at the bottom. This ulex is a plant like rosemary in appearance, rough and prickly, and well-adapted for arresting any pieces of gold that may be carried along. The sides, too, are closed in with planks, and are supported by arches when carried over steep and precipitous spots. The earth, carried onwards in the stream, arrives at the sea at last, and thus is the shattered mountain washed away; causes which have greatly tended to extend the shores of Spain by these encroachments upon the deep. It is also by the agency of canals of this description that the material, excavated at the cost of such immense labour by the process previously described, is washed and carried away; for otherwise the shafts would soon be choked up by it.

The gold found by excavating with galleries does not require to be melted, but is pure gold at once. In these excavations, too, it is found in lumps, as also in the shafts which are sunk, sometimes exceeding ten pounds even. The names given to these lumps are "palagæ," and "palacurnæ," while the gold found in small grains is known as "baluce." The ulex that is used for the above purpose is dried and burnt, after which the ashes of it are washed upon a bed of grassy turf, in order that the gold may be deposited thereupon.

Asturia, Gallæcia, and Lusitania furnish in this manner, yearly, according to some authorities, twenty thousand pounds' weight of gold, the produce of Asturia forming the major part. Indeed, there is no part of the world that for centuries has maintained such a continuous fertility in gold. I have already mentioned that by an ancient decree of the senate, the soil of Italy has been protected from these researches; otherwise, there would be no land more fertile in metals. There is extant also a censorial law relative to the gold mines of Victumulæ, in the territory of Vercellæ, by which the farmers of the revenue were forbidden to employ more than five thousand men at the works.

BOOK XXVI CHAP. 52. CISTERNS.

Cisterns should be made of five parts of pure, gravelly, sand, two of the very strongest quicklime, and fragments of silex not exceeding a pound each in weight; when thus incorporated, the bottom and sides should be well beaten with iron rammers. The best plan, too, is to have the cisterns double; so that all superfluties may settle in the inner cistern, and the water filter through, as pure as possible, into the outer one.

BOOK XXXIII CHAP. 20.--THE METHOD OF GILDING.

On marble and other substances which do not admit of being brought to a white heat, gilt is laid with glair of egg, and on wood by the aid of a glutinous composition,

known as "leucophoron:" what this last is, and how it is prepared, we shall state on the appropriate occasion. The most convenient method for gilding copper would be to employ quicksilver, or, at all events, hydrargyros; but with reference to these substances, as we shall have occasion to say when describing the nature of them, methods of adulteration have been devised. To effect this mode of gilding, the copper is first well hammered, after which it is subjected to the action of fire, and then cooled with a mixture of salt, vinegar, and alum. It is then cleansed of all extraneous substances, it being known by its brightness when it has been sufficiently purified. This done, it is again heated by fire, in order to enable it, when thus prepared, with the aid of an amalgam of pumice, alum, and quicksilver, to receive the gold leaf when applied. Alum has the same property of purifying copper, that we have already mentioned as belonging to lead with reference to gold.

BOOK XXXIV CHAP. 41.--THE DIFFERENT KINDS OF IRON, AND THE MODE OF TEMPERING IT.

Iron ores are to be found almost everywhere; for they exist even in the Italian island of Ilva, being easily distinguished by the ferruginous colour of the earth. The method of working the ore is the same as that employed in the case of copper. In Cappadocia, however, it is peculiarly questionable whether this metal is a present due to the water or to the earth; because, when the latter has been saturated with the water of a certain river, it yields, and then only, an iron that may be obtained by smelting.

There are numerous varieties of iron ore; the chief causes of which arise from differences in the soil and in the climate. Some earths produce a metal that is soft, and nearly akin to lead; others an iron that is brittle and coppery, the use of which must be particularly avoided in making wheels or nails, the former kind being better for these purposes. There is another kind, again, which is only esteemed when cut into short lengths, and is used for making hobnails; and another which is more particularly liable to rust. All these varieties are known by the name of "strictura," an appellation which is not used with reference to the other metals, and is derived from the steel that is used for giving an edge. There is a great difference, too, in the smelting; some kinds producing knurrs of metal, which are especially adapted for hardening into steel, or else, prepared in another manner, for making thick anvils or heads of hammers. But the main difference results from the quality of the water into which the red-hot metal is plunged from time to time. The water, which is in some places better for this purpose than in others, has quite ennobled some localities for the excellence of their iron, Bilbilis, for example, and Turiasso in Spain, and Comum in Italy; and this, although there are no iron mines in these spots.

But of all the different kinds of iron, the palm of excellence is awarded to that which is made by the Seres, who send it to us with their tissues and skins; next to which, in quality, is the Parthian iron. Indeed, none of the other kinds of iron are made of the pure hard metal, a softer alloy being welded with them all. In our part of the world, a vein of ore is occasionally found to yield a metal of this high quality, as in Noricum for instance; but, in other cases, it derives its value from the mode of working it, as at Sulmo, for example, a result owing to the nature of its water, as already stated. It is to be observed also, that in giving an edge to iron, there is a great difference between oil-whetstones and water-whetstones, the use of oil producing a much finer edge. It is a remarkable fact, that when the ore is fused, the metal becomes liquefied like water, and afterwards acquires a spongy, brittle texture. It is the practice to quench smaller articles made of iron with oil, lest by being hardened in water they should be rendered brittle. Human blood revenges itself upon iron; for if the metal has been once touched by this blood it is much more apt to become rusty.

BOOK XXXIV CHAP. 42.--THE METAL CALLED LIVE IRON.

We shall speak of the loadstone in its proper place, and of the sympathy which it has with iron. This is the only metal that acquires the properties of that stone, retaining them for a length of time, and attracting other iron, so that we may sometimes see a whole chain formed of these rings. The lower classes, in their ignorance, call this "live iron," and the wounds that are made by it are much more severe. This mineral is also found in Cantabria, not in continuous strata, like the genuine loadstone, but in scattered fragments, which they call "bullationes." I do not know whether this species of ore is proper also for the fusion of glass, as no one has hitherto tried it; but it certainly imparts the same property as the magnet to iron. The architect Timochares began to erect a vaulted roof of loadstone, in the Temple of Arsinoë, at Alexandria, in order that the iron statue of that princess might have the appearance of hanging suspended in the air: his death, however, and that of King Ptolemæus, who had ordered this monument to be erected in honour of his sister, prevented the completion of the project.

BOOK XXVI CHAP. 25. THE MAGNET: THREE REMEDIES

Upon quitting the marbles to pass on to the other more remarkable stones, who can for a moment doubt that the magnet will be the first to suggest itself? For what, in fact, is there endowed with more marvellous properties than this? or in which of her departments has Nature displayed a greater degree of waywardness? She had given a voice to rocks, as already mentioned, and had enabled them to answer man, or rather, I should say, to throw back his own words in his teeth. What is there in existence more inert than a piece of rigid stone? And yet, behold! Nature has here endowed stone with both sense and hands. What is there more stubborn than hard iron? Nature has, in this instance, bestowed upon it both feet and intelligence. It allows itself, in fact, to be attracted by the magnet, and, itself a metal which subdues all other elements, it precipitates itself towards the source of an influence at once mysterious and unseen. The moment the metal comes near it, it springs towards the magnet, and, as it clasps it, is held fast in the magnet's embraces. Hence it is that this stone is sometimes known by the name of "sideritis;" another name given to it being "heraclion." It received its name "magnes," Nicander informs us, from the person who was the first to discover it, upon Ida. It is found, too, in various other countries, as in Spain, for example. Magnes, it is said, made this discovery, when, upon taking his herds to pasture, he found that the nails of his shoes and the iron ferrel of his staff adhered to the ground.

Sotacus describes five different kinds of magnet; the Æthiopian magnet; that of Magnesia, a country which borders on Macedonia, and lies to the right of the road which leads from the town of Bœbe to Iolcos; a third, from Hyettus in Bœotia; a fourth, from Alexandria in Troas; and a fifth, from Magnesia in Asia. The leading distinction in magnets is the sex, male and female, and the next great difference in them is the colour. Those of Magnesia, bordering on Macedonia, are of a reddish black; those of Bœotia are more red than black; and the kind that is found in Troas is black, of the female sex, and consequently destitute of attractive power. The most inferior, however, of all, are those of Magnesia in Asia: they are white, have no attractive influence on iron, and resemble pumice in appearance. It has been found by experience, that the more nearly the magnet approaches to an azure colour, the better it is in quality. The Æthiopian magnet is looked upon as the best of all, and is purchased at its weight in silver: Zmiris in Æthiopia is the place where it is found, such being the name of a region there, covered with sand.

In the same country, too, the magnet called "hæmatites" is found, a stone of a blood-red colour, and which, when bruised, yields a tint like that of blood, as also of saffron. The hæmatites has not the same property of attracting iron that the ordinary magnet has. The Æthiopian magnet is recognized by this peculiarity, that it has the property, also, of attracting other magnets to it. All these minerals are useful as ingredients in ophthalmic preparations, in certain proportions according to the nature of each: they are particularly good, too, for arresting defluxions of the eyes. Triturated in a calcined state, they have a healing effect upon burns.

In Æthiopia, too, not far from Zmiris, there is a mountain in which the stone called "theamedes" is found, a mineral which repels and rejects all kinds of iron. Of the attractive and repulsive properties of iron, we have spoken more than once.

BOOK XXXIII CHAP. 26. CHRYSOCOLLA.

Chrysocolla is a liquid which is found in the shafts already mentioned, flowing through the veins of gold; a kind of slime which becomes indurated by the cold of winter till it has attained the hardness even of pumice. The most esteemed kind of it, it has been ascertained, is found in copper-mines, the next best being the produce of silver-mines: it is found also in lead-mines, but that found in combination with gold ore is much inferior.

In all these mines, too, an artificial chrysocolla is manufactured; much inferior, however, to the native chrysocolla. The method of preparing it consists in introducing water gradually into a vein of metal, throughout the winter and until the month of June; after which, it is left to dry up during the months of June and July: so that, in fact, it is quite evident that chrysocolla is nothing else but the putrefaction of a metallic vein. Native chrysocolla, known as "uva," differs from the other in its hardness more particularly; and yet, hard as it is, it admits of being coloured with the plant known as "lutum." Like flax and wool, it is of a nature which imbibes liquids. For the purpose of dyeing it, it is first bruised in a mortar, after which, it is passed through a fine sieve. This done, it is ground, and then passed through a still finer sieve; all that refuses to pass being replaced in the mortar, and subjected once more to the mill. The finest part of the powder is from time to time measured out into a crucible, where it is macerated in vinegar, so that all the hard particles may be dissolved; after which, it is pounded again, and then rinsed in shell-shaped vessels, and left to dry. This done, the chrysocolla is dyed by the agency of schist alum and the plant above-mentioned; and thus is it painted itself before it serves to paint. It is of considerable importance, too, that it should be absorbent and readily take the dye: indeed, if it does not speedily take the colour, scytanum and turbistum are added to the dye; such being the name of two drugs which compel it to absorb the colouring matter.

BOOK XXXIII CHAP. 29.--THE CHRYSOCOLLA OF THE GOLDSMITHS, KNOWN ALSO AS SANTERNA.

The goldsmiths also employ a chrysocolla of their own, for the purpose of soldering gold; and it is from this chrysocolla, they say, that all the other substances, which present a similar green, have received their name. This preparation is made from verdigris of Cyprian copper, the urine of a youth who has not arrived at puberty, and a portion of nitre. It is then pounded with a pestle of Cyprian copper, in a copper mortar, and the name given to the mixture is "santerna." It is in this way that the gold known as "silvery" gold is soldered; one sign of its being so alloyed being its additional brilliancy on the application of santerna. If, on the other hand, the gold is impregnated with copper, it will contract, on coming in contact with the santerna, become dull, and only be soldered with the greatest difficulty: indeed, for this last

kind of gold, there is a peculiar solder employed, made of gold and one-seventh part of silver, in addition to the materials above-mentioned, the whole beaten up together.

BOOK XXXIII CHAP. 30.--THE MARVELLOUS OPERATIONS OF NATURE IN SOLDERING METALLIC SUBSTANCES, AND BRINGING THEM TO A STATE OF PERFECTION.

While speaking on this subject, it will be as well to annex the remaining particulars, that our admiration may here be drawn to all the marvels presented by Nature in connection therewith. The proper solder for gold is that above described; for iron, potter's clay; for copper, when in masses, cadmia, and in sheets, alum; for lead and marble, resin. Lead is also united by the aid of white lead; white lead with white lead, by the agency of oil; stannum, with copper file-dust; and silver, with stannum.

For smelting copper and iron, pine-wood is the best, Egyptian papyrus being also very good for the purpose. Gold is melted most easily with a fire made of chaff. Limestone and Thracian stone are ignited by the agency of water, this last being extinguished by the application of oil. Fire, however, is extinguished most readily by the application of vinegar, viscus, and unboiled eggs. Earth will under no circumstance ignite. When charcoal has been once quenched, and then again ignited, it gives out a greater heat than before.

BOOK XXXIII CHAP. 32.--QUICKSILVER.

There is a mineral also found in these veins of silver, which yields a humour that is always liquid, and is known as "quicksilver." It acts as a poison upon everything, and pierces vessels even, making its way through them by the agency of its malignant properties. All substances float upon the surface of quicksilver, with the exception of gold, this being the only substance that it attracts to itself. Hence it is, that it is such an excellent refiner of gold; for, on being briskly shaken in an earthen vessel with gold, it rejects all the impurities that are mixed with it. When once it has thus expelled these superfluities, there is nothing to do but to separate it from the gold; to effect which, it is poured out upon skins that have been well tawed, and so, exuding through them like a sort of perspiration, it leaves the gold in a state of purity behind.

Hence it is, too, that when copper has to be gilded, a coat of quicksilver is laid beneath the gold leaf, which it retains in its place with the greatest tenacity: in cases, however, where the leaf is single, or very thin, the presence of the quicksilver is detected by the paleness of the colour. For this reason, persons, when meditating a piece of fraud, have been in the habit of substituting glair of egg for quicksilver, and then laying upon it a coat of hydrargyros, a substance of which we shall make further mention in the appropriate place. Generally speaking, quicksilver has not been found in any large quantities.

BOOK XXXIV CHAP. 1. THE ORES OF BRASS.

WE must, in the next place, give an account of the ores of brass, a metal which, in respect of utility, is next in value; indeed the Corinthian brass comes before silver, not to say almost before gold itself. It is also, as I have stated above, the standard of monetary value; hence the terms "æra militum," "tribuni ærarii," "ærarium," "obæрати," and "ære diruti." I have already mentioned for what length of time the Roman people employed no coin except brass; and there is another ancient fact which proves that the esteem in which it was held was of equal antiquity with that of the City itself, the circumstance that the third associated body which Numa established, was that of the braziers.

BOOK XXXIV CHAP. 2.--THE DIFFERENT KINDS OF COPPER.

The ore is extracted in the mode that has been described above, and is then purified by fusion. The metal is also obtained from a coppery stone called "cadmia." The most highly esteemed copper is procured from beyond seas: it was formerly obtained in Campania also, and at present is found in the country of the Bergomates, at the extremity of Italy. It is said to have been lately discovered also in the province of Germany.

In Cyprus, where copper was first discovered, it is also procured from another stone, which is called "chalcitis." This, however, was afterwards considered of little value, a better kind having been found in other regions, especially that called "aurichalcum," which was long in high request, on account of its excellent quality; but none of it has been found for this long time, the earth having been quite exhausted. The kind which was next in value was the Sallustian, procured from the Alpine district of the Centrones; but this did not last long, and was succeeded by the Livian, in Gaul. They both took their names from the owners of the mines; the former a friend of the Emperor Augustus, the latter that emperor's wife. They soon failed, however, and in the Livian even there is now found but a very small quantity of ore. That which is at present held in the highest estimation is the Marian, likewise known as the Corduban: next to the Livian, this kind most readily absorbs cadmia, and becomes almost as excellent as aurichalcum for making sesterces and double asses, the Cyprian copper being thought good enough for the as. Thus much concerning the natural qualities of this metal.

The ore is extracted in the mode that has been described above, and is then purified by fusion. The metal is also obtained from a coppery stone called "cadmia." The most highly esteemed copper is procured from beyond seas: it was formerly obtained in Campania also, and at present is found in the country of the Bergomates, at the extremity of Italy. It is said to have been lately discovered also in the province of Germany.

In Cyprus, where copper was first discovered, it is also procured from another stone, which is called "chalcitis." This, however, was afterwards considered of little value, a better kind having been found in other regions, especially that called "aurichalcum," which was long in high request, on account of its excellent quality; but none of it has been found for this long time, the earth having been quite exhausted. The kind which was next in value was the Sallustian, procured from the Alpine district of the Centrones; but this did not last long, and was succeeded by the Livian, in Gaul. They both took their names from the owners of the mines; the former a friend of the Emperor Augustus, the latter that emperor's wife. They soon failed, however, and in the Livian even there is now found but a very small quantity of ore. That which is at present held in the highest estimation is the Marian, likewise known as the Corduban: next to the Livian, this kind most readily absorbs cadmia, and becomes almost as excellent as aurichalcum for making sesterces and double asses, the Cyprian copper being thought good enough for the as. Thus much concerning the natural qualities of this metal.

BOOK XXXV CHAP. 47. VARIOUS KINDS OF EARTH. THE PUTEOLAN DUST, AND OTHER EARTHS OF WHICH CEMENTS LIKE STONE ARE MADE.

But there are other resources also, which are derived immediately from the earth. Who, indeed, cannot but be surprised at finding the most inferior constituent parts of it, known as "dust" only, on the hills about Puteoli, forming a barrier against the waves of the sea, becoming changed into stone the moment of its immersion, and increasing in hardness from day to day--more particularly when mixed with the cement of Cumæ? There is an earth too, of a similar nature found in the districts about

Cyzicus; but there, it is not a dust, but a solid earth, which is cut away in blocks of all sizes, and which, after being immersed in the sea, is taken out transformed into stone. The same thing may be seen also, it is said, in the vicinity of Cassandrea; and at Cnidos, there is a spring of fresh water which has the property of causing earth to petrify within the space of eight months. Between Oropus and Aulis, every portion of the land upon which the sea encroaches becomes transformed into solid rock.

The finer portion of the sand of the river Nilus is not very different in its properties from the dust of Puteoli; not, indeed, that it is used for breaking the force of the sea and withstanding the waves, but only for the purpose, forsooth, of subduing the body for the exercises of the palestra! At all events, it was for this purpose that it used to be brought over for Patrobius, a freedman of the Emperor Nero. I find it stated also, that Craterus, Leonnatus, and Meleager, generals of Alexander the Great, had this sand transported along with their munitions of war. But I forbear to enlarge any further upon this subject; or indeed, by Hercules! upon those preparations of earth and wax of which the ceromata are made, so much employed by our youth in their exercises of the body, at the cost of all vigour of the mind.