

XIII.—*On Submarine Mines.*

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IN the infancy of the art of mining, every attempt which was made to pierce through the epidermis of this habitable globe, must have been regarded with a sort of religious dread, which, without doubt, had its influence in retarding the progress of mining.

These prejudices were not wholly laid aside when the art had attained some degree of perfection; for Seneca and Pliny are loud in their denunciations of the impiety of these pursuits.*

The more common topic, however, of declamation with these two philosophers, was

* “*Persequimus omnes ejus fibras,*” says Pliny, “*vivimusque super excavatam, mirantes dehiscere aliquandò aut intermiscere illam, ceu verò non hoc etiam indignatione sacræ parentis exprimi possit.*” L. XXXIII.

the avarice which had tempted mankind to abandon the agricultural pursuits of their forefathers, and penetrate into the bowels of the earth in search of the noble metals.*

But the most eloquent example of this philosophical declamation, is to be found in the works of Seneca. This writer is giving an instance of the great depth and extent of the Thracian mines before the age of Philip, which affords him an occasion to rejoice that in former times, mankind were no less depraved than in his own.†

* “Imus in viscera ejus,” exclaims Pliny, “et in sedemanium opes quærimus, tanquam parùm benignâ fertillique, quaquâ secatur.” Again, “Mens ad inane evolans reputât quæ deindè futura sit finis seculis omnibus exhauriendi eam : quousquè penetratura avaritia.” L. XXXIII.

† “Illi quoque majores nostri, quos celebramus laudibus, quibus dissimiles querimus nos esse, spe ducti, montes cæciderunt, et supra lucrum sub ruina steterunt. Antè Philippum Macedonem reges fuere, qui pecuniam in altissimis usque latebris sequerentur, et relicto spiritu libero, in illos se dimitterent specus, in quos nullum noctium dierumque perveniret discrimen, et a tergo lucem relinqueret. Quæ tanta spes fuit? Quæ tanta necessitas hominem ad sidera erectum incurvavit, et defodit, et in fundum telluris intimæ mersit, ut erueret aurum, non minore periculo quærendum, quam possidendum? Propter hoc cuniculos egit, et circa, prædam lutulentam incertamque raptavit, oblitus dierum, oblitus naturæ melioris à qua se avertit. Nulli ergo mortuo terra tam gravis est, quam istis supra quos avaritia urgens terrarum pondus injecit, quibus abstulit cælum, quos in imo, ubi illud malum virus latitat, infodit. Illo descendere ausi

Some of my readers, perhaps, will feel inclined to ask who this Stoical philosopher was; who pronounces a long and animated invective against the pursuits of subterraneous wealth. He was the richest man in the Roman empire, and so far from practising what he here professes, was remarkable for the luxury and magnificence in which he lived; and, in short, for the value which he set upon all the good things of this world. Nor was Pliny, who was also a very wealthy man, more disposed to renounce the luxuries of life, or the means of acquiring them.

Setting aside the above awkward circumstances in the private life of these eminent philosophers; which, undoubtedly, have the effect of diminishing our respect for their doctrine; let us figure to ourselves what would be their surprize and indignation, could they be permitted to view the audacious attempts that have been made in our days, to pursue the mineral dæmon into the most hidden recesses of the earth, and to make the elements of fire and water subservient to our avarice.

And yet, unless we suppose them to belong to the class of infallible philosophers, how much would their surprize be heightened and

sunt, ubi novam rerum positionem, terrarumque pendentium habitus, ventosque per cœcum inane experirentur, et aquarum in illis fluentium horridos fontes, et altam perpetuamque noctem. Deinde cùm ista fecerint, inferos metuunt. *Nat. Quæst. l. v. cap. xv.*

their indignation lowered, when they perceived that all our mining operations were carried on by free men and not by slaves, by voluntary, not by compulsory labour.

On a review of the improvements which have taken place in our machinery within the last forty years, I am inclined to think that the spirit of mining enterprize, to which they have imparted so much animation, will soon assume a character of still greater audacity. Perhaps when the veins are exhausted, which lie within the boundary of our sea-girt peninsula, we shall turn our attention to those which extend in the same direction beneath the bed of the ocean; nor, when we consider the increasing depth of our mines, can that period be very distant. Our submarine works will then form a new epoch in the history of mining, and by calling forth still greater exertions of skill and industry, demonstrate in a more striking manner, the powers of the human intellect.

The attempts that have been made to realize this project, shew that it is by no means a chimerical one. There are some coal-mines at Whitehaven which have long been extended under the sea, and there is an instance, I believe, of a lode at Huel Cock, near the Lands-end, which was for some time pursued in that direction, until the ore having been worked out too greedily in the roof of the mine,

fears were entertained that the sea would break through and put an end to the operations.

But by far the most remarkable enterprize of this kind, was formed about thirty years ago, by a poor man of the parish of Breage. It was an attempt, not literally indeed, but in effect, to sink a mine in the sea itself, and to carry on these operations, surrounded by water.

There is something so grand in the conception of this undertaking, when the feeble means are considered, by which it was to be accomplished, that I have long thought it entitled to a very honourable place in the annals of Cornish mining. I shall therefore communicate all the particulars of this singular mine, which were collected by me when it was still open in the year 1791, and that the narrative may not want a classical interest, I shall prefix to it some account of whatever has been attempted in this way by the Greeks and Romans.

I find only two examples in ancient history (and they are not very obvious to notice) of mines wrought in or under the bottom of the sea. One of these is mentioned by Pausanias, who, speaking of the temple at Delphi, observes, "Near the votive offering of the Tarentines, is the treasury of the Siphnians. It was built upon the following occasion. Their isle produced mines of gold. Apollo commanded them to dedicate a tenth part of their

produce to the temple at Delphi. They built a treasury and remitted a tenth; but when through avarice they had ceased to do this, the inundations of the sea destroyed the mines and caused them to disappear."*

There is nothing in this story which may not be accounted for by natural causes. The mines were at first very productive: they were wrought by degrees to a greater depth and with less profit: at length, when the Siphnians were tempted to pursue the veins even under the sea, that might very naturally happen, which is here related; the sea broke through the weak partition, and wholly put an end to the operations of the miners.†

Tournefort, who visited the island of Siphnos,

* PHOSIC, SIVE LIB. X, CAP. XI.

† Suidas relates the same story, *v. Σιφνιοι*. We are informed by Herodotus, that Siphnos abounded in mines of gold and silver to such a degree, that from a tenth of the revenue which was derived from them, the Siphnians offered a treasure at Delphi that might be compared with the richest in the temple there, L. III. CAP. LVII. The period in which the mines of Siphnos were in this flourishing state was, according to the Chronology of Larcher, about 525 years A. C. but they must have been on the decline not long afterwards, for the Siphnians sent only one vessel of fifty oars to the battle of Salamis; and in the time of Demosthenes they were become fully as insignificant as the inhabitants of any of the Cyclades, vide Demosth. *Περί Συνταξίως* quoted by Larcher. Strabo does not even notice the former existence of these mines, so completely were they forgotten in the time of Augustus.

in the year 1700, says, "that the ore of lead abounds there, but as for the mines of gold and silver, the inhabitants scarcely knew where they were. In order to shew us, however, what were principally considered as such, they conducted us to the sea shore, near a ruined chapel, called Aios Sosti, where we saw the entrance of the mine only, not being able to proceed farther on account of the darkness, and the difficulty of access."

The same views led me to visit the island of Siphnos in the year 1787, but the natives, who were, justly apprehensive of the consequences of exciting the financial avarice of the Porte, contrived to oppose so many difficulties to my researches, as obliged me to relinquish the attempt.

A second instance of a submarine mine is mentioned (although indirectly, as well as the preceding), in those extracts from the works of Aristotle, which are known under the title of *Περὶ θαυμασίων Ἀκουσμάτων**

The same circumstance is repeated by another collector of the wonders of Nature, Anti-

* Δημόσιος ἢ Καρχηδονίων νῆσος, ἀπὸ Δημόσιου τοῦ πρώτου ἐργασαμένου, τὴν ἐπινομίαν εἰληφεν. ἔχει δὲ ὁ τόπος κωαῶν το μέταλλον, καὶ χρυσοκόλλης. ταύτης δ' ἡ κελίση πρὸς χρυσίου εὐρίσκει τιμήν. καὶ γὰρ φάρμακον ὀφθαλμῶν ἐστίν. ἐστὶ δὲ αὐτόδι χαλκός κολυμβητῆς ἐν δούτῳ ὀργυῖαις τῆς θαλάσσης. Here the χαλκός κολυμβητῆς is generally understood to mean copper which is collected by diving.

The χαλκός κολυμβητῆς reminds us of the expressions sea-coal, stream-tin, bay-salt.

gonus Carystius, who, however, substitutes Delus for Demonesus; a mistake which probably arose from the celebrity of Delus for its works in brass. "Antiquissima æris gloria Deliaco fuit." PLIN. L. 34. Both these compilations give us Καρχηδονίαν, which, according to the opinion of some eminent critics,* ought to be Χαλκεδονίαν, the Chalcedonians on the Bosphorus.†

But all doubt is removed by the discovery of the vestiges of these mines on a small island near the shore of Chalcedon, which still retains the name of Kalki. Gyllius mentions it in his work de Bosporo Thracio.‡

* Salmasius ad Solin, p. 137. Bochart Can. 1. 26. Holstenius de Pinedo, and Berkelius ad Stephanum, and others. Vide Bechmann's edition of the two works.

† Hesychius is more correct and explicit on this subject "Δημόσιος χαλκός. δύο εἰσι πρὸς πῶ. Βυζαντίῳ νῆσοι, καὶ ἡ μὲν Δημόσιος λεγόμεναι, ἰδιὰ δὲ διαλλάττουσι, ἡ μὲν γὰρ Χαλκίτις, ἡ δὲ Πιτοῦσα."

‡ "Verum ut clarius perspiciatur Demonesus eadem insula esse, quæ [Chalcitis, ut nunc sunt, ostendam vestigia metallorum et situm insulæ, quæ tribus verticibus seu collibus intumescit; unus vergit ad Aquilonem, alter ad occasum, tertius ad orientem. Insulæ latus meridianum est præceps et abruptum in rupes, excepto sinu, admittente recessum magna portuosum, quoque versus patentem paulo plus stadio, tutum ab omni vento, excipio Austrum. Circa hunc sinum existunt æggeres scrobium, pleni ruderibus cæruleis, rejectis ex effusione aris et chrysocollæ, et cærulei, atque inter ipsa rudera collegi eximium cæruleum et absolutam chrysocollam. Quodsi

In the year 1794 I had an opportunity of visiting this small island, which, although hilly, is no where more than twenty fathoms above the level of the sea. I found in the situation here described, prodigious heaps of mining rubbish, in every part of which the green and blue oxydes of copper were observable. From the magnitude of these heaps, compared with the little elevation of the ground above the sea, it was evident that the greater part of the mining operations must have been carried on below the sea level, and as the rubbish lay close to the shore, it may fairly be presumed that the works were extended under the sea. As for the popular notion of the copper having been obtained by diving, that may have arisen from the actual discovery of some native copper towards the surface of the veins below water, a circumstance, which, in Cornwall, would not be thought extraordinary.*

vadum maris ibi effoderetur, sine dubitatione inveniretur aurum illud ab Aristotele laudatum. Aggeres scrobium sunt in radicibus vallis supra sinum jam dictum eminentis et secantis insulam a mari meridiano ad mare septentrionale."

I suspect that Gyllius has been led into this mistake by Stephanus Byzantinus, who renders the expression of Aristotle *ἡ καλλίστη πρὸς χρυσίου περισκελί τμήτη* præstantissima chrysocolla auro contra venditur by *χρυσίου περισκελίαι τμήτων*.

* These mines had ceased to be worked in the time of Pliny, who, describing the different sorts of Smaragdus (our emerald) observes, "Carchedonii (Chalcedonii) nescio an

Such are the obscure and imperfect notices, which, I have been able to discover, of submarine mining in ancient times, and the instances are few, because mines are generally situated at a distance from the sea. I shall now proceed to give some account of the submarine mine near Penzance, which, about twenty years ago, so much attracted the public attention, and to which the name of *Wherry Mine* was given.

The first attempts to work this singular mine are said to have been made towards the beginning of the last century, when many small veins of tin being observed to cross a rocky shoal, which is exposed to view at low water; some persons were induced to make it an object of mining adventure. How long they persevered in this difficult enterprize, and what were the mechanical aids of which they availed themselves, is not known; but the works, after being sunk to the depth of a very few fathoms in the rock, were finally abandoned.

About the year 1778, a poor miner of the parish of Breage, whose name was Thomas Curtis, had the boldness to renew the attempt. But before I proceed to speak of his plan of operations, and the success which attended them, it will be necessary to give my readers

in totum exoleverint, *postquam metalla æris ibi defecerint, et semper viles fuere minimique.*" Theophratus speaks of the same smaragdi, "εἰ τῆ ῥήσω τῆ ἐπιπέμινη Καρχηδόνι."

some idea of the natural obstacles which he encountered.

The distance of the shoal from the neighbouring beach at high water, is about 120 fathoms, and this, in consequence of the shallowness of the beach, is not materially lessened at low water. It is calculated that the surface of the rock is covered about ten months in twelve, and that the depth of water on it at spring tides is nineteen feet. The prevailing winds occasion a very great surf here even in summer, but in winter the sea bursts over the rock in such a manner, as to render all attempts to carry on mining operations unavailing.

Such were the difficulties which a poor individual had to surmount, whose whole capital perhaps was not ten pounds. As the work could be prosecuted only during the short period of time when the rock appeared above water, (a period which was still farther abridged by the necessity of previously emptying the excavation), three summers were consumed in sinking the pump shaft, a work of mere bodily labour. The use of machinery then became practicable, and a frame of boards being applied to the mouth of the shaft, it was cemented to the rock by pitch and oakum, made water tight in the same way, and carried up to a sufficient height above the highest spring tide. To support this boarded turret, which was twenty feet high above the rock, and two feet

one inch square, against the violence of the surge, eight stout bars of iron were applied in an inclined direction to the sides, four of them below, and four of an extraordinary length and thickness above. A platform of boards was then lashed round the top of the turret, supported by four poles, which were firmly connected with these rods. Lastly, upon this platform was fixed a win for four men.

It was thought that the miners would thus be enabled to pursue their operations at all times, even during the winter months, whenever the weather was not particularly unfavourable; but as soon as the excavation was carried to some extent in a lateral direction, this was found to be impossible, for the seawater penetrated through the fissures of the rock, and in proportion as the workings became enlarged, the labour of raising it to the mouth of the shaft increased. Their predecessors, as well as themselves, had carried on their excavations too near the surface, which not only made the rock more permeable, but less able to resist the immense pressure of water at high tide, so that it became necessary to support it with large timbers. To add to this disappointment, it was found impossible to prevent the water from forcing its way through the shaft during the winter months, or, on account of the swell and surf, to remove the tin stone from the rock to the beach opposite.

The whole winter, therefore, was a period of

inaction, and it was not before April that the regular working of the mine could be resumed. Nevertheless, the short interval which was still allowed for labour below ground, sufficed most richly to reward the bold and persevering projector, and to give his mine the reputation of a very profitable adventure.

Whether he ever felt a conviction of the possibility of removing so many natural obstacles to his complete success, I know not, although there is reason to suppose that he did; for when I asked his opinion of the scheme of erecting a light-house on the tremendous Wolf-rock, he professed his belief in its practicability, but suggested as far preferable, the blowing up of the entire rock, which he readily engaged to do for a proper remuneration.

The following was the state of Huel Wherry in the autumn of 1791 :

Depth of the pump, shaft, and of the workings, four fathoms two feet.

Breadth of the workings, eighteen feet.

The roof was worked away in some places to the thickness of three feet.

Twelve men were employed for two hours at the wins in hauling the water, while six men were teaming from the bottoms into the sump. The men worked on the rock six hours afterwards : in all, eight hours.

Thirty sacks of tin-stone were broken on an average every tide ; and ten men, in the space

of six months, working about one-tenth of that time, broke about £600 worth.

There is something very remarkable in the natural history of this mine. The workings were confined to a course or channel of elvan, about eighteen feet in breadth, which runs N.W. and S. E. and underlies one foot and a half in a fathom to the S.W. It is discoverable on the beach at half tide.

Besides the small veins of tin which ran through this rock, its whole mass was impregnated with tin to such a degree, as to be worth the expense of raising; fifteen feet of the eighteen, which composed the breadth of the elvan, producing 1600 of "white tin" in 1000 sacks, and another foot as much as one cwt. of "white tin" in every sack.

On a close inspection of the mass in which the tin is thus abundantly dispersed, the grains appear of a crystalline transparency, and so equal in size, and regularly distributed, as to form, as it were, one of the constituent parts of the porphyry. The term *stannified granite*, which has been applied to it, is not, therefore, improper. It is said to have been the first tin-stone that was ever burnt in Cornwall before it was sent to the stamping-mill, a common lime-kiln having been erected for that purpose, which was found to answer completely. The object of this operation was to render the texture of the stone more friable.

In September, 1792, a friend (Mr. D. Gilbert) wrote to me as follows:—"The course of stanniferous porphyry, near Penzance, (the Wherry) promises to make a very great mine. There are indications of the tin being continued to a great extent in both directions, and the bottoms are growing longer, and remain rich. A house near the green, built with fragments of this stone, which were, probably, picked up on the shore, or broken from the top of the rock, is, I hear, to be pulled down and rebuilt with other stone, for the sake of its tin. An adventurer told me that three thousand pounds worth of tin has been raised from this extraordinary mine in the course of the present summer."

In a subsequent letter, the same friend informed me—"A steam engine is erecting on the green opposite, and they are constructing a wooden bridge from thence to the rock, to serve as a communication, till the engine shaft has been sunk sufficiently deep, and a drift worked out to the mine, as a stage for supporting the sliding, or rather hanging rods." See plate I.

The bridge, thus constructed, answered also the purpose of conveying the *ore* and *deads* to the shore. In this manner the mine was conducted, and ore to the amount of seventy thousand pounds was raised from it. Nor indeed were its treasures exhausted at its close,

which was as romantic as its commencement. An American vessel broke from its anchorage in Gwavas Lake, and striking against the stage, demolished the machinery, and thus put an end to an adventure, which, both in ingenuity and success, was probably never equalled in any country.