

XVIII. *Some Particulars of the present State of Mount Vefuvius; with the Account of a Journey into the Province of Abruzzo, and a Voyage to the Island of Ponza. In a Letter from Sir William Hamilton, K. B. F. R. S. and A. S. to Sir Joseph Banks, Bart. P. R. S.*

Read May 4, 1786.

S I R,

Naples, January 24, 1786.

THE eruption of Mount Vefuvius, which began in the month of November 1784, nearly at the moment of my return from England to this Capital, and which continued in some degree till about the 20th of last month, has afforded much amusement to travellers unacquainted with this wonderful operation of nature, but no new circumstance that could justify my troubling you with a letter on the subject. The lava either overflowed the rim of the crater, or issued from small fissures on its borders, on that side which faces the mountain of Somma, and ran more or less in one, and at times in three or four channels, regularly formed, down the flanks of the conical part of the volcano; sometimes descending and spreading itself in the valley between the two mountains; and once, when the eruption was in its greatest force, in the month of November last, the lava descended still lower, and did some damage to the vineyards, and cultivated parts at the foot of Vefuvius, towards the village of St. Sebastiano; but generally

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the lava, not being abundant, stopped and cooled before it was able to reach the valley. By the accumulation of these lava's on the flanks of Vesuvius, its form has been greatly altered; and by the frequent explosion of scorix and ashes, a considerable mountain has been formed within the crater, which now rising much above its rim has likewise given that part of the mountain a new appearance. Just before I left Naples, in May 1783, I was at the top of Vesuvius. The crater was certainly then more than 250 feet deep, and was impracticable, its sides being nearly perpendicular. This eruption, however, has been as satisfactory as could be desired by the inhabitants of this city, a prodigious quantity of lava having been disgorged; which matter, confined within the bowels of the earth, would probably have occasioned tremors; and even slight ones might prove fatal to Naples, whose houses are, in general, very high, ill built, and a great number in almost every street already supported by props, having either suffered by former earthquakes, or from the loose volcanic soil's having been washed from under their foundations by the torrents of rain water from the high grounds which surround Naples, and on which a great part of the town itself is built.

From the time of the last formidable eruption of Mount Vesuvius, in August 1779 (described in one of my former communications to the Royal Society) to this day, I have, with the assistance of the Father Antonio Piaggi*, kept an exact diary of the operations of Vesuvius, with drawings, shewing, by the quantity of smoke, the degrees of fermenta-

* This Padre Antonio Piaggi is the ingenious Monk who invented the method of unfolding and recovering the burnt ancient manuscripts of Herculaneum, and who resides constantly at Resina, at the foot, and in full view, of Mount Vesuvius.

tion of the volcano; also the course of the lava's during this last eruption, and the changes that have been made in the form of the mountain itself by the lava's and scorix that have been ejected. This journal is becoming very curious and interesting; it is remarkably so with respect to the pointing out a variety of singular effects that different currents of air have upon the smoke that issues from the crater of Vesuvius, elevated (as you know, Sir) more than 3600 feet above the level of the sea; but, except the smoke increasing considerably and constantly when the sea is agitated, and the wind blows from that quarter, the operations of Vesuvius appear to be very capricious and uncertain. One day there will be the appearance of a violent fermentation, and the next all is calmed again: but whenever the smoke has been attended with considerable ejections of scorix and cinders, I have constantly observed, that the lava has soon after made its appearance, either by boiling over the crater, or forcing its passage through crevices in the conical part of the volcano. As long as I remain in this country, and have the necessary assistance of the above-mentioned ingenious Monk (who is as excellent a draughtsman as he is an accurate and diligent observer) the Vesuvian diary shall be continued; and I hope one day to have the honour of presenting these curious manuscripts (which begin now to be voluminous) to the Royal Society, if it should think them worthy of a place in the Library of the Society.

Having never had an opportunity of examining the islands of Ponza, Palmarole, Zannone, and other small islands, or rather rocks, situated between the island of Ventotiene and Monte Circello, near Terracina, on the Continent; and thinking that by a tour of these islands I should be enabled to render my former observations more complete, and to communicate

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to you, Sir, some account of the only volcanic parts of this neighbourhood hitherto undescribed, I determined to take advantage of the absence of their Sicilian Majesties (who were then making the tour of Italy) and visit these islands. But before I put this plan in execution, I made a long excursion in the province of Abruzzo, as far as the Lake of Celano, anciently called Fucinus, and where the famous Emissary of the Emperor CLAUDIUS (a most stupendous work * for draining that lake) remains nearly entire, though filled up with rubbish and earth in many parts, and of course useless. The water of this lake, which is more than 30 miles in circumference, increases daily, and is destroying the rich and cultivated plains on its borders. It is surrounded by very high mountains, many of them covered with snow, and at the foot of them are many villages, and rich and well cultivated farms. Upon the whole it is the most beautiful lake I ever saw, and would be complete, if the neighbouring mountains were better wooded. This lake furnishes abundance of fish, but not of the best quality: a few large trout, but mostly tench, barbel, and dace. In the shallow water on the borders of the lake, I saw thousands of water snakes, pursuing and preying upon a little fish like our thornbacks, but much better armed, though their defensive weapons seemed to avail them but little against such ravenous foes.

I went with torches into the emissary of CLAUDIUS as far as I could. It is a covered under-ground canal, three miles long, and great part of it cut through a hard rock; the other parts supported by masonry, with wells sunk to give air and light.

* A description of this emissary of CLAUDIUS, with plans (though not very exact) has been published by FABRETTI, in the same book in which he has given an account of TRAJAN's column.

According

According to SÆTONIUS, CLAUDIUS employed thirty thousand men eleven years on this great work, intended to convey the superfluous water of the lake into the bed of the river Liris, now called Garigliano; and I make no doubt, but that if it was cleared and repaired, it would again answer that purpose.

In its present state it is a most magnificent monument of antiquity.

The whole country from Arpino, the native place of MARIUS*, by Isola, Sora, Civitella, and Capistrello, to the lake of Celano, is, in my opinion, infinitely more beautiful and picturesque than any spot I have yet seen on the Alps, in Savoy, Switzerland, or the Tyrol. The road is not passable for carriages, and indeed is scarcely so, even in summer, for horses or mules, and is often infested with banditti; a party of which, consisting of twenty-two, had quartered themselves in a village which I passed through, and left it but a week before my arrival. There are many wolves and some bears in the adjacent mountains, which also commit their depredations in the winter. The tyger-cat, *gatto pardo*, or lynx, is sometimes found in the woods of this part of Abruzzo.

The road follows the windings of the Garigliano, which is here a beautiful clear trout stream, with a great variety of cascades and water-falls, particularly a double one at Isola, near which place CICERO had a villa, and there are still some remains of it, though converted to a chapel. The valley is extensive, and rich with fruit trees, corn, vines, and olives. Large tracts of land are here and there covered with woods of

* MARIUS had a large villa, about twelve miles distant from Arpino. I went to visit the spot, on which now stands the only convent of the austere order of La Trappe in Italy. It is in the Pope's state, and has been evidently built of the ruins of MARIUS's house, and its present name is *Casa Mari*.

oak and chestnut, all timber trees of the largest size. The mountains nearest the valley rise gently, and are adorned with either modern castles, towns, and villages, or the ruins of ancient ones. The next range of mountains, rising behind these, are covered with pines, larches, and such trees and shrubs as usually abound in a like situation: and above them a third range of mountains and rocks, being the most elevated part of the Apennine, rise much higher, and, being covered with eternal snow, make a beautiful contrast with the rich valley above-mentioned; and the snow is at so great a distance, as not to give that uncomfortable chill to the air, which I have always found in the narrow vallies of the Alps and the Tyrol. Excuse me, Sir, if from the impression which this enchanting and little frequented country has left on my mind, I have been led to depart from the subject of this letter, to which I will return directly.

On the 15th of August last I went in a felucca to the island of Ischia. I have nothing to add to my former observations on this island, already communicated to the Royal Society; except that about sixty yards from the shore, at a place called St. Angelo, situated between the towns of Ischia and Furia, a column of boiling water bubbles upon the surface of the sea with great force, and communicates its heat to the water of the sea near it; but as the wind was very high, and the surf considerable, I was not able then to examine this curious spot as I could have wished, but will return there on purpose some other time. The inhabitants of the neighbourhood told me, that it always boiled up in the same manner, winter and summer; and that it was of great use to them in bending their planks for ship-building; and that the fishermen also frequently made use of this natural cauldron to boil their fish. Though I
have

have passed at different times many weeks in the island of Ischia, I never before heard of this phænomenon; but in my description of this island mention is made of several spots where, near the shore, I had found, when bathing in the sea, the sand under my feet so hot as to oblige me to retire hastily. This boiling spring reminds me of one near Viterbo in the Roman State, which I have seen, and is called the Bulicame. It is a circular pool of about sixty feet in diameter, and exceedingly deep, the water of which is constantly boiling. It is situated in a plain surrounded by volcanic mountains. A stony concretion floats on the surface of the pool, which being carried off by the superfluous water is deposited, and is constantly forming a labes or tuffa, of which all the soil around the pool is composed. You have seen, Sir, the like operation in greater perfection in Iceland, at the famous boiling spring of Geyser. I am convinced, that many of the finer sort and most compact tuffa's we meet with, in countries formed by volcanoes, have been produced in the same manner.

The 18th of August I arrived at the island of Ventotiene, about twenty-five miles from Ischia. It is greatly improved since my former visit, seven or eight years ago, when his Sicilian Majesty first planted a little colony there. It then produced neither corn nor wine; now it furnishes annually at least seventy butts of wine and two thousand *tomoli* of corn. The soil is remarkably fertile, from whence it probably took its ancient Greek name of Pandataria. This island contains at present more than three hundred inhabitants. The island of Ventotiene, and the smaller one called St. Stefano, within a mile of it, having been described in my *Campi Phlegræi*, as being both entirely composed of volcanic matter, I need not trouble you further on their subject; I will only mention a

curious circumstance in the natural history of birds, of which I was informed by an officer of the garrison of Ventotiene, who is a great sportsman, and shoots often in the island of St. Stefano, inhabited only by hawks, and a large kind of sea-gulls; but is occasionally visited, as a resting place, by divers sorts of birds of passage. In the month of May great flights of quails arrive there from Africa, spent with fatigue; and many of them fall an easy prey for the hawks and sea-gulls; but, as their arrival depends upon one prevailing wind, there is often an interval of many days between one flight and another. My informer assured me, that the hawks constantly, during the flights, make a provision of each day's prey, laying them up in separate heaps of six or seven near their haunts, always feeding first upon those of the oldest date. The sea-gulls have not the same foresight, but greedily fall upon their unhappy victims in their languid state before they reach the shore, and, having beat them down into the sea, swallow numbers of them whole. Extraordinary as this may appear, yet as facts related by persons of credibility in any branch of natural history are always pleasing, I thought you would excuse this digression. Give me leave likewise to add, for the information of the curious in antiquities, that, during my stay in the island of Ventotiene, I got out of the ruins of an elegant ancient bath (supposed to have been built for the use of JULIA, daughter of AUGUSTUS, whilst she was in exile here) a fragment of a tile, on which are stamped the following characters in basso relievo,

HACINI
IVLIAI
AVGV. S. F

which, according to the interpretation of a celebrated antiquary at Naples, mean *Opus HACINI ad commodum Balnei JULIÆ AVGVSTÆ factum*. I was informed, that several entire
tiles,

tiles, with a like inscription, had been dug up on the same spot, and had been made use of in building the church and barracks newly erected in this island. Another fragment of a tile was likewise found here, and given to me, with the following inscription :

SAB. A PI.

which the same antiquary explains, SABINAE AVGVSTAE, *Piæ Imperatrici dicatum Balneum* ; but, I believe, there is no mention in ancient authors of SABINA having been at Pandataria : of JULIA's banishment to this island there can be no doubt.

Between Ventotiene and the island of Ponza, and from the latter at the distance of about twelve miles, a group of rocks rise several feet above the surface of the sea. They are called the *Botte*, and are composed of a compact lava ; probably they are the small remains of another volcanic island, the softer parts of which may have been carried off and levelled by the action of the sea, which is open and violent here.

The 20th of August I arrived at the island of Ponza, about thirty miles from Ventotiene, and the next day I went round it in my boat. It is near five miles long : its greatest breadth not more than half a mile, and in some parts not more than five hundred feet. It is surrounded by innumerable detached rocks, some of them very high, and most of which are of lava ; in many are regularly formed basaltæ, but none in large columns. In some parts the basaltæ have a reddish tint of iron ochre, are very small, and irregularly laid one over another. Some masses of them are in a perpendicular, others in an horizontal, and others again in an inclined position : and the rocks themselves, in which these masses are found, are lava of the same nature as the basaltæ. At first sight these rocks have very much the appearance of the ruins of ancient Roman

brick or rather tile buildings, as may be seen in the drawing (see Tab. XI. fig. 1.) taken on the spot. One rock, as appears in the drawing (see Tab. XII. fig. 4.) is composed of large spherical basalt; and in many parts of the island I found the lava had inclined to take the like spherical form, though on a much smaller scale, some of the first mentioned round basalt being near two feet in diameter. All these rocks have certainly been detached by the action of the sea from the island, which is entirely composed of volcanic matter, lava's, and tuffa's, of various qualities and tints, green, yellow, black, and white. Some of the tuffa's, as well as the lava's, are of a texture more compact than others; and in some parts of the island great tracts seem to have undergone the same operation as is mentioned in one of my former communications to be in full force at a spot called the Pisciarelli, on the outside of the Solfaterra, near Puzzole, and where a hot sulphureous vitriolic acid vapour converts all which it penetrates, whether lava's, tuffa's, volcanic ashes, or pumice stones, into a pure clay, mostly white, or with a light tint of red, blue, green, or yellow. The appearance of a tract of volcanic country, which has undergone this operation, is well expressed in the view of the inside of the harbour of Ponza (Tab. XI. fig. 2.). But I was so struck with the beautiful and uncommon appearance of one of these high volcanic grounds converted to a pure light-coloured clay (Tab. XII. fig. 1.) in contrast with a neighbouring dark basaltic rock, that I caused the drawing, which accompanies this letter (see Tab. XII.) to be made on the spot. You, Sir, who have seen such a variety of countries, will still think this view singular and beautiful. I can assure you, it is very exact, except the rock of round basalt (fig. 4.) which, in nature, is at a distance from this spot, and only placed here
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to illustrate what I have written on its subject. In one part of the island there is a sort of tuffa, remarkably good for the purpose of building. It is as hard as our Bath stone, and nearly of the same colour, without any mixture of fragments of lava or pumice stone, which usually abound in the tuffa's in the neighbourhood of Naples, Baia, and Puzzole.

The drawing (see Tab. XI.), which is a view of the harbour of Ponza, will give you a very good idea of the appearance of the isolated rocks of lava and basalt which have been separated, by the force of the sea, from the softer parts of the island, and of which there are an infinite number, as you will see in the exact geometrical plan of the island of Ponza (Tab. X.), which likewise accompanies this letter.

When I was last in England, I inquired of many of the manufacturers of glass, whether it had ever happened, that the glass cooling in their furnaces had taken any distinct forms like prisms or crystallizations; but I got no satisfactory answer until I applied to the ingenious Mr. PARKER, of Fleet-street, who not only informed me, that, some years ago, a quantity of his flint glass had been rendered unserviceable by taking such a form in cooling; but also gave me several curious specimens of the glass itself: some of them are in laminæ, which may be easily separated; and others resemble basaltic columns in miniature, having regular faces. I was much pleased with this discovery, proving to me, beyond a doubt, the volcanic origin of most basalt. Many of the rocks of lava of the island of Ponza are, with respect to their configurations, strikingly like the specimens of Mr. PARKER's above-mentioned glass, none being very regularly formed basalt, but all having a tendency towards it. Mr. PARKER could not account for the accident that occasioned his glass to take the basaltic forms;

forms; but I have remarked, both in Sicily and at Naples, that such lava's as have run into the sea, are either formed into regular basaltcs, or have a great tendency towards such a form. The lava's of Mount Etna, which ran into the sea near Iacci, as appears in my account of them in the *Campi Phlegræi*, are perfect basaltcs; and a lava that ran into the sea from Mount Vesuvius, near Torre del Greco, in 1631, has an evident tendency to the basaltic forms. On Mount Vesuvius I never found any thing like columns of basaltcs, except the above-mentioned at Torre del Greco, and some fragments of very complete ones, which I picked up near the crater, after the eruption of 1779, and which had been thrown out of the mouth of the volcano.

The island of Palmarole, which is about four miles from Ponza, is not much more than a mile in circumference, is composed of the same volcanic matter, and probably was once a part of Ponza; and indeed it appears as if the island of Zannone, which lies at about the same distance from the island of Ponza, was once likewise a part of the same island of Ponza; for many rocks of lava rise above water in a line between the two last mentioned islands, and the water is much shallower there than in the other parts of the gulph of Terracina.

The island of Zannone is larger and much higher than Palmarole, and the half of the island nearest the Continent is composed of a lime-stone, exactly similar to that of the Apennines, on the Continent near it; the other half is composed of lava's and tuffa's, resembling in every respect the soil of the other islands just described. Neither Palmarole nor Zannone are inhabited; but the latter furnishes brushwood in abundance for the use of the inhabitants of Ponza, whose number, including the garrison, amounts to near seventeen hundred.

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The uninhabited island of St. Stefano furnishes fuel in the like manner for the inhabitants of Ventotiene.

It is probable, that all these islands and rocks may in time be levelled by the action of the sea. Ponza, in its present state, is the mere skeleton of a volcanic island, as little more than its harder vitrified parts remain, and they seem to be slowly and gradually mouldering away. Other new volcanic islands may likewise be produced in these parts.

The gulphs of Gaeta and Terracina may, in the course of time, become another Campo Felice*; for, as has been mentioned in one of my former communications on this subject, the rich and fertile plain so called, which extends from the bay of Naples to the Apennines, behind Caserta and Capua, has evidently been intirely formed by a succession of such volcanic eruptions. Vesuvius, the Solfaterra, and the high volcanic ground, on which great part of this city is built, were once probably islands; and we may conceive, the islands of Procita, Ischia, Ventotiene, Palmarole, Ponza, and Zannone, to be the outline of a new portion of land, intended by nature to be added to the neighbouring Continent; and the Lipari islands (all of which are volcanic) may be looked upon in the same light with respect to a future intended addition of territory to the island of Sicily. If you cast your eye, Sir, on the map at the head of my description of the Campi Phlegræi, you will better understand my meaning.

* The governor of the castle of Ponza, who has resided there fifty-three years, told me, that the island was still subject to earthquakes; that there had been one violent shock there about four years ago; but that the most violent one he ever felt there was on the very day and hour of the great earthquake which destroyed Lisbon; that two houses out of three, which were then on the island, were thrown down. This seems to prove, that the volcanic matter, which gave birth to these islands, is not exhausted.

The more opportunities I have of examining this volcanic country, the more I am convinced of the truth of what I have already ventured to advance, which is, that volcanoes should be considered in a creative rather than a destructive light. Many new discoveries have been made of late years, particularly, as you well know, Sir, in the South-Seas, of islands which owe their birth to volcanic explosions; and some, indeed, where the volcanic fire still operates. I am led to believe, that upon further examination, most of the elevated islands at a considerable distance from Continents would be found to have a volcanic origin; as the low and flat islands appear in general to have been formed of the spoils of sea productions, such as corals, madrepores, &c. But I will stop here, and not deviate from the plan which I have hitherto strictly followed, of reporting faithfully to my learned Brethren of the Royal Society such facts only as come immediately under my own observation, and as I think may be worthy of their notice, and leave them at full liberty to reason upon them.

We may flatter ourselves, as a very great progress has been made of late years in the knowledge of volcanoes, that by combining such observations as we are already in possession of, with those which may be made hereafter, in the four quarters of the world (in all of which nature seems to have operated in a like manner), a much better theory of the earth may be established than the miserable ones that have hitherto appeared.

Those who have not had an opportunity of examining a volcanic country, as I have for more than twenty years, would little suspect, that many curious productions and combinations of lava's and tuffa's were of a volcanic origin; especially when they have undergone various chemical operations of nature, some of which, as I have mentioned in a former

communication, as well as in this, have been capable of converting tuffa's, lava's, and pumice stone, into the purest clay.

I have remarked, that young observers in this branch of natural history are but too apt to fall into the dangerous error of limiting the order of nature to their confined ideas: for example, should they suspect a mountain to have been a volcano, they immediately climb to its summit to seek for the crater, and if they neither find one, or any signs of lava or pumice-stone, directly conclude such a mountain not to be volcanic: whereas, only suppose Mount Etna to have ceased erupting for many ages, and that half of its conical part should have mouldered away by time (which would naturally be the consequence) and the harder parts remain in points, forming an immense circuit of mountains (Etna extending at its basis more than one hundred and fifty miles); such an observer as I have just mentioned would certainly not find a crater on the top of any of these mountains, and his ideas would be too limited to conceive, that this whole range of mountains were only part of what once constituted a complete cone and crater of a volcano. It cannot be too strongly recommended to observers in this, as well as in every other branch of natural history, not to be over-hasty in their decisions, nor to attribute every production they meet with to a single operation of nature, when perhaps it has undergone various, of which I have given examples in the island which has been the principal subject of this letter. That which was one day in a calcareous state, and formed by an insect in the sea, becomes vitrified in another, by the action of the volcanic fire, and the addition of some natural ingredients, such as sea salts and weeds, and is again transformed to a pure clay by another curious process

of nature. The naturalist may indeed decide as to the present quality of any natural production; but it would be presumption in him to decide as to its former states. As far as I can judge in this curious country, active nature seems to be constantly employed in composing, decomposing, and recomposing; but surely for all-wise and benevolent purposes, though on a scale perhaps much too great and extensive for our weak and limited comprehension.

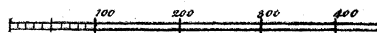
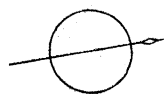
I have the honour to be, with great regard and esteem, &c.

W. HAMILTON.

P O S T S C R I P T.

THE earth is not yet so perfectly quiet in Calabria and at Messina, as to encourage the inhabitants to begin to rebuild their houses, and they continue to live in wooden barracks. There has, however, been no earthquake of consequence during these last three months. My conjecture, that the volcanic matter (which was supposed to have occasioned the late earthquakes) had vented itself at the bottom of the sea between Calabria and Sicily, seems to have been verified; for the pilot of one of his Sicilian Majesty's sciabecques, having some time after the earthquakes cast anchor off the point of Palizzi, where he had often anchored in twenty-five fathom water, found no bottom till he came to sixty-five fathom, and having sounded for two miles out at sea towards the point of Spartivento in Calabria, he still found the same considerable alteration in the depth of the sea. The inhabitants of Palizzi likewise declare, that during the great earthquake of the 5th of February, 1783, the sea had frothed and boiled up tremendously off their point.

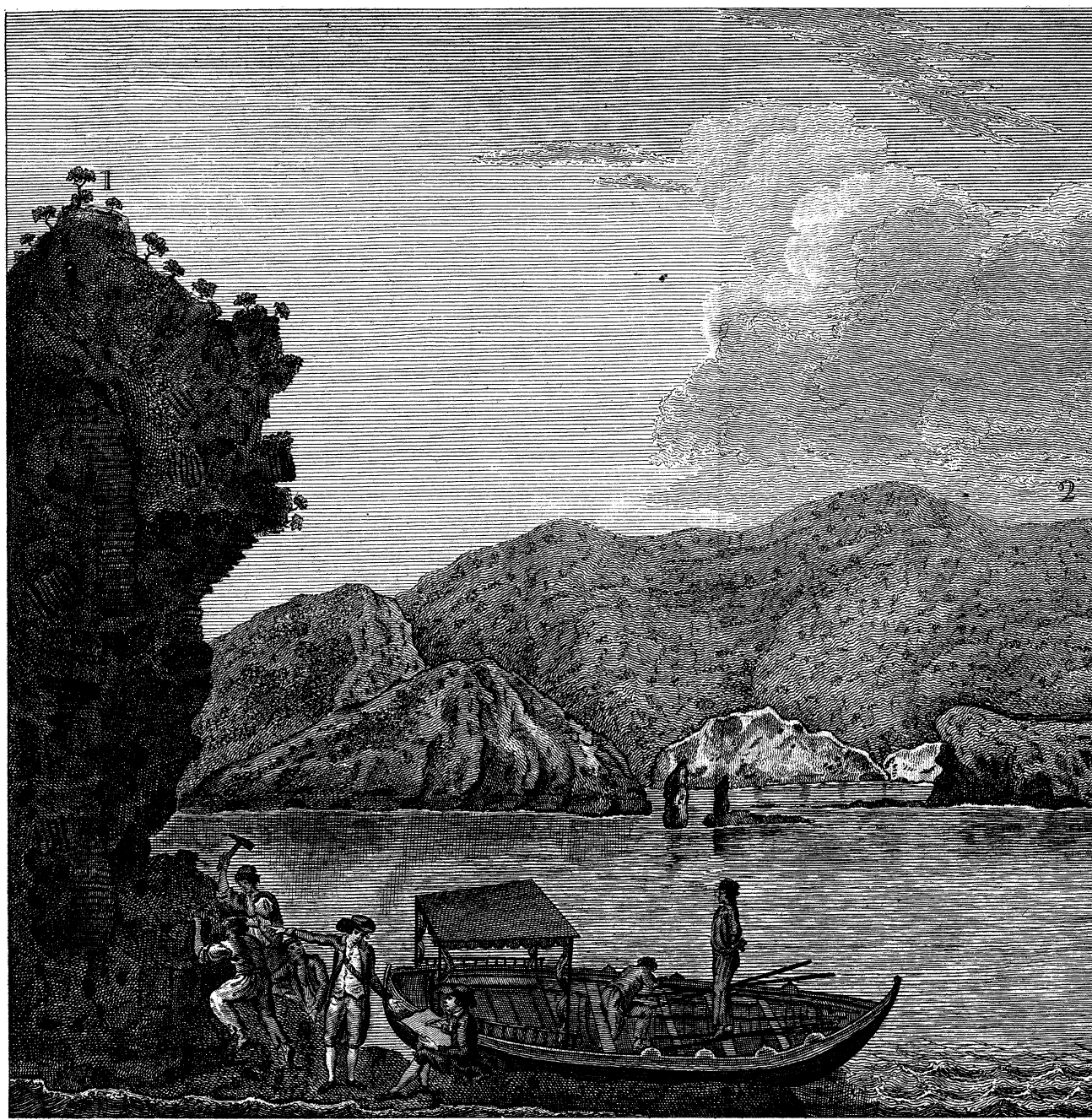
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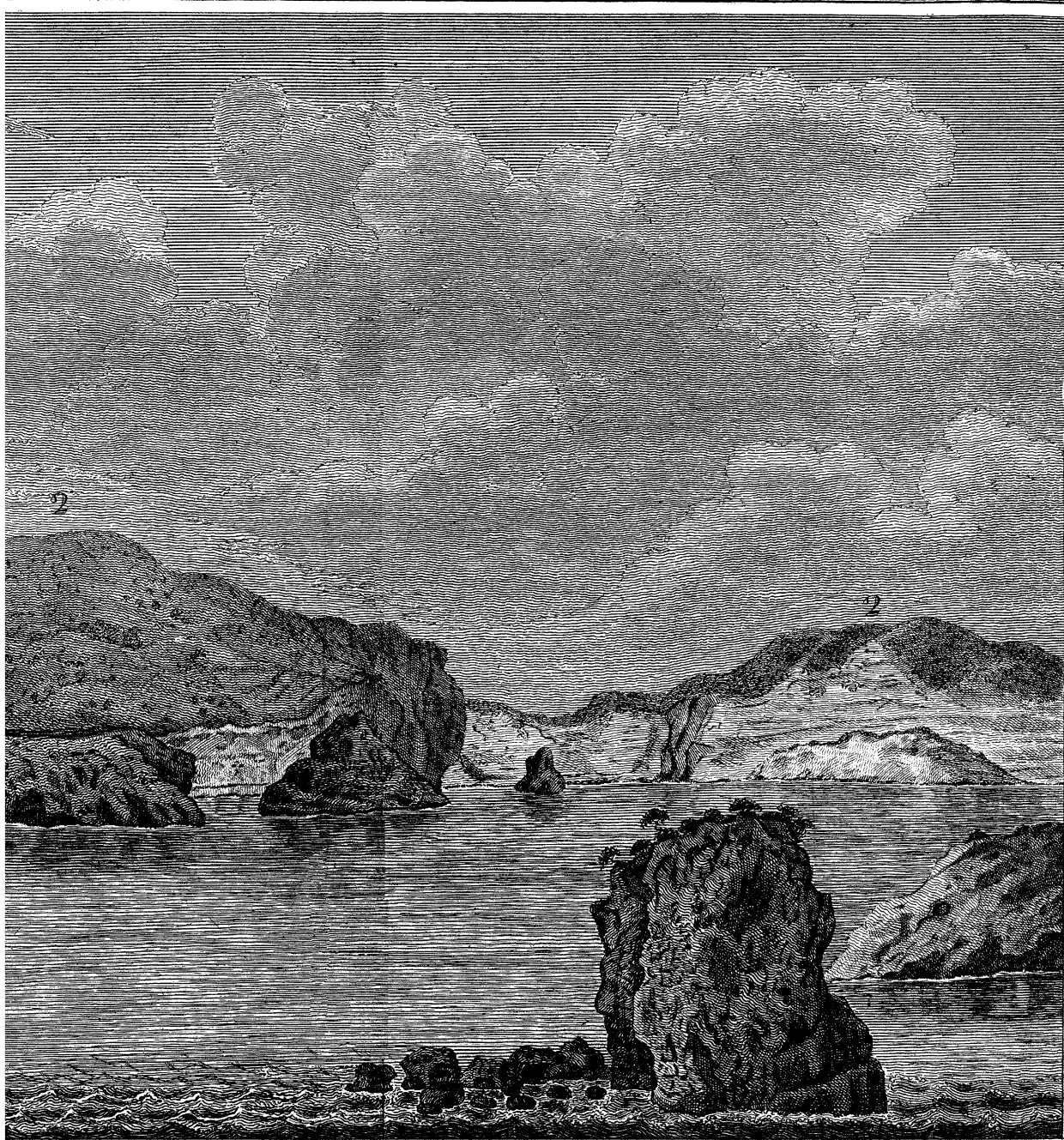
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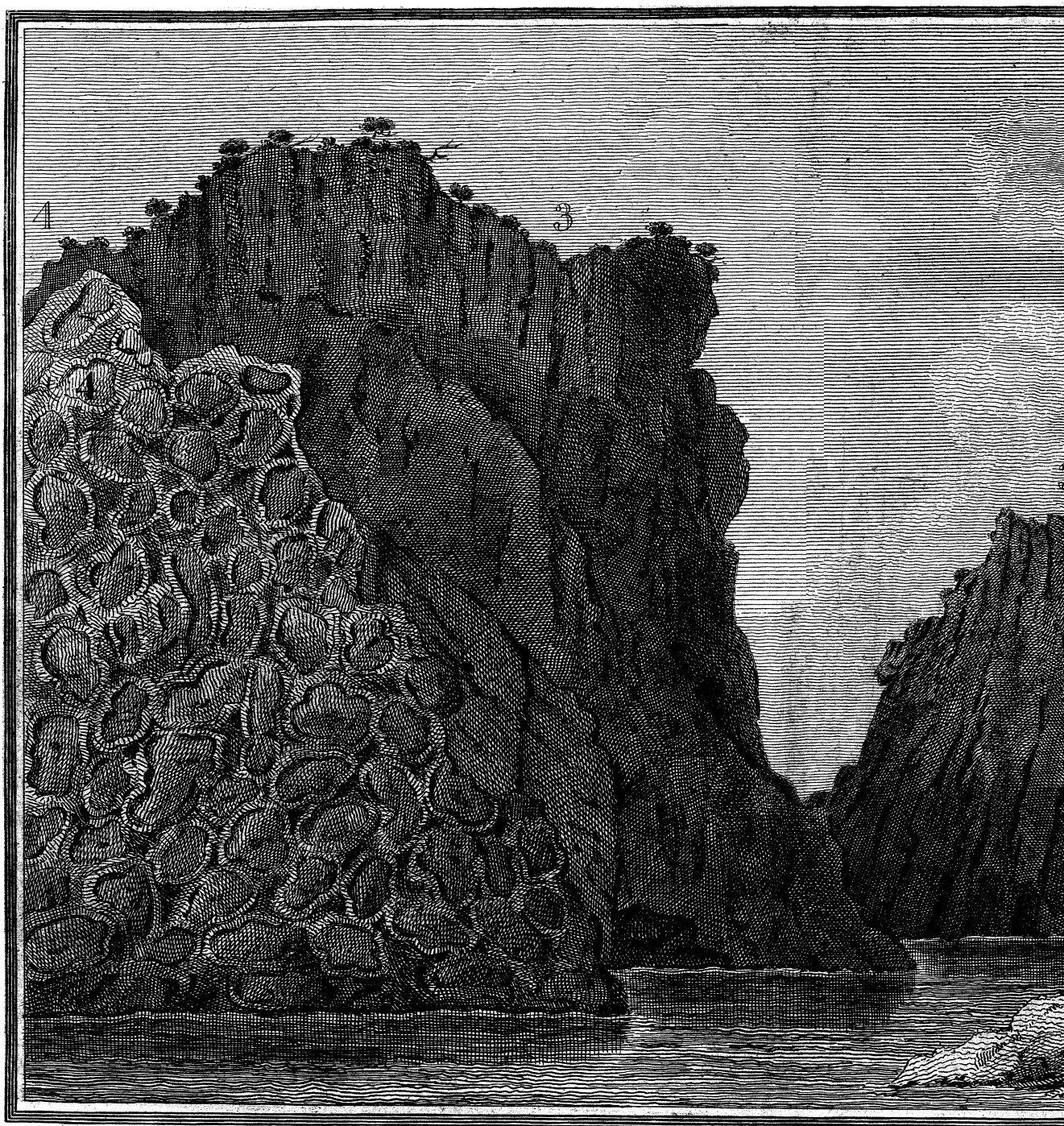


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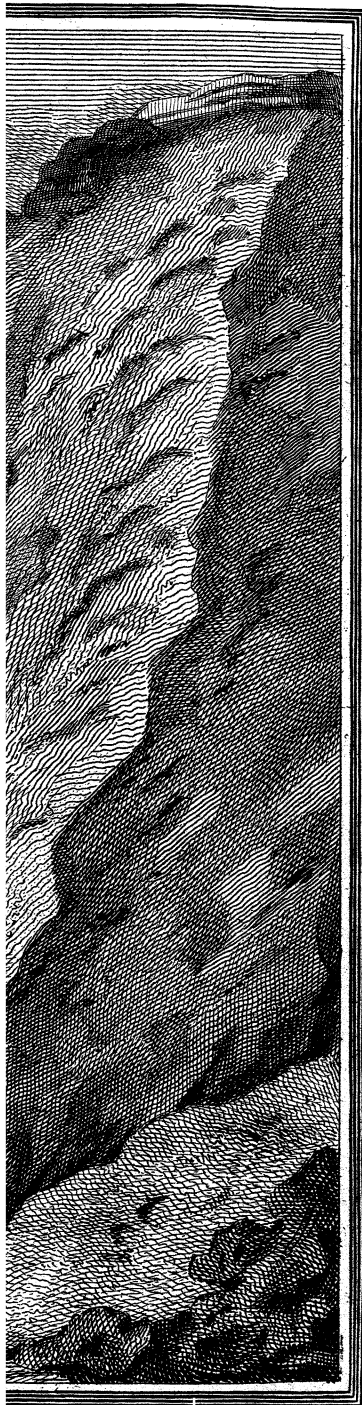
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EXPLANATION OF THE PLATES.

Tab. X. Plan of the island of Ponza.

Tab. XI. View of part of the inside of the harbour of the island of Ponza.

Fig. 1. Rock of lava, which in many parts is formed into regular small basaltic of a reddish cast, having probably been tinged with some ochre. Most of the detached rocks of this island resemble this.

Fig. 2. See p. 374.

Tab. XII. View taken from the outside of the harbour of the island of Ponza, near the Lighthouse.

Fig. 1. Rock of volcanic matter converted to pure clay.

— 2. Ditto, with strata of pumice-stone.

— 3. Rocks of lava inclining to take basaltic forms.

— 4. Rock composed of spherical basaltic.



