

IX. *Some Account of the Strata and Volcanic Appearances in the North of Ireland and Western Islands of Scotland. In two Letters from Abraham Mills, Esq. to John Lloyd, Esq. F. R. S.*

Read January 21, 1790.

L E T T E R I.

DEAR SIR.

Fence House near Macclesfield, Jan. 20, 1789.

**Y**OUR request shall be complied with; I will endeavour to describe the Whyn Dykes in the island of Ilay, and give you my reasons for supposing them to be of volcanic origin; but you must not expect a complete and scientific description from me who am so little versed in mineralogy, and have so little leisure to pursue that useful and engaging study.

My engagements in the mineral line were the cause of my going to Ireland in 1787, to inspect the copper mines in the county of Wicklow, whence I proceeded to the county of Antrim.

As I performed my journey through Ireland on horseback, I availed myself of the opportunity that mode of travelling gave me, to note the strata as I passed along; but shall not trouble you with my observations till I arrived in the neighbourhood of Moneymore, where I first perceived tumblers of lava; from hence by Maghera, Garvagh, Coleraine, Portrush, and

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to Bush-Mills, lava is continually seen, either in solid masses, forming the basis of the vegetable soil, or else in tumblers dispersed over the surface. I employed two days in studying the various appearances at the Giant's Causeway, and regretted being obliged to quit it so hastily. So much has been already said upon this spot, that I will only venture to remark, that the red ochry joints between the beds of rude lava, and the different heights at which the basalt pillars are seen, give probability to the conjecture, that the whole mass has been the produce of several successive eruptions.

I embarked at Port Ballintrea, and after twelve hours sailing arrived at Ilay. My object was to inspect the lead mines which were open, and to view the other mineral veins in several parts of the island. It was impossible to do this, without at the same time noticing the singular appearance of those masses, which run in a kind of veins in various directions, and are called Whyn Dykes. As my attention was principally engrossed by the former, and my stay in the island very short, I only cursorily remarked, that the latter had in some places a basaltic appearance; but my time did not admit of a minute inquiry into their nature.

On my return from Ilay I landed at Portrush; and, in my way to Ballycastle, I viewed the Giant's Causeway from the top of the cliffs, and was much struck with seeing below me, in the fourth or eastern bay, a kind of Whyn Dyke, which ran into the sea towards the N.N.E.

Examining the cliffs at Ballycastle, I found the horfes (or faults) of which there are several between the coals, were veins of lava (resembling the Whyn Dykes of Ilay) standing vertically, intersecting the various strata of coal and freestone, and running into the sea. The largest of the veins or Whyn Dykes

Dykes is near twelve feet in breadth, and ranges N. by E. and S. by W. Your subsequent voyage to Raghery discovered that the Whyn Dykes pervade that island.

Returning to Dublin, through Clogh, Ballymena, Antrim, Glanevy, Moira, Banbridge, Loughbrickland, and until within a short distance of Newry, I constantly saw tumblers of lava, and in some places the fixed mass of lava, in which were figures ranging N.E. and S.W.

When I reached home, my mind being strongly impressed with the similitude that subsists between the Ilay Whyn Dykes and those of Ballycastle, which take their rise in a country confessedly abounding with volcanic matter; that I might be enabled to form a better judgement of their substance when I should again visit Ilay, I repeatedly and attentively examined the Derbyshire toadstone in the neighbourhood of Buxton, and found it very like the specimens of the Whyn Dykes, which I had brought with me from Ilay.

Early in the last summer I went into Ireland, and having spent some time at the mines in the county of Wicklow, I proceeded to Belfast; and a little to the northward of that town (near the spot where an unsuccessful trial was some time since made for coal), I discovered in a bank a body of marl, running N.E. and S.W, between red and white sandstone, the whole included and surmounted by a kind of toadstone and rude lava, whose joints had no particular direction. Above five miles north from the town, is a mountain called Cave Hill (from its containing three natural caverns); at the distance from which I saw it, the summit appeared basaltic, under which is white limestone.

At Belfast I embarked for Ilay; but the wind, hanging to the northward, obliged us to tide along the Irish shore,

which, after passing Carrickfergus, chiefly consists of stupendous basalt cliffs; in which we observed the noted seven caves, which are fissures of various dimensions going in to the westward. Farther north the cliffs are divided into horizontal beds of considerable thickness, by the intervention of a red substance, similar in appearance to that at the Giant's Causeway; near the water's edge, and under the lava, the white limestone is frequently seen; and these appearances continue all the way to Red Bay. At some distance from the coast are the Maiden's Rocks, which, from their dark colour, I judge are also basaltic. At the head of Red Bay, the mountains slope gradually to the sea, have a red hue, and, I am told, iron ore is found in its vicinity. Being obliged to anchor in a little sandy cove on the north side of Cushendun Bay, I landed, and found the beach skirted with tumblers of basaltes, hornstone, granite, and gneiss. In a brook is a string of iron ore, half an inch thick, running north between compact hornstone sides. At a small distance from the beach is a large fissure or cavern, whose sides are tinged red. Westward from hence are very large blocks of gneiss; but I could not discover whether they composed the firm strata, or were only tumblers: it is however to be remarked, that north from hence, at Murlogh, there is a bed of gneiss, whose thickness is unknown; and again, four miles from Clogh (which is S.W. from hence), under a bed of white limestone, forty feet thick, I saw the upper part of a bed of gneiss; so that what is seen here is probably the firm stratum. Sailing from hence, I plainly saw that the high broken point, which forms the N.E. point of Cushendun Bay, is composed of lava, with some rude appearance of pillars near the top; whilst close to the water's edge, and at some little distance in the sea, were tumblers of an immense size.

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It was evening when we failed from hence, and in the morning we were so far to the northward of Raghery, as to have but a very imperfect view of its basalt cliffs, whilst Fairhead and Ballycastle were totally obscured by the haziness of the weather. At length, having been four days and nights in the passage, we landed at Loch Loudain, in the east side of Ilay.

The volcanic country, which we explored together in the island of Mull, having hitherto remained undescribed by any traveller, I shall now beg leave to remind you of what we saw there, and in our voyage to Staffa; which may help to confirm my opinion respecting the Ilay Whyn Dykes, which I shall reserve for the subject of another Letter.

Sailing from Freeport, in the island of Ilay, at ten o'clock at night, of Wednesday, July 2, 1788, we passed Colonsay, without being able to distinguish the substance of its shores; but entering the sound of Iona, we saw that the rude coast of Mull, and the less elevated shore of Iona, was composed of red granite. At the landing place in Iona is laminated hornstone; and a quarter of a mile north from the ruins of the Cathedral is a vein of coarse red granite, two feet wide, standing nearly vertical, and ranging with the hornstone E.N.E. and W.S.W.; on the surface are tumblers of red granite, and some few of lava. About a mile N.W. from the Cathedral, and near the shore, is a vein, two feet wide, containing feldspath and white mica, ranging E. and W. between granite sides. Many of the rocks are tinged with iron, and there is some bog iron ore in the mosses. In the S.W. part of the island, is a body of white marble, veined with pale green. At the Cove, where it is said St. Columb landed, the cliffs are of red granite, and the shore is covered with great variety of pebbles of serpentine, basaltes, granite, quartz, and other substances. The  
N.W.

N.W. part of the island is very rocky, affording little pasture, except in some low spots, where the soil is sandy, and produces not only grass, but likewise corn and potatoes. The whole extent of the island is three miles in length N.E. and S.W. and one mile in breadth; and it intirely consists of alternate barren crags and little fertile vales.

Having engaged a boat with four rowers, we went from Icolmkill through the Bull Sound, which runs between Nun's Island and the island of Mull; on both sides the cliffs are of red granite, ragged and broken, without any regular beds or fissures, and having no particular range or inclination. Hence we steered for Ardlun Head, which forms the S.W. point of Loch Leven. When we approached the Head, we stopped the rowers, and sat some time contemplating the wonderful arrangement of the basalt columns; and, as we again rowed along shore to the eastward, had a fine view of the various situations into which the columns were thrown. The coast being every where steep, it was some time before we could find a convenient place to land; but having at last got on shore, we walked to the extreme point or head: here, struck with the errors of our maps, which placed the islands in sight very differently from their true situations, I took the following bearings by the compass.

The N.E. point of Iona N.W. by W.—The Dutchman's Cap N.N.W.—Cairnborough N. by W.—Staffa from N. to N.  $\frac{1}{2}$  W. distant, by estimation, about three leagues.—Rhu Thalve, the northernmost extreme of Mull, N. by E.—Inch Kenneth N.E.  $\frac{1}{2}$  N.—The point of Ben Vawruch, on the north side of Loch Leven, N.E. distant, by estimation, three miles.—The range of Loch Leven E. by S. and W. by N.

About a quarter of a mile from the spot where the bearings were taken, is a deep glen, running N.N.E. to the sea. It is about thirty yards in length, and twenty in breadth. The strata are disposed in the following extraordinary manner. The uppermost is ten yards of lava, with horizontal divisions and vertical joints, taking the form of rude pillars. Under this is an horizontal bed of a perfectly vitrified substance, which appears to have been a shale, and is from one to two inches in thickness. Beneath this, is about three yards of a siliceous gravelly concrete; below which are horizontal beds of indurated marl, of various thicknesses, from six to twelve inches. The whole of these beds, taken together, are about four yards, and there is a large fissure in them, on the west side of the glen. Lastly, are ten yards of rude lava, containing specks of quartz and mica unaltered, pieces apparently of granite, and some nodules of calcined chert. The whole is incumbent on regular basalt pillars, of various dimensions, from eighteen to six inches diameter, varying in the number of their sides, some having five, some six, and others seven sides. They are also as variously disposed; those on the western extremity of the glen being straight, and lying horizontally; whilst of those on the east side some are bare, and standing perpendicularly; and others, which are surmounted by the rude lava, are inclined and curved, as if they had taken that form in cooling from the pressure of the incumbent weight. See Tab. IV. fig. 1. Many of the pillars are very full of bladder-holes; the articulations of the joints are close, though not so close as those of the Giant's Causeway; but, like those, their tops, where exposed, are either concave or convex.

At the extremity of the glen is an insulated rock, supported by basalt pillars (fig. 2.), which are somewhat curved and inclined.

inclined. Incumbent on these are other pillars, lying nearly horizontal, and having a rude face of lava to the westward. At high-water this rock is inaccessible without a boat; but at low-water it may be easily got at, by stepping from one tumbler to another; and on the north side it is not difficult to climb to the top. The bottom of the glen is covered with large tumblers of lava the whole way down to the rock, and presents the rudest scene imaginable.

Opposite Ardlun Head, on the north side of Loch Leven, is Ben Vawruch, an high promontory, whose strata are in horizontal beds; and the hill being of a circular figure gives it the appearance of having several terraces, with a kind of castle or cairn on the top.

The columnar pillars at Ardlun are more or less regular for an extent of near a mile and an half; and all the projecting points of Loch Leven, as far as the eye could reach, appeared to be composed of lava.

Amongst the rude lava, which forms the basis below high-water mark, are nodules of crystal and agate, adhering in small lumps to the rocks; but, being blackened by the washing of the sea, are not to be discovered without a very nice search. Our boatmen informed us, that higher up the Loch there is a bed of coal. This we wished to see; but, as they also told us, that the weather, which had for some days past been very tempestuous, was now favourable for landing on Staffa, we determined to avail ourselves of the opportunity, and got into the boat, highly pleased with what we had seen; and for which pleasure we were indebted to the hint in Dr. JOHNSON's Tour to the Hebrides.

We landed without difficulty on the eastern side of Staffa, and on an eminence, near the center of the island, I observed



the following bearings. The Dutchman's Cap N.W.—Cairnborough N. by W.—The Paps of Jura (over Mull) S. by W.

The greatest extent of the island is about one mile from N.E. to S.W. and in one part not more than a quarter of a mile from S.E. to N.W. It is tolerably level, the shore everywhere steep, and the cliffs formed by basalt pillars or rude lava. The usual landing place for boats is in a small cove on the N.E. side of the island; but we were assured, that there is no anchorage for vessels round its whole coast. On the south side, rising from a nearly horizontal bed of reddish stone, are beautiful basalt pillars of considerable height, and standing vertically; at a little distance are others inclined, and others which are curved, very similar to the ribs of a ship. There are three caverns amidst the basaltic pillars; the northernmost goes in to the eastward, how far I know not; for, though we went entirely round the island in our boat, the tide was too high, and the swell too great, to permit our entering any of the caverns without the utmost risk; we therefore forbore to make so dangerous an attempt. One of the caverns is now usually called Fingal's Cave; but the school-master at Icolmkill informed us, that the Erse name for it is *Fein*, which signifies the melodious or echoing cave. On the northern part of the island, and at the cove where we landed, the cliffs are of coarse lava, without any pillars. In some parts of the island the tops of the pillars are standing bare; in other parts the surface is formed by a rude argillaceous lava, full of bladder-holes, some empty, others replete with quartz crystals. Calcareous spar, pebbles of indurated clay and shoerl, detached pieces of zeolite, are frequently seen, and the vegetable soil is a decomposed lava. In some places we met with gravel containing pebbles of basaltes, of red granite, and of quartz,

whose angles were worn off, and they were become round and smooth. On the N.W. side, the cliff has lately given way; a large portion of it has fallen into the sea, and a still further part appears likely to follow it.

On the island are two springs of excellent fresh water. There were three houses (July 5, 1788) uninhabited; and barley, oats, flax, and potatoes, growing near the center, and good grass in several spots. When the crops are ripe, labourers are sent to gather them in; after which, thirty head of cattle are sent to winter in the island, which, with a solitary herdsman to attend them, continue till feed-time the ensuing spring.

In attempting to return to Ilay, after having got within three miles of the N.W. part of Colonsay, an heavy gale of wind came on, which obliged us to bear away, and take shelter in the Bull Sound. The weather continuing stormy, we landed, and walked to Fidden, the house of Lieut. Col. CAMPBELL, of the Plymouth division of Marines, who received us with the utmost cordiality, and hospitably entertained us for five days, which we were detained by an adverse wind and severity of weather. Availing ourselves of this delay, and of Col. CAMPBELL's polite offer to be our guide, we set out on foot with him and Lieut. STEWART, to view the seam of coal on the south side of Loch Leven. After passing some moory ground, and continuing our route to the northward for an hour and an half, we came to a spot where the rock which puts up to the day is a laminated micaceous stone of the gneiss kind (KIRWAN, p. 102.); and in another half hour, near a small town on the S.W. side of Loch Lyne, we were shewn a quarry where the gneiss ranges N.E. and S.W. and has a slight hade to the S.E. It is in ribs from two to twelve inches thick,  
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and is stratified by intermediate ribs of red granite of about an inch thick. We crossed Loch Lyne in a boat, and landed on a rude mass of lava, which continues away to the N. E. by the town of Ardlun, and onwards to the S.W. side of Loch Leven.

In a small bay, about one mile to the S.E. of Ardlun Head, under a bed of jointed lava, which has some resemblance of pillars, and just at high-water mark, is a bed of coal, exactly twelve inches thick, intermixed with shale or bituminous shistus (KIRWAN, p. 89.) dipping S.E. towards the Loch one yard in three: there is not any intervening substance between the coal and superincumbent lava, which contains many bladder holes. Beneath the coal is also lava without any intervening matter. About twenty yards to the N.W. the coal again appears in the cliff, but is not more than from eight to ten inches thick. Here are tumblers of various sizes, scattered on the shore. Amongst them are some resembling the Derbyshire toadstone; and a short distance inland (to the S.W.) are rude masses of lava, standing up at day, not unlike the great Whyn Dykes of Ilay. In the Loch, and at some distance from the opposite shore, there stood, within the memory of man, an insulated pillar of coal, from which the country people were accustomed to procure a supply for smiths use; but the quantities they carried away, and the continual washing of the sea, have now entirely removed it.

We returned to Fidden House, which is situated on level ground near the sea, and near a small Loch, which affords an harbour to small vessels, but is dangerous to enter. The flat country in front of the house is entirely composed of sea sand, including shells: when dug into, fresh water is constantly found at a few feet below the surface. At the back of the house, towards the sea, are cliffs of red granite, which extend round to the

Bull Sound. On the shore are pebbles of basalt, of granite, and of gneiss; and from the firm rocks we collected several specimens of granite, in which the feldspath, quartz, and black mica, are differently blended, but without any shoerl.

During our stay at Fidden, I learned from Mr. STEWART, that Rhos Mull, which is the N.W. part of Mull, is chiefly red granite: in the southern part of the island is very fine white freestone, and between that and the granite all whynstone. The island of Lismore, in the sound of Mull, is entirely limestone, excepting where it is crossed by the Whyn Dykes. In the island of Ulva are pillars somewhat resembling those of Staffa, but of a paler colour.—Canna also is basaltic, and resembles Staffa.—The Dutchman's Cap has rude pillars — Cairnborough the same. Dunvegan in the isle of Skye has basaltic pillars, similar to Staffa.—On the south-west side of the isle of Egg is a curious cavern.

We again embarked for Ilay; but, it being calm, and the tide against us, were obliged to anchor; and we landed on an island which forms the S.E. point of the sound of Iona. From the point, which is a bare rock of red granite, broken and jointed in every direction, I observed the following bearings. Icolm-kilm Church N.N.E.—The northernmost part of Staffa, over the N.E. point of the sound of Iona, N.E. by N.—The south Pap of Jura, over Colonsay, S.

The upper surface of the granite, even in the very highest part, is all convex, which seems to prove, that by some convulsion it has been thrown up from the bed of the ocean, which, by long washing over it, had previously worn down its substance at the edges of all its numerous joints. On the east side of the point, and on the west side of a little bay, where the granite cliffs are at least fifteen yards perpendicular, we

discovered a Whyn Dyke, or vein of lava\*, about two feet wide, included in a vertical fissure ranging S.E. by E. and N.W. by W. Going round to the opposite side of the bay, we found the lava on the cliff ranging as above; but the vein, or Whyn Dyke, much smaller, being only from eight to ten inches between the granite sides, which seemed to continue closing; nor could it be seen on the main land of Mull, which was at no great distance. The fissure, which includes the lava, is, where first discovered, wider than the vein of lava it contains, which therefore stands wholly detached from the S.W. side. The lava and fissure range quite through the point; and to the N.W. by W, on the opposite side of a small sound or inlet, it appears on a rocky island, divided into two veins, still keeping nearly the same direction.

About six yards to the westward of the lava vein, or Whyn Dyke, is an immense fissure in the granite, ranging N. by W. and S. by E. It is from nine to ten feet wide, and, by estimation, about an hundred and twenty feet deep. At the northern extremity, near the top, two stones are suspended in a most extraordinary manner between the sides: the under one is fixed, and upon that the other appears to lie loose. (See fig. 3.) There is a large cavern in the western side of the fissure, and a corresponding fissure is seen on the opposite shore.

In the evening, when the tide favoured us, we sailed. The night proved calm and foggy, and in the morning we found ourselves near the west coast of Jura, to the northward of Loch Tarbut. As we approached the shore, we found it rocky for the distance of a quarter of a mile from the cliffs, which are low, and apparently of chert. Being quite calm, we rowed along shore,

\* See MAGELLAN's *Cronstedt*, p. 916.

passed the entrance of Loch Tarbut, and observed several Whyn Dykes, or lava veins, running into the sea. The Paps of Jura were mostly covered by the fog; but which breaking away at intervals gave us a view of their lofty summits, and of the narrow stripe of rock mentioned by Mr. PENNANT (*Voyage in 1772, p. 217.*), called the slide of the Old Hag, to which is annexed a curious legend; but which, in reality, appears to be the surface of a Whyn Dyke, running down the side of the cherty Mountain. After entering the foun of Ilay, observing a very considerable Whyn Dyke, or vein of lava, on the Jura shore, we landed, and found it range N.N.W. and S.S.E. It is of a dark colour and compact texture, and in some parts will give fire with steel. Near to this Whyn Dyke is a red argillaceous substance, strongly impregnated with iron, and contained in an inclined stratum, varying in thickness, and terminating in a cavern, whose sides and roof are of the same substance, but wonderfully broken and thrown into every direction, as is the including chert, amongst which we found some that is brecciated.

Soon after we returned to our boat, a squall of wind came on, attended with heavy rain, which almost wholly obscured each shore, and continued till we landed at Freeport, wet and fatigued, but highly gratified by the recollection of the many curious objects we had visited during our excursion.

It having been considered as very extraordinary, that a bed of coal should be found, as at Ardlun, incumbent upon, and surmounted by, a mass of lava; I was induced to look into some of the authors who have treated of volcanic countries; and find there are many instances of coal in the vicinity of lavas, though I have not met with any precisely situated like the coal at Ardlun.

May not the coal found at Ardlun be an indurated bitumen, which, exuding in a liquid state from the incumbent matter, penetrated the argillaceous shistus, which previously constituted the intervening stratum between the lava? It has some of the properties of jet; the specific gravity of that which we procured is 1,284; it is of a glossy black, its fracture glassy and conchoidal, does not soil the fingers when handled, and when warmed by friction will attract light bodies. Placed on a red-hot iron it decrepitates, emits a dense smoke which has a resinous smell, becomes thoroughly ignited, bursts into flame, and yields an impalpable residuum, which is not attracted by the magnet, and of which I only procured half a grain, of a yellowish brown colour, from twenty grains of the crude substance.

The learned Bishop of LANDAFF, in the third volume of his *Chemical Essays*, in his *Essay on Bitumens* (p. 6.), supposes that, under certain circumstances, naphtha, petroleum, and asphaltum, might be produced by a kind of subterraneous distillation, and might impregnate the porous strata of several kinds of stones and earth. Consider then, whether the substance I have been describing may not have been produced in that manner, since it is included within a mass of matter which carries every appearance of having formerly been acted upon by fire.

I am, &c.

A. MILLS.

P.S. If you compare the bearings which I have taken with the map in Mr. PENNANT's *Voyage in 1772*, they will be found to agree; and if the variation of the needle be allowed, they will coincide with the map in Dr. ANDERSON's *Present State of the Hebrides*.

## L E T T E R II.

D E A R S I R,

Fence House, Feb. 1, 1789.

HAVING in my former letter shewn, that Whyn Dykes, or, in other words, veins of lava, are found in the vicinity of columnar basalt, which latter are now, by almost universal consent, acknowledged to be of volcanic origin; I shall proceed to describe the Whyn Dykes of Ilay, and shall commence with giving you a general idea of the extent and various strata of that island.

Ilay, from the northern to the southern extremes, is about thirty miles in length, and in one part extends nearly as much in breadth from the eastern to the western shores. The S.W. part of the island is low; but the land rises to the N.E. and the mountains and cliffs which form the north-east coast are steep and lofty. At the head of Loch-in-Daal, and near Bomore, the rock which appears at day is of curled hornstone, and does not seem to have any particular direction. Pursuing the road (N.E.) to Port Askeg, the hornstone becomes more regularly laminated, and ranges N.W. and S.E.; and some of the hollows between the little rising hills are found to contain gravel. At four miles from Bomore commences the limestone stratum, the joints in which are nearly vertical, and range in general N.E. and S.W. It is about four miles in breadth from S.E. to N.W.; but I have not been able to discover how far it extends in the course of its range, never having traced it more than three miles in that direction; but it is nearly certain, that it does not reach either the eastern or the western shore,

from



from the Mull of Kinmouth, the eastern side, being hornstone till near M<sup>c</sup> Arthur's Head; and from thence, round to the westward, the cliffs being of chert. Continuing the route for almost a mile along the high road, after leaving the limestone, veins of shale, and of a whitish stone marl, are seen; then the chert appears, which reaches to Port Askeg, and north and south from thence along the shores of the sound not only on the Ilay but likewise on the Jura side. Within the island are several small lochs (or lakes) and many turf mosses. Where the limestone prevails are some minute strings of rich copper ore, and mines are opened in lead ore veins; but they are not productive of profit to the adventurers. There are many old workings, supposed to have been opened by the Danes. Iron ore is found stratified in the mountains. Bog iron ore is met with in the mosses; and near Bally-echra is a body of form iron ore. At Loch Knock, near M<sup>c</sup>Arthur's Head, is an extensive bed of gneiss; and near Ardleestree is an immense Whyn Dyke, and the hill Knock Renefle is a magnetic mass of rock, which considerably deranges the compass, as you discovered when you visited it last summer.

The Whyn Dykes are too singular in their formation to escape the eye of the naturalist who traverses this island. They are masses, or rather veins, generally of a dark-brown (apparently basaltic) matter, not unfrequently containing bladder-holes; from three, four, and six feet, to eight or more yards in breadth, running in various directions. In some places they are straight for a considerable length; in others, their course, though progressive, is inflected; and in some parts they rise between three and four feet above the surface, forming natural boundaries or dykes (from whence their name seems to be

derived) standing vertically, and appearing to fill up the chafms formed at some remote period in the strata.

In giving a more minute account of the Whyn Dykes which have fallen under my observation, it becomes necessary to mention, that when I arrived at Loch Loudain, I there hired a row boat, in which I proceeded to Freeport Bay. At the place where I re-imbarked, the shore is low, and composed of hornstone. After passing the ruins of an ancient castle, in about an hour and an half I landed on a rocky point, where I discovered a large Whyn Dyke, between three and four yards wide, standing vertically, and ranging S.W. into the land. It is of a dark-brown colour, externally approaching to black, and contains bladder-holes, some of which are filled with quartz, and others with reddish lamellar spar, which effervesces strongly with nitrous acid, as do many parts of the basis of the substance, which is too soft to strike fire with steel, but is considerably magnetic, and of the specific gravity of 2,863. Embarking from hence, and crossing a small sandy bay (named THUROR's Bay, from that gallant Frenchman having landed there), we reached the high mountainous point called M<sup>c</sup>Arthur's Head, which forms the S.E. point of the foud of Ilay. The stratum here is white chert, with many large patches and stripes of red, which indicate that it contains iron; but the great height, and almost perpendicularity, of the cliffs, prevented my minutely examining them. From thence to Portaskeg and Freeport Bay, the rocky shore, which is composed of chert, is less elevated, shews many indications of iron, and has several fissures and caverns; and in some places has Whyn Dykes bursting through it, which appear to re-enter on the opposite cherty shore of Jura.

About

About two hundred yards north from Freeport Lodge is a Whyn Dyke, which ranges N.W. and S.E., and appears in that direction on the Jura shore, which is more than a mile distant. This Whyn Dyke is bare at the cliffs several yards in height, and is near nine feet in width. It consists of an inner part of a granular and somewhat porous texture, of a dark grey colour, with shining parts like mica, includes opaque zeolite specks, and its specific gravity is 2,811. On each side of this, and divided from it by small vertical fissures or joints, not more than an eighth, or at the most a quarter, of an inch wide, are two bodies, each near eighteen inches in width, of a dark colour, much resembling the preceding substance, but without the zeolite specks; the specific gravity is 2,850. Both the outer and inner substances slightly effervesce with the nitrous acid; both are magnetic, and both give fire with steel. The whole mass is intersected, at various distances, by lateral joints, and is included between the chert rock, which does not appear the least altered where it comes in contact with the Whyn Dyke. Farther along the shore is a cavern in the chert; the entrance is low and narrow, but within it is very capacious.

Intending to visit the cave *Ea mawr*, on the western side of the island, I took boat at Freeport, and rowing along shore, which is of chert, I observed several fissures or caverns in the cliffs, and many Whyn Dykes, some ranging N.W., others N.E. I landed, within the sound, on a white shingly beach, the stones of which are all chert, rounded by attrition, and the shingle is thrown up so much above the present high-water mark, that it affords strong reason to believe, that the sea has greatly receded from these shores. Above the beach, the cliffs are of chert. From hence I walked three miles over moors and open pastures across the north-west point of the island, and in some

of the hollows between the hills met with beds of stones, similar to those I had seen on the beach. Approaching the western shore, I saw a cavern, whose mouth opened to the eastward, and whose bottom was covered with water. Passing this, I arrived at a narrow steep path, which leads down the cliffs to the shore. Here are several caverns, whose general range is S.E. into the cliffs, which are composed of chert. South from these caverns, in traversing the sandy shore, I passed a vein of laminated hornstone (approaching to the nature of a shistus) containing pyrites in the joints of the stone, which range nearly N.N.W. and S.S.E. Farther south is an immense Whyn Dyke, bursting from the cliffs; it stands vertically, is many yards in height, projects from the cliffs to the north-westward, and in that direction runs many fathoms into the sea. It bears the buffeting of the waves of the Atlantic Ocean from the south-west, and seems to defy their rage, though its breadth, compared with its height and length, is very inconsiderable, it not being more than five or six yards wide. It is of a dark granular substance, very similar to the Whyn Dyke near Freeport, excepting that the central part is softer and of a paler colour. The outer sides, which are each about two feet thick, are of a very dark colour, hard, contain some bladder-holes and specks of zeolite, are detached from the center (in general) by very small joints, and the whole is divided by transverse joints into irregular polygons of various dimensions. If this stupendous object is viewed from the north, it has much the appearance of a lofty wall of human fabrication.

A small distance more to the southward is the great cave, in the Erse dialect called *Ea mawr*. The entrance is near twenty-three yards wide, and from six to eight yards high. After going in a little way the roof rises, and the cavern extends in

breadth; but at about an hundred and fifty yards from the entrance, all its dimensions are contracted, and it becomes so small as barely to admit further progress without crawling on hands and knees. There are some calcareous stalactites pendent from the roof; and in this cave, as well as those before mentioned, wherever the water pervades through the joints of the chert, it tinges the sides of a ferruginous hue.

From hence I returned by the same route to the boat and to Freeport; and having given you an account of the principal Whyn Dykes which I examined on the sea coast, I will proceed to relate those observations which occurred in my progress through the interior parts of the island, confining my remarks more particularly to the Whyn Dykes which constitute the subject of present consideration.

Ascending the hill from Freeport, in the way to Shinegart, the road goes for about a mile over chert. Near Persabus are beds of stone marl, and a very large Whyn Dyke, ranging N.E. and S.W. Hence the path leads over hornstone; and in one part is a laminated hornstone, ranging E. and W. It inclines to a schistus; but where it stands bare at day, is soft and partly decomposed; but probably might be found useful for coverings, if it was tried in depth. Again the chert is seen, and again hornstone, in which is included the lead vein of Shinegart, situated on the S.E. side of Portnealin Loch. This vein had been formerly worked; but, when the old workings were cleared out, was found not worth pursuing. The vein ranges N.N.E. and S.S.W., is two feet wide, and fades to the eastward, and is crossed at right angles (a few yards to the northward of the workings) by a small Whyn Dyke. At Mullrees are old workings on a lead vein, which is about four feet wide, but left poor, and ranges N. and S. between limestone

stone sides, hading to the westward. South-south-west from hence is a natural cavity in the limestone, called the Giant's Hole. Here the joints of the limestone range S.E. and N.W. and are crossed by a shale string, three feet wide, ranging N.E. and S.W. The water of a little stream, which falls into the Giant's Hole, passes through a fissure in the limestone, and issues again to the day in lower ground, fifty yards to the south-eastward. Returned by Perfabus to Freeport, having gone over several Whyn Dykes of various widths, and running in various directions.

From Freeport went (by Perfabus) to Gartnefs lead mine, which is situated in the center of the limestone country; much work has been done here, but at present there are no great prospects of success. The principal vein, which in some parts is about one foot wide, has a slight hade to the north-eastward, and ranges south-east and north-west, along the side of an immense Whyn Dyke, between which and the limestone it is included, the points of the latter running north-east and south-west at right-angles with the vein and Whyn Dyke.

This Whyn Dyke is the largest I have yet seen, being twenty-three yards wide. Where cut through, from Abel's to Hodgson's shafts, it divides the limestone strata, and is nearly vertical, having, like the vein, a very slight hade to the north-eastward. It is chiefly compact, but not entirely without fissures. It varies both in colour and texture; in some parts approaching to the texture and hardness of basalt; in others, being granular, of a black iron-grey colour with shining parts, gives fire with steel, is slightly magnetic, does not effervesce with nitrous acid, and its specific gravity is 2,631. Other parts, of nearly the same texture and colour, have none of the preceding qualities; specific gravity 2,698. Some

pieces are found which contain minute specks of fluorspar, and of a calcareous spar; specific gravity 2,484. In some parts it is of a whitish grey calcareous substance, specific gravity 2,542; in others of a pale greenish grey, whose specific gravity is 2,322, and which does not effervesce with nitrous acid, but contains threads of calcareous spar, and is sometimes also found coated, and sometimes spangled, with pyrites, and then its specific gravity is increased to 2,833. Throughout this great mass, nodules of a yellowish grey colour are found, which do not effervesce with acids, or give fire with steel, and which are in appearance very similar to some kinds of Derbyshire toadstone; specific gravity 2,652. Other nodules are also met with, of a kind of indurated clay, coated like the geodes, and tinged with iron. The central part, which is the softest, after being drawn up, and lying some time exposed to the action of the air, decomposes, and moulders into a friable earth, similar to that which is found on the surface near Belfast, and various other places in the county of Antrim, and in the island of Staffa.

Going from Gartnefs to the lead mines at Ardachie, I passed Glasgow Beg, where is a lead vein, formerly wrought, ranging between limestone sides E.S.E and W.N.W.: a small Whyn Dyke crosses this vein, running nearly S.S.W. and N.N.E. Farther south is an old open cast in a lead vein, ranging E. and W., and having S. At some distance from hence is Ardachie mine. This vein, which has formerly been much wrought, has the same range and hade as the preceding, and is crossed by a Whyn Dyke, ten feet wide, which throws the vein nine feet from its general direction. Proceeding from hence over moory ground, near Allala, saw a dead vein of spar,

spar, limestone, and an argillaceous substance mixed with mica; the whole tinged with iron. Continuing my walk, I arrived at the foot of Ben Vinkie, which is composed of a granulated whitish chert. This mountain is said to be the highest in Hay. It is very steep on the S.W. side, where I ascended it by following the course of a Whyn Dyke, which reaches very near to the summit. This Whyn Dyke is similar to those before mentioned. It consists of a dark-grey granular substance, which does not effervesce with nitrous acid, but gives fire with steel, is slightly magnetic, and its specific gravity is 2,901. It consists also of a very dark granular substance, with the same properties as the foregoing; and further, in some parts, it has a granular substance, which includes small pieces of white chert; other parts are of an argillaceous substance, somewhat resembling hornstone, and others of a calcareous substance which slightly effervesces with nitrous acid. Here is also a kind of vein, containing a brownish argillaceous substance, and reddish cubical calcareous spar. The very summit of the mountain is composed of white crystalline chert, which is not unfrequently tinged with iron.

Loffit Hill being an object of great curiosity, I shall with pleasure retrace our walk from Gartness by Glasgow Beg to Loffit Loch and to the Hill. Walking on the western shore of the Loch we saw a vein of blue shistus, many yards wide, ranging N.E. and S.W.; not far from which is an ochraceous earth, and much bog iron ore. Observing, on the south side of the Loch, the appearance of an ochry earth, we went round to examine it; and near it we found an immense Whyn Dyke, ranging nearly S.E. and N.W. composed of a friable substance containing zeolite, of a black granular substance which gives fire with steel, and a yellowish grey substance, perfectly similar



in appearance to that before described. In its vicinity the chert is extremely broken and cellular; and I am of opinion, that this is a continuation of the Gartnefs Whyn Dyke, it having the same range, and nearly the same breadth. After viewing the Fort (see PENNANT'S Voyage in 1772, p. 219.), we began our examination of the substances which compose the hill. They are in general siliceous, variously blended; the northern brow is of chert, the joints of which range E. and W. and the beds are in some parts vertical, in others horizontal. Here is an irregular bed of iron ore, called emery by the inhabitants; it is from six to twelve inches in thickness, and may be traced about four fathoms in length. Above it is a strange mixture of chert, hornstone, and friable yellow sand-stone, blended together without any order or regularity. This bed of iron ore is visible on the S.W. part of the hill, where it is near two feet thick, is stratified with the chert, which lies in beds from three inches to two feet in thickness, and is covered with a crystalline sand. On the south side of the hill, where a trial has formerly been made for iron ore, there are several lumps collected in an heap, but no appearance of bed or vein. Where the rock has been laid bare, it is an hard chert, with an outer coat of soft yellow sand-stone. Higher up the hill is an hard chert, with a kind of bladder-holes. Skirting the hill we descended on the north side, and saw two places, formerly wrought, where there is not any appearance of a vein, but merely a jumble of iron pyrites. At a very small distance from hence, the limestone shews itself, and trials have been made for lead ore. Having surrounded the hill, and examined it attentively, and having seen the chert, of which it is chiefly composed, thrown into an infinite variety of forms; in some parts broken and indented, with a kind of empty bladder-

holes; whilst in other parts they are filled with a crystalline chert, with which the tops of the neighbouring mountains, and the Paps of Jura, abound: in short, from the very rude and irregular appearance of the summit of the hill, from its rising so suddenly from the limestone strata, and from the Whyn Dyke which runs through it, and which may be traced ranging far away to the north-eastward, I am strongly induced to believe it of volcanic origin.

If it be admitted that I am right in my opinion of the volcanic origin of these different substances, a large tract will then be added to that already proved by others to have been subject to the effects produced by subterraneous fire; which, as far as has hitherto been discovered with us, commences in the S.W. part of Derbyshire, and, if I mistake not, is again seen in Seathwaite, about five miles from Hawkhead, in the N.W. part of Lancashire, and appears (N.W. from thence) in the neighbourhood of Belfast in Ireland, and ranging through the northern part of that kingdom; it is perceived in several of the western islands of Scotland, extending as far north as the island of Lewis, which is the northernmost of the Hebrides, and crossing east from Ilay (which is the southernmost) by Tarbut, Dumbarton, Stirling, and Edinburgh to Dunbar.

Some persons may consider, with astonishment, the extent of those veins and masses of lava which appear in the northern part of the British isles, where no crater is visible; whilst others; who have read VON TROIL, and recollect that he says (at p. 234.), "That lava is seldom found near the opening of a volcano, but rather tuff, or loose ashes and grit," may perhaps unite with me in opinion, with Mr. WHITEHURST, "that the crater from whence that melted matter flowed, together with an immense tract of land towards the north, have

“ have been absolutely sunk and swallowed into the earth, at  
 “ some remote period of time, and became the bottom of the  
 “ Atlantic Ocean. A period indeed much beyond the reach of  
 “ any historical monument, or even of tradition itself.”

That you may more readily compare the specific gravities of  
 the Ilay lavas, and other substances (mentioned in these letters)  
 with those from other parts, I have annexed a table of their  
 several weights; and remain, &c.

A. MILLS.

Ardlun Coal,	-	-	-	-	-	1,284
Jet, according to Dr. WATSON,	-	-	-	-	-	1,236
						1,180
Cannel coal, from Haig in Lancashire,	-	-	-	-	-	1,275
Whyn Dyke, from near M <sup>r</sup> Arthur's head, N <sup>o</sup> 1.						2,863
Whyn Dyke from Freeport, inside	N <sup>o</sup> 2.	-	-	-	-	2,881
	outside	3.	-	-	-	2,850
Whyn Dyke from Gartnefs, N <sup>o</sup> 4.		-	-	-	-	2,631
	5.	-	-	-	-	2,698
	6.	-	-	-	-	2,484
	7.	-	-	-	-	2,542
	8.	-	-	-	-	2,322
	9.	-	-	-	-	2,833
	10.	-	-	-	-	2,652
Basaltes from the Giant's Causeway,		-	-	-	-	2,743
———— from Fairhead,		-	-	-	-	2,950
———— from Ardlun,		-	-	-	-	2,724
———— from Staffa,		-	-	-	-	2,736
	O 2					Vitreſcent

Vitrescent substance from Ardlun,	-	-	2,800
Toadstone, from great rocks Derbyshire, yellow grey,			2,133
		dark compact,	2,634
		ditto cellular,	2,528
-----		yellow grey from Bonfal,	2,219

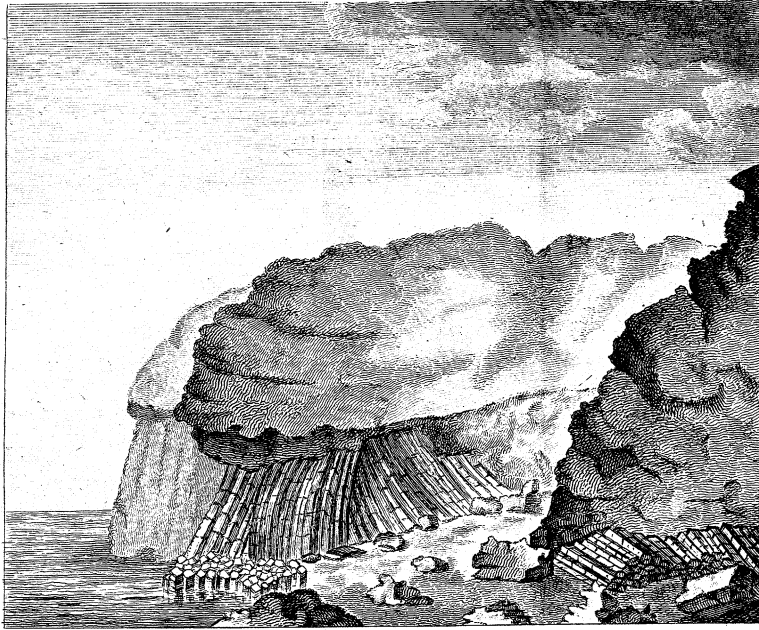
[Specimens of all these substances, except the Jet and Cannel Coal, accompanied the Paper.]

EXPLANATION OF THE FIGURES, TAB. IV.

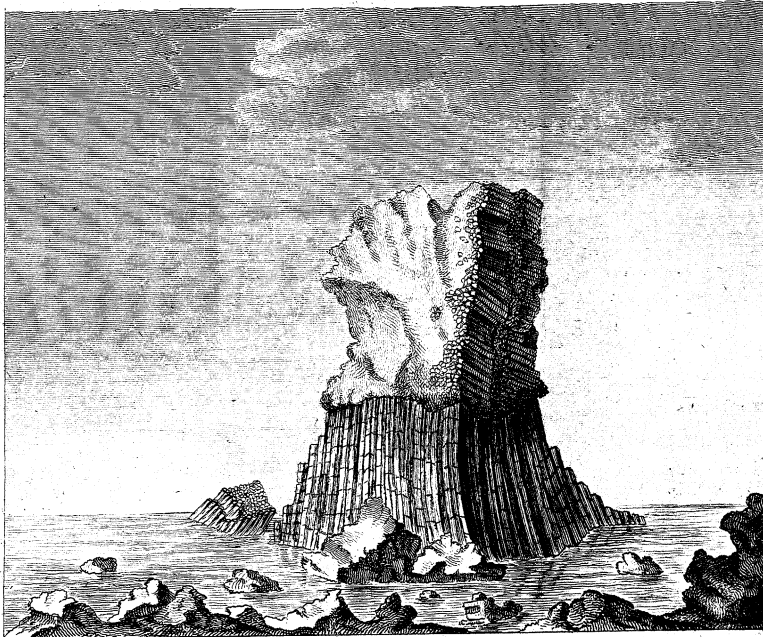
- Fig. 1. View of the Glen near Ardlun Head in Mull.
2. View of the insulated Rock at the termination of the Glen.
3. A view of the great Fissure, the Cave, and the suspended Stones, in the Island of Mull. The fissure ranges N. and S., is about ten feet wide and forty yards deep: the sides and the suspended stones are granite.



*Fig. 1.*



*Fig. 2.*



*Fig. 3.*

