



LXXI. On Staffa

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To cite this article: J. MacCulloch M.D. F.L.S. (1814) LXXI. On Staffa , Philosophical Magazine Series 1, 44:200, 445-451, DOI: [10.1080/14786441408637486](https://doi.org/10.1080/14786441408637486)

To link to this article: <http://dx.doi.org/10.1080/14786441408637486>



Published online: 27 Jul 2009.



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diameter and more pressed together, the effects were much less striking, although they were fully sufficient to prove that no more electricity escaped by the insulators or the air from the upper extremity when the latter was moistened than when it was drier.

I would draw from these experiments the following conclusions; but I do not wish to insist very confidently on their validity.

1. The quantity of electricity arriving at a certain intensity, which a column of this kind is capable of manifesting, as measured by the vibrations of the pendulum apparatus, or the striking of a gold-leaf electrometer, in a given time, is great in proportion to its degree of moisture within certain limits.

2. Under certain circumstances this greater quantity, thus manifested in a moist state of the column, does not produce greater intensity than when it is in a drier state.

3. Since electricity does not pass off in one of the above cases by the insulators or the air more copiously than in the other, it must pass by the water, which is the cause of its accumulation; otherwise the intensity would be proportional to the quantity.

4. If the last proposition is correct, the great quantity and low intensity of the electricity produced by Voltaic batteries charged by acids and salts, may be attributed to a similar cause.

I am, sir, your humble servant,

Hammersmith, Dec. 16, 1814.

FRANCIS RONALDS.

LXXI. *On Staffa.* By J. MACCULLOCH, M.D. F.L.S. *Chemist to the Ordnance, and Lecturer on Chemistry at the Royal Military Academy at Woolwich.* V. Pr. Geol. Soc.*

IF the "Description and Natural History" of Staffa, by Faujas de St. Fond, or the various other descriptions which have been published of this island by naturalists and by tourists, had exhausted the subject, I should have forborne to have troubled the Society with any remarks on a place which ought now to be well known.

But a visit to this celebrated island having given me an opportunity of remarking a circumstance before unnoticed, and of some importance in its natural history, I think it my duty to lay it before the Society. In so doing, I find it difficult to avoid entering rather minutely into the general description of the island, particularly since a second examination, besides confirming the remarkable fact I at first noticed, has enabled me to investigate its structure more completely. I shall doubtless still leave something to be corrected by those who may come after me. A

* From the *Géological Transactions*, vol. ii.

multiplicity of objects pressing at once for regard, a visit always necessarily hurried from the impossibility of remaining long on the island, a boisterous sea, and a stormy atmosphere, are hostile to that accuracy of observation which may preclude future corrections.

The circumference of Staffa is estimated at about two miles. It forms a sort of table land of an irregular surface, bounded on all sides by perpendicular cliffs, varying in altitude and broken into numerous recesses and promontories.

It is intersected by one deep cut, scarcely to be called a valley, which divides the higher and more celebrated columnar part from the remainder of the island. At the highest tides this more remarkably columnar part which forms its southwestern side, appears to terminate almost abruptly in the water, but the retiring tide shows a causeway of broken columns forming a sort of beach at its foot. Round the other sides of the island there is also a beach of varying breadth, consisting of detached fragments, and of rocks jutting out into the sea in many irregular directions. This beach, when the weather is perfectly calm, and the swell off the shore, will, under due precautions, afford landing in various places, but it is on the eastern side that the most numerous landing places occur. Various narrow creeks sheltered by the island itself from the predominant western swell, admit of easy access in moderate weather, provided the wind is in any direction from SW. to NW. And for the encouragement of the mineralogist, who may be terrified at the exaggerated reports of this difficulty, I can assure him that I have landed on Staffa when the vessels that navigate this sea have had their sails reefed, and the boatmen of Iona and Ulva have called it impracticable. The love of the marvellous has conferred on Staffa a terrific reputation, which a greater resort has discovered to be somewhat akin to that of Scylla and Charybdis.

It is easy to perceive from the southward, that with this flat disposition of its surface, and notwithstanding its irregularities, Staffa possesses a gentle inclination towards the N.E. although no opportunity is afforded for ascertaining the precise dip. It is not of importance to ascertain it, nor can it amount to more than five or six degrees of variation from the horizontal plane.

The highest of the perpendicular faces which bound it, rise about 60 or 70 feet above the high-water mark, and these are on the south-western side, where the most remarkable columns and where the great caves exist.

The greatest elevation of the island cannot be more than 120 feet above the level of the sea. There are no sunk rocks round it; but the water deepens rapidly from the shore, and admits of large vessels coasting it close at hand, provided they have a leading wind.

There

There is a soil of considerable depth on the surface, and it is covered with herbage.

It is almost superfluous to say that the whole island consists of a mass of basalt. I have indeed been told, that a sandstone bed has been seen at low water on the southwestern side, but I had not an opportunity of observing it. This is the part of the island, where, if in any place, it should, from the inclination of the strata, be perceived; and there is no reason to doubt the assertion, as we find most of the trap rocks of the Western Islands lying on beds of sandstone. It is equally superfluous to describe the basalt, since specimens of it are in every one's possession. It may be sufficient to remark, that its texture is more compact, more crystalline, and less earthy than that of basalt in general, and that it is at the same time less homogeneous, less black, more fragile, and more sonorous. But it would be idle to attempt to apply different terms to the endless varieties of the rocks of this tribe.

This basalt exhibits two modifications: the columnar, so often described, and the amorphous, which is generally more or less amygdaloidal, containing imbedded zeolites of different sorts. I saw no examples of basaltic breccia, or of trap tuff, as it is improperly called.

It is in the amorphous basalt that the zeolites are most abundant. The nodules vary from the size of a pea to that of a hen's egg and upwards, and generally exhibit specimens of radiated mesotype and of analcime. The cubical zeolites (chaabasite) are of rare occurrence, and the mesotype is seldom granular, and never, as far as I saw, capillary. The lamellar variety of stilbite is occasionally found filling the intervals of approximate columns. I did not observe any zeolites in the larger and more perfect columns, but in the smaller and more irregular ones they occur, though rarely.

If we were to view the island only from the southwestern side, and at half tide, we should conclude that it has been formed of three distinct deposits, or beds of basalt. Of these the lowermost appears in some places amorphous, but it is not easy to see enough of it to judge whether it actually forms a continuous bed. It is only from the analogy of Canna, and the other basaltic islands of this sea, that we should be tempted to generalize this conclusion.

The next bed is that which is divided into those large columns which form the most conspicuous feature of Staffa, and it varies from 30 to 50 feet in thickness. The upper one appears at a distance to be an uniform mass of amorphous basalt; but on a nearer inspection it is found to consist of small columns, laid and entangled in every possible direction, often horizontal, and generally

generally curved. It is this bed which forms the ponderous cap (as it is called) which crowns the summit of the grand *façade*.

Although the great columnar bed occupies but a small portion of the whole exterior face of the island, the columnar form is perhaps predominant throughout the whole. Yet it would be equally difficult, as useless, to attempt to determine its proportion to the amorphous part where they are irregularly mixed, as they are at the northern and eastern sides. On these sides also the division into distinct beds such as I have described above, is by no means easy to trace, and possibly it does not exist.

To those who have seen the beautifully regular columns of the Giant's Causeway, those of Staffa will appear rude and comparatively shapeless. They nowhere exhibit that accuracy of design which is so conspicuous in the former, and are rarely seen of any considerable length without some incurvation. But their thickness is much greater, since they often attain a diameter of four feet. They vary perpetually in the number of their angles, the pentagonal and hexagonal being the most common, and those of an inferior number of angles being less common than those of a superior. Their joints are very irregularly placed, and are frequently wanting through a considerable length. When separated, the touching surfaces are either flat, or marked by a slight respective concavity and convexity. In many places, and most conspicuously in the great cave, the angles of the upper joint are considerably and obliquely truncated at the point of contact with the lower one. But I did not perceive any instance where a corresponding projection of the end of the inferior angle rose to cover the truncation, a circumstance of such frequent occurrence at the Giant's Causeway. I may add, that the articulated columns are most remarkable in the great cave, and that the straightest columns generally exhibit the most frequent articulations. The curved columns visible at the cave called the Clamshell cave, extend for 40 or 50 feet without a joint.

The disposition of the variously curved columns above this small cave, is perhaps one of the most striking features of the whole island. But it will be time enough to speculate on the formation of a curved basaltic column, when we have something rational to offer on that of a straight one.

A very extraordinary aggregation of columns lies off this cave, forming a conical detached rock, corruptly called *Boo sha la*. The Gaelic name *Buachaille* (*Βουκόλος*?) the herdsman, is commonly applied to conspicuous single rocks all over the country. This rock consists of variously inclined columns resting against each other, and meeting till they form a conical body, which appears to repose on a bed of curved and horizontal columns.

It

It is superfluous to attempt a description of the great cave. The language of wonder has already been exhausted on it, and that of simple description must fail in an attempt where hyperbole has done its utmost. I may however remark, that its dimensions appear to have been over-rated, in consequence of the mode of measurement adopted, and that the drawings of it which have been engraved, give it an aspect of geometrical regularity which it is far from possessing. Its superiority in point of effect to the greatest efforts of architecture, might admit of dispute if there were any disputing about feelings. Another cave occurs at a short distance westward, of inferior dimensions, and inaccessible unless when it can be entered in a boat, an event requiring a combination of circumstances of no very common occurrence at Staffa. Large fissures are seen above this cave, with an incipient detachment of considerable masses, threatening a ruin which is perhaps not far distant. Beyond this there is still another cave which appears to pass through the promontory in which it lies, but equally or even more difficult of access, and still involved in uncertainty. Many other caves of less note are to be seen in various parts of the cliff around the island, into which the sea breaks with a noise resembling that of heavy and distant ordnance.

In a letter transmitted last year to the Secretary of this Society, I took notice of a fact of considerable importance in the natural history of this island, which had before escaped the remarks of visitors. This is, the occurrence of a bed of alluvial matter on some parts of its surface, containing fragments of the older rocks. It is most easily seen at that side of the island which faces Iona, and on the summit of the cliffs of a semicircular bay opening in that direction. The bed is here broken at the edge of the cliff, so as to expose its whole thickness for a considerable extent. But the same appearance may also be observed immediately above the ordinary landing place, where the bed has also been broken. The stones which it contains are all rounded, and of various, often considerable dimensions, and they exhibit specimens of granite, gneiss, micaceous schistus, quartz, and red sandstone. Together with these, are some rolled pieces of basalt.

Here then is a circumstance in the mineral history of Staffa, adventitious it is true, but involving difficulties of no small importance. If we cast our eyes on the map, we shall perceive that it is embayed in a large sinuosity formed in the island of Mull, and nearly inclosed on the opposite side by Iona and the Treshanish islands. Beyond the latter, a second line is drawn by Tirey and Coll; while to the north, but at a greater distance, are placed the islands of Muck, Rum, Egg, Canna, and

Sky. The whole island of Mull, with the exception of the Ross, is of a trap formation, containing however some partial tracts of sandstone and other rocks which I need not notice. The islands of Ulva and the Treshanish, with their dependent rocks, are also of trap formation. So are the islands which lie to the north, and which I have enumerated above. Iona however, together with Coll and Tirey, consists principally of gneiss and mica slate traversed by granite veins, rocks which also form the chief parts of the coasts of Lorn, Appin, Morven, and Arduamurchan.

It is to the former, then, that we must look for the origin of the rolled stones which cover Staffa, if, limiting the great operations of nature by our own narrow views, and the ages which have contributed to change the face of the globe by our own short span, we are led to seek for that solution which may appear the least difficult. Even then, we must admit that Staffa has formed part of one continuous land with the islands of Coll, Tirey, and Mull, since no transportation could have been effected without the existence at some period of a continuous declivity between them.

The language which this circumstance speaks is not obscure, and the nature of these changes allows of little dispute. If we admit this obliteration of so large a portion of solid land, and consider that a deep sea now rolls above the foundations of former mountains, we have no further difficulties to obstruct us in accounting for the numerous and distant accumulations of transported materials which occur over the whole surface of the earth. The same power, whatever it was, that hollowed the great sinuosity of Mull, might well remove the solid matter that once filled the valleys which now separate Mont Blanc from the ridge of Jura.

But if, appalled at the supposed magnitude of those changes, and at the period of time which must have elapsed to complete them, we suppose that the island of Staffa was elevated from the bottom of the sea in its present detached form, and retaining on its summit a portion of the bed of loose matter deposited under the present waters, another order of phenomena crowds on us no less important, and involving circumstances almost equally repugnant to the visible operations of nature.

The appearances are perhaps insufficient to enable us to decide between two difficulties of equal magnitude, nor is it here necessary to enter further on that question. I may also leave it to those who have engaged more deeply in such investigations, to determine whether, in the supposition of the first of these causes, whether the wasting of the land has arisen from the gradual action of natural operations, or the more violent efforts of an occasional

occasional destroying force. It is my humble task to point out a fact, as a contribution to that mass of accumulating information on which a consolidated fabric may at some future time be erected. Yet the idle spectator or enthusiastic lover of Nature, who shall hereafter view this interesting spot, may, when he contemplates these grand revolutions, learn to wonder less at the efforts of that power which has hollowed the cave of Fingal, and submerged in the depths of the ocean those columns which seemed destined for eternity.

LXXII. *An Account of some Experiments on Animal Heat.*
By JOHN DAVY, M.D. F.R.S.*

THE recent inquiries of Mr. Brodie have rendered questionable the different prevailing hypotheses relative to animal heat, and have shown that fresh investigation is necessary, before we can expect to arrive at any accurate theory.

In the present uncertain state of our knowledge, three circumstances are particularly deserving of attention, viz. the relative capacities of venous and arterial blood for heat, their comparative temperatures, and the temperatures of different parts of the animal body.

On the first of these subjects we possess only the experiments of Dr. Crawford, which I believe have not yet been repeated, notwithstanding they form the basis of his hypothesis.

On the second, little inquiry has been made, and especially of late years, since the improvement of the thermometer.

And on the third, the observations that have been collected are very few in number, and, with the exception of those of Messrs. Hunter and Carlisle, are scarcely, perhaps, deserving of confidence.

Such were the inducements that led me to the consideration of each of these subjects apart, and to endeavour to acquire by experiment some more certain knowledge respecting them. The experiments that I have made will be described in the two following sections, and in the last will be offered the few remarks and conclusions which naturally arise, and are fairly deducible from the results.

1. *On the Capacities of venous and arterial Blood for Heat.*

I must premise, that my object has been to endeavour to ascertain the relative capacities of venous and arterial blood for heat, rather than their exact specific caloric. The latter, from many

* From the Philosophical Transactions for 1814. part ii.