



Vitrified Forts On The West Coast Of Scotland

Edward Hamilton M.D., F.L.S.

To cite this article: Edward Hamilton M.D., F.L.S. (1880) Vitrified Forts On The West Coast Of Scotland, Archaeological Journal, 37:1, 227-243, DOI: [10.1080/00665983.1880.10851937](https://doi.org/10.1080/00665983.1880.10851937)

To link to this article: <http://dx.doi.org/10.1080/00665983.1880.10851937>



Published online: 14 Jul 2014.



Submit your article to this journal [↗](#)



Article views: 2



View related articles [↗](#)

VITRIFIED FORTS ON THE WEST COAST OF SCOTLAND.

By EDWARD HAMILTON, M.D., F.L.S.

In many districts of Scotland, particularly in the north and west, are found remains of buildings, or enclosed sites, the walls of which are formed by stones cemented together by means of great heat. These relics of the past which go by the name of "Vitrified Forts" have arrested the attention and excited the interest of antiquarians from the time of their first discovery in 1777 to the present moment. During the last autumn I had an opportunity of making a thorough investigation of two of these vitrified forts which have been hitherto undescribed, both presenting features differing from those already known, and throwing further light not only on their mode of structure but on the manner in which the vitrification was produced.

Before however describing these it will be as well to give a summary of what has already been written on this subject, so that we may be enabled to have some idea of the various opinions and theories which these curious structures have elicited.

Although Mr. John Williams has always been considered to be the discoverer, yet the first recorded notice of any of these vitrified forts is in Pennant's *Tour in Scotland*, commenced in 1769 and published in 1774.

"Rode to the Castle of Tor Down . . . a rock two miles west of Fort Augustus. On the summit is an ancient fortress. The face of the rock is a precipice—on the accessible side is a strong dyke of loose stones—above that is a ditch, and a little higher a terras supported by stones—on the top a small oval area, hollow in the middle—round the area, for the depth of nearly twelve feet, are a quantity of stones strongly cemented with almost vitrified matter and in some places quite turned

into black scoria. The stones are generally granite mixed with a few grit stones of a kind not found nearer than 40 miles. Whether this was the antient site of some forge or whether the stones which form this fortress had been collected from the strata of some volcano (for the vestiges of such are said to be found in the Highlands) I submit to further enquiry."

He was evidently of opinion that these masses were of volcanic origin, see vol. ii, pp. 411-12. Pennant also states that he was told that at Arisaig there was an old castle formed of the same materials.

The next observer is Mr. John Williams, who in all probability had investigated these sites previous to Pennant. He read a paper before the Royal Society of Edinburgh in 1777 on this subject, and also published a small octavo volume, entitled—"An account of some remarkable ancient ruins lately discovered in the Highlands and northern parts of Scotland." In a letter to Lord Kames he says, "above a year ago a copy of my paper concerning the vitrified forts was sent to London to be disposed of to the booksellers, but they looked upon it as a fiction."

Lord Kames answers—"This discovery of yours will serve to detect an error that several ingenious naturalists have fallen into, viz., of burning mountains formerly in Scotland, verified say they, by the burnt remains still to be traced. I suspect that these remains are no other than the debris of the vitrified forts you mention." Mr. Williams was of opinion that the process of vitrification by these ancient people was produced either in running bog ore for their utensils or in offering burnt sacrifices, "in burning oxen or other animals whole a strong fire would be required." "It is evident," he says, "from the earliest records of antiquity, that it was the old universal practice of almost all nations to offer burnt sacrifices."

This paper of Mr. John Williams attracted at the time much attention and created a considerable amount of controversy, many supposing that he was entirely mistaken in his views. The Honourable Daines Barrington for instance, in a paper read before the Society of Antiquaries February 15th, 1781, derides the idea that these walls were built as forts, and says that they are nothing but stones exposed to heat to make fences for

cattle, and that the heat was caused either by lightning or volcanoes.

Mr. James Anderson took up the subject with great interest, and in a paper read before the Society of Antiquaries and published in the *Archæologia*, 1777, vol. v, p. 241, *et seq.*, entitled, "an account of Ancient Monuments and Fortifications in the Highlands of Scotland," he says—

"The most remarkable of all the Scottish antiquities are the vitrified walls first observed by Mr. John Williams. These walls consist of stones piled loosely together and firmly cemented by a matter that has been vitrified by means of fire. They for the most part surround a small area on the top of some conical hill very difficult of access. It appears at first sight surprising that a rude people should have been capable of discovering a cement of such a singular kind as this—it is less surprising that the knowledge of it should not have been carried into other countries, as distant nations in those periods had but little intercourse one with another—but it is no difficult matter for one who is acquainted with the nature of the country where these structures abound to give a very probable account of the manner in which this art has been originally discovered, and of the causes that have occasioned the knowledge of it to be lost, even in the countries where it was once universally practised.

"Through all the northern parts of Scotland a particular kind of earthy iron ore of a very vitrescible nature much abounds. This ore might have been accidentally mixed with some stones at a place where a great fire was kindled, and being fused by the heat, would cement the stones into one solid mass, and give the first hint of the uses to which it might be applied. This knowledge being once obtained nothing seems to be more simple and natural than its application to the formation of walls of these fortified places" "nothing seems to be more judicious or simple than this mode of fortification adopted by our forefathers. The stones forming the walls were probably dug up from the top of the rock forming the side of the hill, and therefore served at once to level the area of the fort, and to erect massive walls without any expense of carriage."

Mr. Anderson, in *Archæologia*, vol. vi, p. 87, *et seq.*, gives a further description of these ancient fortifications, and he states that at *Tappernaugh*, in Aberdeenshire, the vitrified crust is on the *inside*; at *Knoch Ferrell* it is on the *outside*. At Dun o' Deer, in Aberdeenshire, on the top of the hill, besides the remains of the vitrified fort there are also the remains of another ancient structure of stone and lime. There is no tradition of the time when either this structure or the vitrified walls were erected, but it is sufficiently apparent that the latter must have been of a date much prior to the former and built by a nation of a very different state of civil polity, as they

applied the vitrified walls to the erection of the new building; this is evident from the fragments of the vitrified walls and scorched stones which are everywhere discernible in the ruins of the stone and lime buildings.

Mr. Anderson quoting from Mr. Williams' pamphlet gives Dr. Black's letter to Mr. Williams to prove the existence of the fusible stone. Dr. Black's letter is as follows :

"Sir, I am much obliged to you for the sight of your letters concerning the vitrified fortresses of the north. I had got formerly from some of my friends some account of the extraordinary vitrified walls which they had seen in the Highlands, and Mr. James Watt who spent some time in surveying a part of that country communicated a number of particular observations which he had made upon one of these ruins; but we were not enabled to judge with any certainty, for what purposes, or in what manner, these hitherto unheard of buildings had been erected. It is very probable that they were executed in some such manner as you have imagined. There are in most parts of Scotland different kinds of stone, which can, without much difficulty, be melted or softened by fire to such a degree as to make them cohere together; such is the grey stone called *whinstone*, which for sometime past has been carried to London to pave the streets; such is also the granite or moorstone which is applied to the same use, and pieces of which are plainly visible in some specimens of these vitrified walls which I received from my friends. There are also many lime stones which in consequence of their containing certain proportions of sand and clay are very fusible, and there is no doubt that sandstone and puddenstone, when they happen to contain certain proportions of iron mixed with sand and gravel of which they are composed must have the same quality. A puddenstone composed of pieces of granite must necessarily have it. There is abundance of one or the other of these kind of stones in many parts of Scotland, and as the whole country was anciently a forest and the greater part of it overgrown with wood, it is easy to understand how those who erected these works got the materials necessary for their purposes.

"I am, sir, your obedient servant,

"JOSEPH BLACK.

"Edinburgh, 1777."

In 1790 Mr. Alexander Fraser Tytler, Professor of Civil History in the University of Edinburgh, read a communication before the Royal Society of Edinburgh, entitled—"An account of some extraordinary structures on the tops of hills in the Highlands of Scotland," and he describes Craig-Phadrack and its vitrified walls, but he supposes that the vitrification was the result of accidental burning, that these forts were erected with wood and stone, and that when in warfare they were destroyed

by fire, the vitrification ensued by the heat of the wood firing the stone.

Mr. Robert Riddell on November 11th, 1790, read a letter published in the *Archæologia*, in which a description is given of two vitrified forts found in Galloway, one on the Moat of Marks, in the Barony of Barclay, and the other, Castle Gower, in the parish of Bartlee, he says—“Many sensible enquirers were much puzzled whether to consider these appearances as the work of man alone or as volcanic remains.”

Chalmers, in his *Caledonia*, published 1807, gives a long and interesting account of these ancient remains.

“We are now to review those curiosities which have been lately discovered, viz., the vitrified forts that exist in every part of north Britain. They were first brought before the public in 1777. It is apparent from the description of these vitrified forts that they are in every respect, except the vitrification, the same as the hill forts of the Britons in north and south Britain and in Ireland. The sites of all are the same, being constructed on the level summit of lofty hills, the access to which are generally on one side. The ramparts which defended the area on the top were in the same manner formed of stones without mortar, though some of these ramparts appear now to have had with the stones a mixture of earth and rubbish; they seem also to have had the usual adjuncts of such strength, consisting of wells, roads, tumuli, temples, and other accommodations; and it thus equally appears that all those hill forts in Britain and Ireland were the works and the safeguards of the first people or their immediate descendants.”

Dr. John Macculloch, *History of the Highlands*, 1824, vol. i, pp. 237, *et seq.*, in writing about these forts, states that there was a tradition existing that these buildings were destroyed by fire from Heaven, and hence the vitrification of the stones; he says—

“Mr. Williams must have the merited honour, not only of pointing out their real value as being forts but of explaining the mode in which they were constructed. In constructing these singular buildings it was suggested by Mr. Williams that by raising a mound of earth on each side of the intended wall and filling it with firewood and stones a sufficient heat was produced to operate and cause the intended effects.”

Macculloch goes on to say—

“It is a highly interesting subject, as well from the singularity and ingenuity of this mode of architecture, from its being limited nearly or perhaps entirely as far as is yet known to Scotland, and from its obscurely and apparently remote antiquity.

“The materials in the vitrified walls are, as at Dun Mac Snuchan, partly roasted without adhesion, and partly vitrified or glazed or scarified in a similar manner. It is easy to see that the dark granite forms the

vitrified and scarified substances, and that, wherever stones not capable of vitrification themselves have undergone this change, it has been produced by the alkali of the wood used in the process, whence the glazed surfaces of many unvitriifiable substances. The materials of the hills were not vitrifiable, but the presence of a very fusible rock at a short distance. It is hence evident that the builders of these works were aware of the qualities of the various rocks, and it was equally evident that they chose the fusible in preference to the infusible, although with a considerable increase of labour. The obvious conclusion is that they designed from the beginning to vitrify their walls.

"The plan suggested by Mr. Williams, viz., that of constructing a species of furnace by means of earthen mounds into which stones and fire were introduced till the structure was erected, not only answers all the conditions, and among the best that of vitrifying the materials below more perfectly than the upper ones, but is confirmed as to the efficacy and probability, by a practice in use in some parts of India, where, according to reports of a French engineer, houses of clay are burnt into a solid brick in this very manner, and at this day to prevent the effect of inundations.

"There appears thus to be an oriental cast about the history of this art and these vitrified forts, which leads us back to the early Celtic tribes, while this species of antiquity and origin is countenanced by all those numerous facts which indicate the remote eastern origin of that far spread people, viz. (Celts). The ancient Caledonians or Picts did not possess the Highlands, and these forts must belong to a time prior to the division of Scotland into a Pictish or Caledonian or a Scottish and Norwegian dominion. Thus they should be referred to the aboriginal Celts or first settlers of Scotland, that people whom the Pictish invaders found and on whose defeats they settled themselves. This speculation may probably be thought to give support to the notion of their being specimens of remote Celtic or Oriental art; but after all that we can do or conjecture, the date of these works and the people by whom they were erected must remain a problem, and it is not one very likely to be solved."

Dr. Macculloch concludes by expressing a hope that some future traveller in the East will find further reasons to prove that they are among the earliest military works of our oriental Celtic ancestors.

In 1825 Dr. Hibbert's "Observations on the theories which have been proposed to explain the vitrified forts of Scotland," was read before the Archæological Society of Scotland.

Dr. Hibbert disagrees with the views enumerated by Mr. Williams and Dr. Macculloch, and expresses some doubts that any of these vitrifications were either designed or were the walls of forts, that the vitrification was the result of beacon fires in most of them. He says that none of these vitrified forts exhibit, as from many writers

we should be erroneously led to suppose, any regular masonry in their structure; that at Dun Evan, the vitrification is only partial, and he says that this circumstance is fatal to the notion that the vitrification was the effect of design, but is only incidental to some other view.

Dr. Hibbert considers that the theories of the vitrification being the result of beacon fires is the most plausible, but owns that this theory is not without its difficulties, and he comes to the conclusion that many vitrified sites owe their origin to beacon fires as described by Olaus Magnus and others. That as it cannot be proved that the vitrification in question is in every instance confined to fortified sites the term vitrified forts is too frequently the language of error. That as nothing can be more satisfactorily established that the vitrification is an incidental not a designed effect, the name of vitrified forts may with much advantage be exchanged for the more comprehensive and untheoretical one of vitrified site.

In a later paper however he modifies his previous assertions, and does not think that some of the sites were used as beacon fires, but does not explain further; he is fortified in his idea of beacon fires by the discovery of vitrified cairns at Elsness, on the island of Gandy, in Orkney; but these are round cairns from three to five yards in diameter and were no doubt caused by lighting beacon fires.

Dr. Hibbert also considers that these ancient duns (or forts where vitrification can be traced), belong to the oldest fortified sites in the country.

He gives a list of these vitrified forts or sites.¹

<i>Perth</i>	Dunsinnan. Barra Hill.	<i>Moray</i>	Clunie Hill, near Forres.
<i>Forfar</i>	Menefick. Dumsturdy Dundee Law. Findhaven.		Doune Hill of Relugas. Castle Finlay.
<i>Kincardine</i>	Fenellas Castle. Stonehaven.	<i>Inverness</i> (including the two now described)	Dun Evan. Dun Daviot. Dun le Chatti. Dun Ardiul. Tor Duin.
<i>Aberdeen</i>	Dun o' Deer. Top o' Noath		Dun Dhuirgale. Arisaig, 2.
<i>Banff</i>	Promontory of Troup, Brough Head.		

¹ The names of these forts are spelt in various ways by different authors.

<i>Inverness</i>	Dun Fion. Castle Spynie. Craig Phadric.		Thurots Bay, Islay, near Killean.
<i>Ross</i>	Dun Avor, near Dingwall. Knock Farril. Ord of Keppoch.		Dunskeig Hill, Cantyre. Bay of Carradall, Cantyre.
<i>Sutherland</i>	Dun Creich.	<i>Bute</i>	Dungall. Kyles of Bute.
<i>Argyle</i>	Island on Loch Sunart. Island on Loch Teachus. Dun MacSnuichan, Loch Etive.	<i>Berwick</i> <i>Galloway</i>	Couden Knows. Anworth. Moat of Mark. Castle Gower.

In July, 1846, Mr. J. Pryer, in the Proceedings of the British Archæological Association, gives an account of Craig Phadric, and ascribes its origin as Celtic and not Caledonian.

At the same meeting a letter was read from M. le Comte Dasson, giving some account of a vitrified wall near St. Brieux, in Brittany, known by the name of Pierre brulée, or Camp of Peran, and from what he says the vitrification was produced by the intermixture of charcoal and earth in the burning.

And in the meeting of the same association in December, 1867, Mr. Lukis forwarded the following observations upon vitrified forts, dated Nantes, 5th November, 1867.

"A few weeks ago an International Celtic Congress was held at St. Brieux, department of the Cotes du Nord, Brittany, and during the meeting an excursion was made by the members to the vitrified forts of Peran, a few kilometres distant from the city. By permission of the government, to whom the fort belongs, a trench was dug across the embankment and wall, thereby revealing the construction down to the ground level. The vitrified wall ran between a bank of earth on one side and a bank composed of loose stones and earth on the other."

He says, embedded in this vitrified wall was a fragment of Roman roofing tile, and speculates on the period when this wall was constructed.

Dr. Daniel Wilson, *Prehistoric Annals of Scotland*, vol. ii, p. 92, says—The so-called vitrified forts, which have been the subject of many ingenious and baseless theories, form another interesting class of native works. Dr. Wilson agrees with Dr. Hibbert, whom he quotes, that the vitrification was an incidental and not a designed effect, and resulted accidentally from the frequent kindling of beacon fires as signals of war invasions, as well as from

bonfires which formed a part of festive or religious rejoicings, he says—

“This susceptibility of the degree of fusion usually observable on vitrified sites, which trap and others of the common rocks of Scotland possess, has long been recognised by chemists; and when it is taken into consideration along with the very diversified circumstances under which vitrification has been observed, the conclusion seems inevitable, that it is an incidental and not a designed result of the application of fire. But neither the interest nor the importance of this inquiry is exhausted when we have established the undesigned origin of vitrified sites. The question still remains—are they peculiar to Scotland? because even if we reject the idea that cementing stone buildings by means of fire is among the *Artes deperditæ Scotiæ*, still the discovery of so many vitrified sites in nearly every district of Scotland would seem to indicate the practice of peculiar customs and observances during those early centuries in which the *primaeval* forests furnished an unlimited supply of fuel.

“To attempt to assign a date for the primitive forts or vitrified sites would be manifest folly, but even to apportion them to one or more of less definite periods is difficult.”

In the Proceedings of the British Archæological Association, January 23rd, 1867, the following is recorded:—

Dr. Kendrick exhibited a stag-like piece of stone from the vitrified fort of Dun-Phinu or Castle of Fingal in the Isle of Arran.

Mr. Gordon M. Hills added to his remarks on this stone. “Although seventy years ago antiquaries were led to believe in the existence of forts in Scotland, whose walls were cemented by vitrification, he did not suppose such a belief would be accepted now.”

Mr. E. Roberts, F.S.A., said that he had visited several of the so-called vitrified forts in Scotland, but could not discover the slightest trace of vitrification about them.

Mr. John Honeyman, in a paper read at a meeting of the Glasgow Archæological Society, February, 1868, “Remarks on the construction of vitrified forts,” says—

“The conclusion to which the phenomena exhibited at Dunskeig pointed seemed to me to be this—that the walls were constructed of loose materials, bound together into a solid mass by being grouted with a liquid vitreous cement composed chiefly of greenstone and other easily fused materials, and that the process was effected *on* the wall, not on either side of it. In this way it would be as easy to construct a wall twelve feet thick as two, and as easy to carry it along the verge of a precipice as on a plain. But it may be asked if the agglutination is chiefly effected in this way, how is it that we find so large a portion of the remains bearing the evidence of the action of intense heat? The reason I think is obvious; the material could not have been melted at all without the action of intense heat on whatever enclosed the fire, and these enclosures

must necessarily have been very numerous. It would, with our present amount of information on the subject, be obviously absurd to dogmatize as to the exact *modus operandi*, but I shall suggest a possible method. Suppose that first a course of loose stones was laid all round the enclosure, the width of the proposed wall across this is a series of furnaces about eighteen inches wide and two feet high, closed at each end and separated by partitions formed chiefly of trap, the ends would form the outside and inside faces of the wall, and would be provided with holes for the purpose of air through the furnace; the whole was then covered with stones (to a considerable extent), trap, and probably turf and seaweed added. In such a furnace, the means of producing a blast being satisfactory, an intense heat would be produced, and the result would be that the partitions and top would be fused."

Mr. Honeyman goes on to say—

"Having extended my observation much since the above was written, I am able to add that the vitrification is generally *less perfect towards the outside than in the centre of the wall*; that in some forts which I have examined the vitrified mass rests upon a rough building which has never been subjected to a great heat, and that in these cases the centre of the wall is vitrified to a greater depth than either of the sides. It seems evident, therefore, that the vitrification was effected from the top of the wall, not from the sides. In every wall I have examined there is abundant evidence that the cementing material has run down among the loose stones, and the same appearances prove that the dry building above referred to occupies still its original position under the vitrified mass. In the interstices among the unvitrified stones drops and small streams from above still remain as they cooled.—J. H., 1879."

J. H. Burton, *History of Scotland*, 1866, says—

"Of the hill forts of Scotland one kind has been and still remains a mystery, defying the learning and acuteness of all investigators. These are called vitrified forts, because their substance has passed through fire and taken a vitreous character. Some portions of these are bright like the scoræ of a glass house, but the greater part more resemble those of an iron work. When they were first brought to light nearly a century ago, scientific men caught at the idea that they were the remains of recent volcanoes. The geologists now scout that supposition, and indeed no one can see them without pronouncing them as the handiwork of man. But how, or with what end, had they been subjected to so strange a process? One view was that they were the mere receptacles of gigantic fires of timber, whether lighted as beacons or for some religious observance. But if some of them are of a merely fragmentary character there are others so elaborately put together, rampart within rampart, that it is difficult to think of any other object in raising them but that of a fortress. The vitrified forts here are numerous; there is not one in England or Ireland, nor have the industrious antiquarians of Scandinavia found anything of the kind within their own field to speculate upon. The general tendency of the evidence about them is in direction of design. It has been noticed that in the portion of these works where the fire has not obliterated the characteristics of the original stone, it is sometimes not of the kind nearest at hand but has

been brought from a distance. Toward the motive for taking this trouble, Professor Macculloch says what, if fully established might be counted conclusive, he is commenting on Dun o' Deer as a strong military position. 'I remarked that at Dun Macnuachan the materials of the hill itself were not vitrifiable, but that a very fusible rock was present at a short distance, or scattered in fragments about the plain. The same is true here, and in both cases the forts are not erected out of the materials nearest at hand, which are infusible, but collected at material labour from a distance.' He infers as the obvious conclusion, that those who made the fortress *intended to vitrify the walls*. It would be satisfactory to have fuller scientific information on the point especially as it is one which skill and trouble can to all appearance settle."

In a work lately published, entitled *Loch Etive*, the author gives an interesting account of the vitrified forts of Dun Mac Uisneachan or Berigonium, on Loch Etive, and a description of the early inhabitants. He says—

"After all, the best general observations on these forts are found in a small volume by the discoverer, Mr. John Williams, in 1777.

"The difficulty of cementation by heat I have never seen where basalt is abundant and where so many mixtures of silica with bases are readily found, abundance of fuel will do the rest.

"I have ventured to adopt or at least to hold prominently the opinion that the vitrified fort of Dun Mac Uisneachan was inhabited in the early centuries of our era, we need not define the date to a century or two. Traditions and dawnings of history like the fancies of childhood are mixtures of the real and the ideal, whilst time and place are not very distinctly bounded. All fancies about earthquakes, volcanoes and lightnings go also from the sight, fancies which I would not have mentioned had they not been entertained by men whose opinions are to be respected on other subjects.

"The vitrified fort was introduced by men who quite understood the mode of putting stones together in layers, a part of the vitrified mass in situ *overlying* a built portion of the wall.

"Vitrified walls take us far back, but not necessarily beyond the early centuries of the Christian Era, since one existing near St. Brieux, in Brittany, was evidently built after the Romans had shown their skill there.

"Vitrified forts are the work of a rude people learning to emerge from the rude state indicated by building loose stone walls, if we may judge from this fort of the Usnachs, in Loch Etive. Such forts would cease to be built when the country was laid bare of wood, and that certainly would be after the Roman occupation of the east coast of Scotland. The habits of the west coast would remain longer."

Having thus given a summary of the various opinions and theories, I will now proceed to describe the two forts which form the subject of this paper.

On the west coast of Scotland between the headland, north of Loch Moidart and Arisaig, is a deep inlet of the

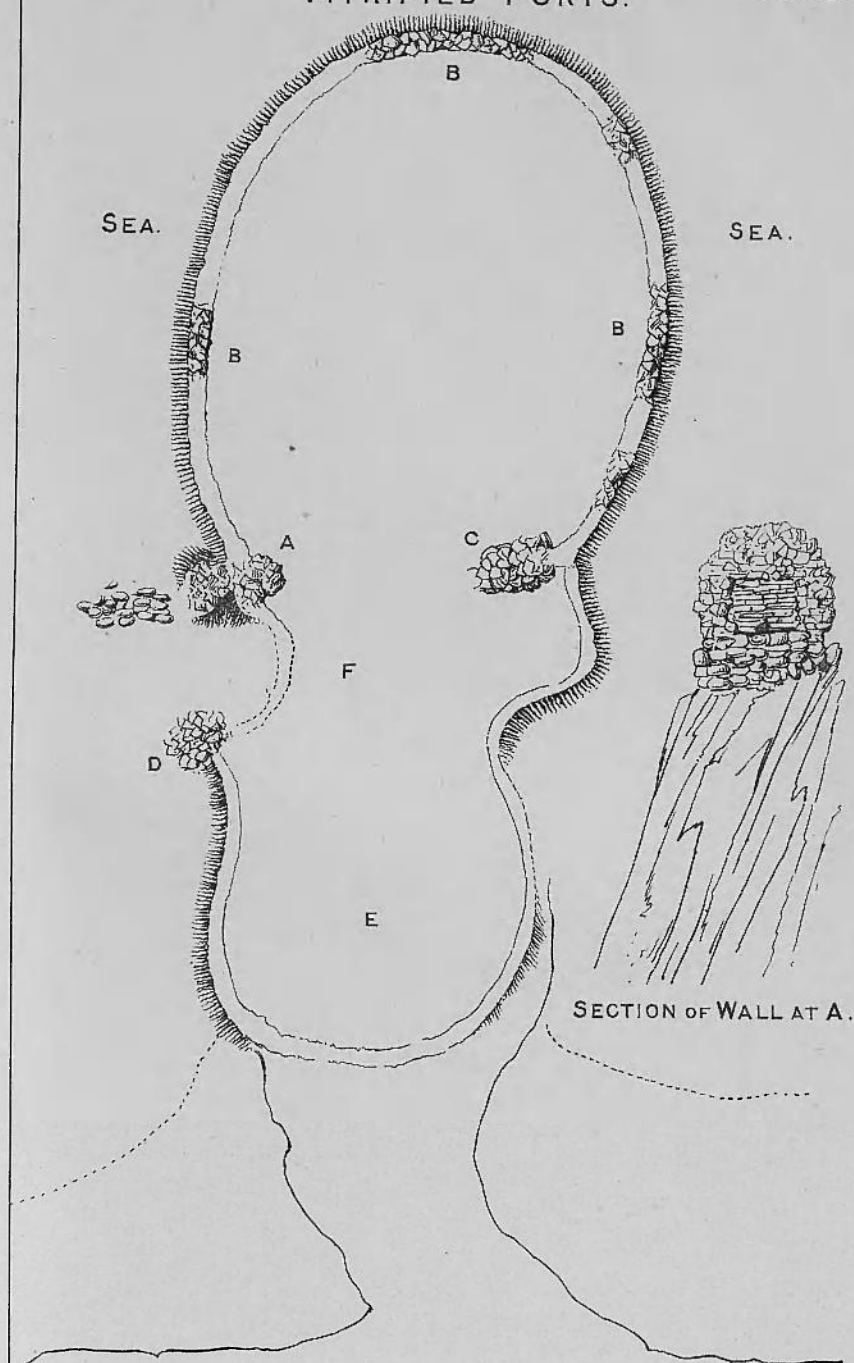
sea. This inlet, near its termination, is divided by the promontory of Ardnish into two branches, called Loch na Nuagh and Loch Ailort. At the entrance to Loch Ailort are two islands, one of which is called Eilean na Goar.

Loch na Nuagh trends to the east and terminates some four or five miles up, and washes the rocks on which runs the high road leading from Arisaig to Fort William. At the point where Loch na Nuagh begins to narrow, where the opposite shore is about one-and-a-half to two miles distant, is a small promontory connected with the mainland by a narrow strip of sand and grass, which evidently at one time was submerged by the rising tide. On the flat summit of this promontory are the ruins of a vitrified fort (Plate I), the proper name for which is Arka-Unskel.

The rocks on which this fort are placed are metamorphic gneiss, with indications of trap, covered with grass and ferns, and rise on three sides almost perpendicular for about 110 feet from the sea level. The smooth surface on the top is divided by a slight depression into two portions. On the largest, with precipitous sides to the sea, the chief portion of the fort is situated, and occupies the whole of the flat surface. It is of somewhat oval form. The circumference is about 200 feet, and the vitrified walls can be traced in its entire length, but are most perceptible at A, B, C, and D. The width of the interior is fifty feet. At one part, A, the vitrified wall is seven feet high and about six feet in thickness. At C the wall is three feet three inches high and five feet thick, and so continues through the whole of the walls, although they are not all so high. The wall at A appears to have been the termination on the east side of the first portion of the fort, as about twenty-five feet from this is another large mass of vitrified wall, D; the space between these two is without any signs of wall. It almost appears as if this might have been the entrance to the larger fort as well as the smaller, which is situated on the lesser portion of the rock, at E. This smaller fortress or portion of the larger is about 100 feet in circumference, 21 feet in width, and 24 feet in length, and appears to have been divided from the larger fort by a narrow strip, F; but although the line

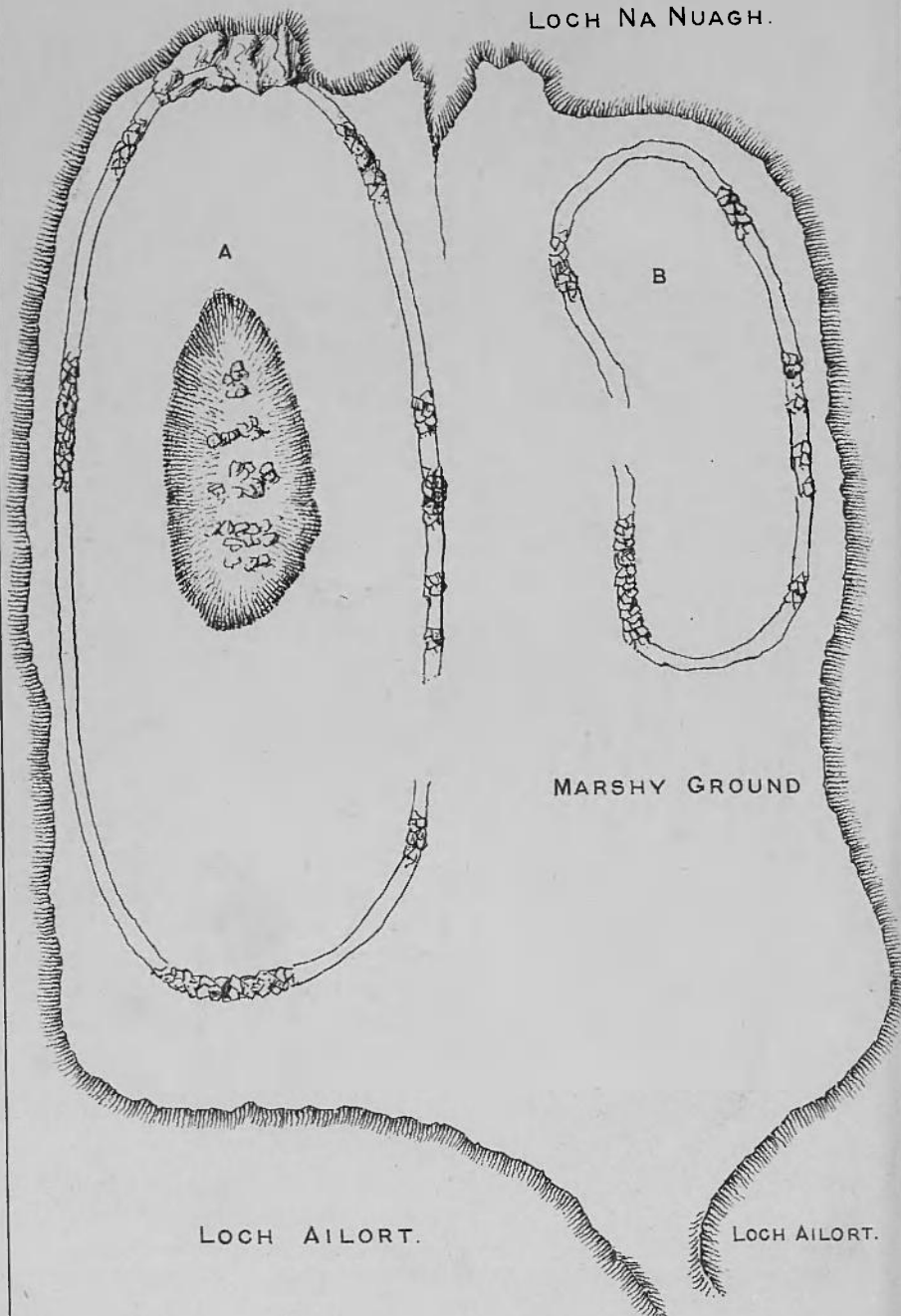
VITRIFIED FORTS.

PLATE I.



VITRIFIED FORTS.

LOCH NA NUAGH.



LOCH AILORT.

LOCH AILORT.

of ramparts may be traced there is no vitrified wall. On excavating at A, below the vitrified wall, we came upon a great mass of large and small boulders, all water-worn, and evidently brought up from the shore, to form a foundation on which the vitrified wall rested (see section, Plate I). This foundation was three feet deep and five feet across, and rested upon the original gneiss rock.

We dug under the vitrified mass, and there found what was extremely interesting, as throwing some light on the manner in which the fire was applied for the purpose of vitrification. The internal part of the upper or vitrified wall for about a foot or a foot-and-a-half was untouched by the fire, except that some of the flat stones were slightly agglutinated together, and that the stones, all fellsptic, were placed in layers one upon another (see section, Plate I.)

It was evident therefore that a rude foundation of boulder stones was first formed upon the original rock, and then a thick layer of loose, mostly, flat stones of fellsptic sand, and of a different kind from those found in the immediate neighbourhood, were placed on this foundation, and then vitrified by heat applied externally. This foundation of loose stones is found also in the vitrified fort of Dun Mac Snuichan, on Loch Etive.

The other vitrified fort (Plate II) is much larger than that just described, is situated on the island at the entrance of Loch Ailort. This island, locally termed Eilean na Goar, is the most eastern and is bounded on all sides by precipitous gneiss rocks; it is the abode and nesting place of numerous sea birds. The flat surface on the top is 120 feet from the sea level, and the remains of the vitrified forts are situated on this, oblong in form, with a continuous rampart of vitrified wall five feet thick; attached at the S.W. end to a large upright rock of gneiss. The space enclosed by this wall is 420 feet in circumference and 70 feet in width. The rampart is continuous and about five feet in thickness. At the eastern end, A is a great mass of wall in situ, vitrified on both sides. In the centre of the enclosed space is a deep depression in which are masses of the vitrified wall strewn about, evidently detached from their original site.

Separated by a deep depression which is now a wet

morass, and nearly parallel to the larger construction, is a smaller fort placed on another flat surface of the island (Plate II). It is 100 feet in circumference and 25 feet across, entirely surrounded by the wall which in many parts remain in its original state.

One remarkable feature in these forts is their *double* form; none other previously described, as far as I am aware, having this peculiar character.

The examination of these two forts leads us to the consideration of the different opinions held by previous investigators as to whether

1st. Were these structures built as a means of defence.

2nd. Was the vitrification the result of design or accident.

3rd. How was the vitrification produced.

On looking at the plates which illustrate this paper and also at the plans of the great forts which illustrate some of these works I have quoted on the east coast, one can only come I think to one conclusion,—that they were intended for places of defence. The regular design of these walls, their great extent and uniformity, the large area enclosed, all lead to prove that these early people had a design in their construction; and it is a curious circumstance that many of the most important of these works were re-occupied by the conquerors of the original designers, as places of defence. The remains of the wooden buildings in the vitrified fort of Dun Mac Uisenachan, on Loch Etive, are the structures subsequently raised by the Irish conquerors of the builders of the original fort. In the ruins of the building on Craig Phadric, some of the original vitrified walls have been built up in the structures of the second occupation. It is scarcely possible then to believe that these extensive walls, all vitrified, encompassing so large an area, could have been merely the site of beacon fires or that the vitrification was caused by such fires or by those for burnt sacrifices. Another argument against the site being only used for beacon fires is that many of these forts are not placed on the highest points of land but generally at the entrance of some strath or some inland loch.

2nd. Was the vitrification the result of design or accident? No doubt in the first instance the discovery

that the stones were fusible was accidental, and was discovered probably as Mr. Williams suggests, by kindling great fires for burning their sacrifices; but I would also suggest another accidental mode by which this discovery might have been made. The aborigines of every country cooked or rather baked their food in ovens made in the ground. These ovens were lined with stones, and stones were placed over the object to be cooked, and then heat applied, oftentimes no doubt very intense. It may be that during this process of cooking the stones employed were of that fusible nature which we know exist in parts of Scotland, and that these were found agglutinated in their ovens, and vitrified. Very little acuteness on their part would lead them to apply this discovery to the building of their places of defence.

The investigation of these forts at Arisaig shew with what a regular design the builders worked. First the foundation of the water-worn boulders all brought up from the sea shore, then the stones known to be fusible, and generally brought from a distance, placed in regular layers on the top of the foundation of boulders to the prescribed height and thickness, and then the fire applied externally, both on the top and on every side; and thus we come to the question,

How was the vitrification produced? As we have seen, various theories have been put forward, but I think we may conclude that in the two forts which I have described, the fire was applied externally and on all sides. This is proved by the internal part of the wall being unvitrified, solely because the heat did not extend so far, leaving the stones in their original condition, or only partly agglutinated, and only not fused because unable to be effected by the fire applied externally.

It is easy to suppose, in the then state of Scotland, that abundant fuel could be obtained from the great pine forests, which combined with seaweed and earth would, with a proper amount of draught, cause heat intense enough to melt or vitrify the fusible material it came in contact with.¹

¹ The proximate amount of heat I have been able to ascertain through the kindness of Mr. Cotterell of the Royal Institution. He has submitted some of the unvitrified stone forming a portion of

the inner layers of one of these forts to the blast of the blow-pipe, and he finds that vitrification ensues at a temperature of about 1,500 degrees of Fahrenheit.

It is an interesting fact that Professor Ramsay, in his *Physical Geography of Great Britain*, gives a remarkable corroboration of the manner in which vitrification was in all probability produced.

"Unlike limestones, basalts, and other hard and tough rocks, such sandstones as the millstone grit and gannister beds of the coal measures are ill adapted for macadamising roads, for traffic rapidly grinds it into its original state of loose sand. Nevertheless, in some regions they have nothing else to use, and to obviate its defects the following process is used near Barnsley and in other parts of Yorkshire. The rocks in question were made from the debris of granite and gneiss, similar to those of the Scotch Highlands. The stone being quarried in small slabs and fragments, is built in a pile about thirty feet square and twelve or fourteen feet high, somewhat loosely; and while the building is in progress brushwood is mingled with the stones, but not in any great quantity. Two thin layers of coal, about three inches thick, at equal distances are, so to speak, interstratified with the sandstones, and a third layer is strewn over the top. At the bottom facing the prevalent wind, an opening, about two feet high, is left something like the mouth of an oven. Into this, brushwood and a little coal is put and lighted. The fire slowly proceeds through the whole pile, and continues burning for about six weeks. After cooling the stack is pulled down, and the stones are found to be completely vitrified. Slabs originally flat have become bent and contorted like gneiss, and stones originally separate get, so to speak, glued together in the process of vitrification, aided by the soda, potash, and iron, which form part of the constituents of felspar and mica, and act as a flux."

He goes on to say—

"In the year 1859 I visited a vitrified fort called *Knochfarrel*, near Strathpeffer in Ross-shire, and came to the conclusion that the vitrification had been done of set purpose, and that the effect had been produced by burning wood. In the first volume of Dr. John Hill Burton's *History of Scotland*, 1866, he expresses a wish that science would explain the manner in which vitrification of forts was effected. Having formed the opinion that the Yorkshire method of vitrification most closely resembled that used by the old fort builders, I wrote to Mr. Burton giving an account of it.

"All the vitrified forts in Scotland are either in the Highlands or in Berwickshire and Galloway, where rocks easily vitrified abound, and but that there are neither vitrified forts nor native Celts in modern Yorkshire, one would almost be tempted to speculate on the act of vitrification having descended there, from an ancient Pictish people of the bronze age, such as are supposed by Dr. Julius Ernest Fordisch to have erected the scorified ramparts of the forts of Bohemia. The vitrification of rocks in Yorkshire I have thought worthy of being recorded, throwing as it does some light on the method employed in the construction of forts in times that seem to us to be prehistoric."¹

¹ In the *Archaeological Journal*, vol. viii, p. 315, there is a notice of Gatacre House in Shropshire, an ancient residence, the material forming the walls being chiefly red sandstone. To these walls a

silicious flux has been applied, forming a *vitrified crust on the stone*, but the stone itself has not been in any way acted upon by heat.

These facts stated by Professor Ramsay, combined with previous and present investigations, appear to me to prove that although there may be many places with vitrified stones which have been used as beacon sites, yet that these ruins of forts in which there is a continuous wall of vitrified stones encompassing a considerable space must have been built by design for a specific purpose, either of defence or refuge, and that the view put forth by their original discoverer, Mr. Williams, and subsequently confirmed by Dr. John Macculloch and Mr. Anderson, was the correct one.¹

¹ My best thanks are due to Mr. Ashley, of Arisaig House, for giving me the opportunity of examining these

interesting forts, and also to Miss Constance Ashley for the able manner in which she assisted me.