

THE RELATION BETWEEN ARCHÆOLOGY, CHRONOLOGY,
AND LAND OSCILLATIONS IN POST-GLACIAL
TIMES; BEING THE OPENING ADDRESS TO THE
ANTIQUARIAN SECTION AT THE LANCASTER
MEETING.¹

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One of the most remarkable features of the Ice Age is the correspondence which runs between the variations of climate and the successive land oscillations which have taken place, in Western Europe, during quaternary times—it being now generally admitted by geologists that the maximum cold in each glacial epoch coincided with the maximum submergence of the land. If the astronomical theory, as propounded by Dr. Croll and modified by Sir Robert Ball, be accepted as the best explanation of these fluctuations in climate, we have to assign to the interval between each of these glacial epochs, at least, 21,000 years. I mean, by the astronomical theory, that which accounts for these glacial and interglacial epochs as the combined effects of the eccentricity of the earth's orbit, and the precession of the equinoxes—a result which, however, may be considerably modified by the distribution of land and water. Sir John Lubbock, in discussing this theory, makes the following remarks:—

“The interval between the times at which perihelion occurs on the same day of the year, is about 21,000 years. At some future day, about 5,000 years hence, the perihelion will occur on the 20th March, and in about 21,000 years it will again be on the 31st December. The aphelion changes of course in the same way, and, consequently, the northern and southern hemispheres alternately enjoy a preponderance of summer. The year 1248 A.D. was that in which the first day of winter corresponded with the passage of the earth into perihelion, and consequently was the period when the balance of summer in favour of the northern hemisphere was greatest. Up to that date the duration of summer was increasing; it is now, and has been for 630 years, gradually diminishing.” (*Prehistoric Times*, p. 414.)

¹ Delivered at Lancaster, July 19th, 1898.

According to these calculations, the last cold epoch would have occurred about 11,000 years ago. Our first object, in attempting to draw a comparison between positive chronology and the results of archæology, is to find some fixed landmark which can be correlated with that event. Let us, therefore, assume, as a probable basis for such an inquiry, that the last cold epoch corresponded with the time when the clays in the Carse of Stirling were deposited—the greatest submergence and cold having occurred when the land sat 50 feet lower in the sea than it does at the present time. This corresponds with Professor Geikie's fifth glacial epoch,¹ which he correlates with the 50-foot sea margin extending along the Scottish shore-lands. The subsequent interglacial epoch he associates with the re-emergence of the land, the retreat of the valley glaciers, and an arborescent growth known as "the upper buried forests." It was during this period, as we shall subsequently see, that neolithic man appeared in Central Scotland, and, although we have no reason to suppose that his immigration dates as far back as the maximum period of cold, we have positive proof that he was resident in the country when the sea washed its shores some 25 or 30 feet higher than it does at the present time. On this hypothesis it will be the special object of this communication to show that there is a striking parallelism between astronomical and archæological deductions: so much so, that, instead of regarding them as useless speculations, we shall be forced to admit them within the category of subjects for legitimate investigation, and, perhaps, finally to accept their conjoint results as valuable data in defining, more accurately than hitherto, the limits and phases of human civilisation.

That subterranean causes are sufficient to alter the relative level of sea and land is patent to everyone who has studied the stratification of the earth's crust; and it seems to me that the elevation of the 25-foot raised beach, in Scotland, was due to some local disturbance of this kind, and not to glacial phenomena, as maintained by Professor Geikie. (*Loc. cit.*, p. 612.) That this movement took place since the locality became inhabited by man is now well established, as will be afterwards shown.

¹ *Great Ice Age*, 3rd edit., p. 612.

But, on the other hand, there is ample evidence to prove that, contemporaneous with this upheaval in Scotland, submergence was going on in other parts of Britain. However inexplicable such land oscillations may be it is capable of demonstration that they are often limited, both in duration and in the areas of their occurrence. In support of these general statements, I submit the following notices of researches which, whatever their correct interpretation may be, bear evidence of having been conducted and recorded by experienced observers.

Changes of Level on the Coast of Lancashire.

The following series of deposits have been recorded by Mr. De Rance, as occurring on the coasts of Cheshire and Lancashire from above downwards (*Quart. Journ. Geolog. Soc.*, Vol. XXVI, p. 657), with which he correlates certain archæological discoveries and well-known historical events.

<i>Deposits.</i>	<i>Archæological Remains.</i>
(1) Sand dunes	Present time to Norman Conquest.
(2) Clays and silts, partly } marine and partly fresh- } water. }	Danes and Saxons.
(3) Peat and forest bed	Romans and Celts.
(4) Clay and silt, like No. 2 } (5) Marine sands. }	Neolithic weapons.
(6) Peat and forest bed	No trace of man.

According to the above statements, Roman and Celtic remains were found in the upper peat (No. 3), which underlies marine deposits. Hence, a post-Roman submergence must have taken place since these peat and forest growths formed the land surface.

Submergence in the South of Sweden.

At the meeting of the International Congress of Pre-historic Archæology (*Compte Rendu*, p. 15), held at Copenhagen in 1869, Dr. N. G. Bruzélius, Director of the College at Ystad, gave a description of some very remarkable discoveries made during the year 1868, while excavations were being made to deepen and widen the

small harbour of Ystad, in the extreme south of Sweden, of which the following is an abstract:—

- (a) Beds of sand and gravel, forming part of the present sea beach, amounting to a depth of over 3 metres.
- (b) At 3 metres below the normal level of the sea, and 5 metres below the bank of the quay, there was a peat bed, composed of the decayed roots of trees and some alluvial clay, to a depth of from 10 to 18 inches. About 100 roots of trees, chiefly oak, of various sizes were discovered, some of the roots being 2 or 3 feet in diameter, and there could be no doubt that they grew *in situ*, as their rootlets ramified deeply into the underlying clays.
- (c) Beneath this peat and forest bed there was an old moraine containing glacial (striated) gravel, and on the surface of it, here and there, were patches of alluvial sands and clays.

In the upper of the layers an extraordinary collection of mediæval relics was found, none of the objects, however, being older than 400 or 500 years. Among them were twenty-three well-built ordinary boats, one of which was laden with tiles; six brass cauldrons (with handles), the largest being 18 inches in diameter; two copper pans and a tin plate, etc.; two primitive guns or arquebuses, 4 feet 6 inches in length, the barrel of one being made of brass, and that of the other of forged iron; eight cannon balls (six of iron and two of stone); two iron hatchets; a stone candle-holder, etc.; and a huge quantity of the bones of domestic and wild animals, chiefly skulls.

Beneath the peat were some alluvial deposits, overlying the old land surface into which the roots of the trees had deeply penetrated, in which a totally different class of relics was found. Among them were a flint flake-knife, 4 inches long, half of a polished flint axe, and a beautifully worked dagger of flint, 8 inches long—all these being about a foot below the peat. An Etruscan club-head of bronze (*massue*) ornamented with prominences, and a beautifully carved knife-handle of bone, terminating

in a dragon's head, were also found, but only slightly below the peat.

As corroborative evidence that the trees grew *in situ*, at a time when the morainic land was above water, it is stated that land shells, *elytra* of insects, a number of fresh-water plants, branches of trees, &c., were found in the peat.

The *tout-ensemble* of the phenomena observed warrants the following inferences:—

That during the Stone and Bronze Ages, and probably as late as the ninth century A.D. (the date assigned to the carved knife-handle), the forest of oaks was still above the sea level; that during the decay of the trees, peat had formed; and that, finally, submergence had taken place some time prior to the early part of the fifteenth century.

These conclusions are more remarkable in face of the well-known fact that Norway and the middle regions of Sweden, as far south as Calmar, are now, and have been for several centuries, undergoing a movement in the opposite direction. (Nilsson, *Loc. cit.*, p. 53.)

The depression at the port of Ystad is not, however, a local phenomenon; for M. Nilsson (*ibid.*, p. 59) has shown that an analogous movement has been going on all along the coast of the extreme south of Sweden. In excavating the harbour of Malmœ, not only was there a submarine peat-bed containing worked flints found, but also a submerged street. In 1749, Linnæus measured the distance between the sea and a large stone called *Stafstén*, near Trelleborg. This same distance M. Nilsson re-measured nearly 100 years later, and found it diminished by about 100 feet. (See also Lyell's *Principles of Geology*, Vol. II, p. 190.) According to Sir J. Lubbock, the middle and northern parts of Denmark have not undergone any material change in the relative level of sea and land since the period of the Kjøkkenmøddings. (*Prehistoric Times*, p. 235.)

Subsidence of the Shores of Brittany since the Stone Age.

On Er-Lanic, a small rocky islet situated close to the island of Gavr' Inis, in the Morbihan Sea, M. de Closma-deuc has discovered (*Bull. de la Soc. Polymathique du*

Morbihan, 1867, p. 18), two cromlechs or stone circles, placed so close to each other as to resemble the figure 8, the peculiarity of which is that only a portion of the upper circle is on dry land, the rest, as well as the whole of the lower circle, being under water—the latter being only visible when the tides are exceptionally low.

On their sites numerous objects characteristic of the Stone Age have been collected—such as pottery, flint implements of all kinds, including axes of fibrolite and diorite, similar to those found in the dolmens of Brittany. “Des centaines de Celtæ, ou haches en pierre, de toute forme, de toute dimension, le plus grand nombre en diorite; très peu en quartz-agate, en fibrolitte, etc; presque tous brisés.” (*Ibid.*, 1882, p. 10.) Since it cannot be supposed that these cromlechs were originally erected under water the land must have sunk, and so permitted the waves to wash over a portion of the island, including that on which these stone monuments were placed.

M. de Closmadeuc has also observed, in confirmation of this opinion, that some of the stones in the celebrated dolmen of Gavr’ Inis, are of a kind of rock which is not found on the island, but at some distance on the mainland. Hence he suggests that, when the dolmen was built, Gavr’ Inis was not really an island but part of the mainland. (*Ibid.*, p. 12.)

There are several other remains of antiquity in the Commune of St. Pierre-a-Quiberon, which clearly show that the sea has greatly encroached upon the land since Neolithic times. Among these may be mentioned the standing stones of St. Pierre, near the village of that name, two dolmens at Port Blanc, and a Celtic cemetery on the Isle of Thinic. (For further particulars and references see *L’Homme*, 1884, pp. 421–424, and *Proc. Soc. Ant. Scot.*, Vol. XIX, p. 198.)

The Abbé Hamard (*Études Critiques d’Archéologie pré-historiques*, p. 37) points out that the subsidence of the coast of Brittany offers the best explanation of the curious description which Cæsar has given of the towns of the Veneti, from which the following passage may be quoted:—

“The sites of their towns were generally such that, being placed on extreme points [of land] and on promontories, they neither had

an approach by land when the tide had rushed in from the main ocean, which always happens twice in the space of twenty four hours, nor by ships, because, upon the tide ebbing again, the ships were likely to be dashed upon the shoals. Thus, by either circumstance, was the storming of their towns rendered difficult; and, if at any time perchance the Veneti, overpowered by the greatness of our works (the sea having been excluded by a mound and large dams, and the latter being made almost equal in height to the walls of the town), had begun to despair of their fortunes; bringing up a large number of ships, of which they had a very great quantity, they carried off all their property and betook themselves to the nearest towns; there they again defended themselves by the same advantages of situation." (Book iii, Chap. xii.)

But there are now no towns or promontories on these shores to which this description can be correctly applied, and hence the supposition that they have partly disappeared below the present sea-level, and partly become the islets and rocks now seen scattered in the adjacent sea.

Traditions and legends of buried towns, as, for example, the submersion of the once opulent city of Is, in the fifth century—the work of Divine vengeance for the iniquity of its inhabitants—are more prevalent in Brittany than anywhere else in Western Europe. (*Barzaz Briez*, by Villemarqué, p. 39.) The ruins of ancient buildings and streets are said to be seen passing under the sea at the village of Troguer, on the desolated shores of the Bay of "Les Trepasses," which covers the supposed site of Is. In the vicinity are also found quantities of Roman bricks and pottery, of the third and fourth centuries. (*Guide Joanne*, p. 567.)

M. Jehan, in his picturesque sketches of Brittany (*La Bretagne*, p. 42), describes several cities which have been destroyed by the advancing sea within historical times. Tolente, the most commercial town of Armorica, and historically known to have been pillaged and destroyed by the Normans, in 875, is now entirely under the sea, and its very site is unknown.

According to the Abbe Hamard (*Loc. cit.*, p. 37), there is an old manuscript, of the eighth or ninth century, preserved in the library of Avranches, in which it is stated that, formerly, there was, in the vicinity of Mont-Saint-Michel, a dense forest, extending six miles from the sea, which harboured all manner of wild beasts. Now the whole district is covered by the sea and sand beds.

From another manuscript, also preserved in the same library, and dating from the end of the fourteenth, or beginning of the fifteenth century, he gives the following extract:—

“ Avant la révélation de l'ange (à Saint Aubert), nous dit-il, le pays environnant était rempli de forêts et de grands arbres, de sorte que, du bourg d'Avranches à Dalet (Aleth), qui tire aujourd'hui, et à juste titre, son nom de Saint-Malo, il n'y avait par mer aucun passage facile ni même possible, tandis que maintenant l'on peut se rendre avec sécurité jusqu'à Poulet (le Clos-Poulet entre Saint-Malo et Châteauneuf).” (*Loc. cit.*, p. 39.)

To show how much the sea has encroached on the land in these parts he reproduces an old map of Cotentin, of the thirteenth century, which shows Mont-Saint-Michel a long way inland, the island of Jersey as united to the Continent, and a corresponding increase of land all along the adjacent shores.

The older land oscillations are also intelligently discussed by the Abbé. Certain marine deposits at the foot of Mont-Dol, investigated by M. Sirodot, have yielded remains of quaternary mammalia, including the reindeer and Irish elk, associated with the industrial relics of man, which M. de Mortillet assigns to the Époque Moustérienne. The upper of these deposits stood 13·10 m. above the present sea level. From these facts we infer that man was an inhabitant of the country when the sea washed the foot of Mont-Dol, that upon the retreat of the sea its exposed bed became overgrown with great forests, and that, after a long interval, the sea again encroached on the land and submerged the forests within early historic times.

Further Evidence of Submergence in Central Europe.

Evidence of submergence of the land has been observed over a large portion of Western Europe. The Zuydersee, once a marsh, seems to be still sinking, as it is said that in recent years vessels of heavier burden than formerly can now sail over it. A tomb of the Stone Age is said to have been found in the midst of a submerged forest of birch at the bottom of the port of Husum, in Schleswig. Remains of submarine forests have also been observed on

the shores of the island of Bornholm, in Pomerania, and in Eastern Prussia.

I need not occupy your time by describing the numerous submerged forests on the shores of England and Ireland. So far as this kind of evidence goes it proves that man inhabited the country when the land stood, some 30 or 40 feet at least, above its present level; and since all the relics hitherto found consist of a few flint knives, and bones of the stag, horse, hog, and *Bos longifrons*, we may safely conclude that the time when these forests flourished was the early Neolithic period. Mr. Ellis found a large quantity of flint flakes and cores, bones, teeth, oyster shells, &c., over a space of only several square yards, as well as mammalian remains, in the submerged forest of Barnstaple, in North Devon. (*International Congress of Prehistoric Archaeology*, p. 89, 1868.)

With regard to the submerged forest on the coast of West Somerset, described by Sir Henry de la Beche and Mr. Godwin-Austen (*Quart. Jour. Geo. Soc.*, 1865), Professor Boyd-Dawkins makes the following remarks:—

“These submerged forests are mere scraps, spared by the waves, of an ancient growth of oak, ash, and yew, extending, in Somersetshire, underneath the peat and alluvium, and joining the great morasses of Glastonbury, Sedgemoor, and Athelney, in which Neolithic implements have been met with by Mr. Stradling. The discovery of flint flakes and an old refuse-heap with mammalian remains, by Mr. Ellis, in the submerged forest of Barnstaple, affords the same kind of evidence that man was living in Devonshire while the land stood considerably higher than it does at the present time. The bones of Celtic short-horn (*Bos longifrons*), stag, sheep, and goat, had evidently been accumulated around the piles before they were in their present position between high and low water mark, since such an accumulation would have been impossible in a spot between tides. In all probability the piles were driven into a peaty morass on the land surface.

“Conclusive proof of submergence within comparatively modern times is brought forward by Mr. Pengelly, in his paper ‘On the Submerged Forest of Torbay.’ The forest consists of a layer of peat, sometimes ten feet thick, which sweeps upwards from low water mark to the higher ground, the sub-aerial portion being covered with three feet of loam. From it have been obtained the stag, hog, horse, and Celtic short-horn, and antlers of stag cut by man. Here, therefore, as well as in North Devon and Somersetshire, man was in possession of the country when the land stretched farther out to sea than at the present time. In this particular case, Mr. Pengelly estimates the submergence to have been not less than forty feet since the forest was alive.” (*Early Man in Britain*, p. 251.)

From these examples of subsidences of wide areas, in comparatively recent times, we pass on to Scotland, where I propose to show that an elevation of the land has taken place since Neolithic man came into the country.

The MacArthur Cave at Oban.

The cave known under this name was discovered in December, 1894, by quarrymen, while removing stones for building purposes from the cliff facing the bay of Oban. In the course of these operations, a cavity was exposed in the rock which proved to be a cave, 25 feet long and from 16 to 20 feet broad. This opening was made near the back of the cave, but its natural entrance, which had been effectually concealed by an old talus of earth and stones was at the other (north) end. Before the discovery came under the notice of the Society of Antiquaries of Scotland, the whole of the roof had been removed by the quarrymen, but as the floor, already ascertained to be an accumulation of relic-bearing *debris*, remained practically undisturbed, it was decided to have it thoroughly excavated. Subsequently, a full report of the investigation was read at a meeting of the Society, 11th March, 1895, by Dr. Joseph Anderson, who superintended the excavations.

The contents of the cave consisted, first, of a layer of black earth in which, besides the bones of various animals, some human remains were found. It is unnecessary to examine the special characters of these human bones as, from their superficial position in the cave, their owners had probably no relationship with the cave-dwellers who left the implements and weapons in the subjacent deposits. The next layers are thus described by Dr. Anderson:—

“ It was found that underneath the layer of black earth there was a bed of shells, varying from 27 inches to about 3 feet in thickness, extending over the whole floor of the cave, and showing little or no intermixture of black earth or gravel, but here and there patches of ashes mixed with wood-charcoal and charred splinters of bone. Under this shell-bed was a bed of fine clean gravel, composed entirely of small water-rolled stones. In this gravel, at a depth of about 18 inches (where the section was first made), there was intercalated a deposit of shells, which we at first spoke of as the lower

shell-bed, but which proved to be of partial extent and unequal thickness, thinning out towards the sides and towards the mouth of the cave, and in several places presenting an irregular or patchy appearance in the section, as if the shells had been deposited in heaps or pockets in the gravel. Underneath this intercalated layer of shells the gravel extended for about 4 feet or more to the cave-bottom, where it was mixed with large and small fragments of loose rock. The whole thickness of the gravel-bed under the upper deposit of shells was thus about 6 feet, including the intercalated lower deposit of shells."

Both the upper and lower shell-beds were composed of the shells of edible species found on the neighbouring shores, and of the bones of land and marine animals, the entire mass being a true refuse heap, evidently the result of a lengthened occupation of the cave by people who fed on the fauna represented in it. The bones were, for the most part, broken into splinters, both for the purpose of extracting the marrow and of manufacturing bone implements, of which a large number was collected.

All the implements recovered were made of bone or deer-horn, with the exception of three hammer-stones, and a few flint flakes.

The bone and horn implements consist of three pins, three borers, and a few bones pointed or flattened at one end, 140 "round-nosed, chisel-ended implements having an extraordinary likeness to each other," and seven harpoons (two being entire) made of deer-horn. The larger of the entire harpoons is six inches long and has four barbs on each side, and a perforation at the butt-end. The other differs from the former only in being smaller ($4\frac{1}{2}$ inches in length), and having no perforation at the butt-end.

The animal remains from the respective deposits were identified by Mr. James Simpson, assistant to Sir William Turner. All the layers included bones of the ox, pig, red deer, roe, badger, and various birds, together with the vertebræ of fish, claws of crabs, shells of patella, solen, whelk, and the ordinary edible molluscs—oyster, cockle, and mussel.

Only in the black earth was the dog represented, and, in the lower shell-bed, bones of the cat and otter were recognised.

The evidence of the fauna conclusively proves that the

chronological horizon to which the Oban Troglodytes must be assigned is the Neolithic period in Scotland.

After careful consideration of the phenomena disclosed by the investigation of this cave, I hold that the layer of clean-washed gravel, which so completely separated the upper and lower shell-beds, was the result of a severe storm, during which the waves dashed into the cave, carrying with them a certain amount of shingle; and that the cave-dwellers, after the abatement of the storm, again resumed occupancy of it.

If this be so, the importance of the discovery at Oban cannot be exaggerated, because it proves that man was an inhabitant of the district when this cave was on the sea-beach sufficiently near the water to permit of the waves to enter it. But the beach of to-day is 100 yards distant, and the lower shell-bed lay fully 30 feet above the present high-water mark. (In addition to Dr. Anderson's report, see *Proc. Soc. Antiq.*, May 21st, 1896.)

Rock-shelter at Oban.

At the beginning of May, 1898, another discovery was made at Oban which yielded similar remains of human industry associated with a refuse-heap of shells and broken bones, precisely analogous to those from the MacArthur cave. This was a rock-shelter at the base of a steep rock overlooking a marsh in which some years ago the remains of a lake-dwelling were found. The area of this shelter was some 10 feet square and the refuse-heap had been covered for ages by a deep talus. It was while clearing away this talus that the shell-heap became exposed. Among the relics were a few stone hammers or polishers, a number of "round-nosed" chisels of bone, and the front portions of two harpoons made of deer-horn, of the same character as those found in the MacArthur cave—differing from them only in having the barbs (three barbs in each case) on one side. M. Piette also records unilateral barbed harpoons from the cave of Mas-d'Azil, in France. Hence the discovery of this variety at Oban only strengthens the remarkable analogy between these relics in the French and Scottish caves, a subject which I have elsewhere discussed at considerable length. (See *Prehistoric Problems*, pp. 60-77.)

*Stag's-horn Implements found along with Skeletons of
Whales in the Carse of Stirling.*

On the 17th September, 1889, Professor Sir William Turner read a paper at the British Association, then held at Newcastle-upon-Tyne, "On implements of Stag's-horn associated with Whales' Skeletons found in the Carse of Stirling." In this paper the author describes a perforated horn implement, shaped like a hammer-axe head, 11 inches in length, and $6\frac{1}{2}$ inches in its greatest girth. It was found in 1877, resting on the skull of the skeleton of a Balænoptera, exposed in the course of drainage operations on the estate of Meiklewood, a few miles west of Stirling. In 1819 and 1824 it is recorded that implements of deer-horn (two of which are described as having been perforated with a round hole about one inch in diameter) were found also associated with whales' skeletons, but they appear to have been lost. (*Wernerian Soc.*, Vol. V.)

Sir William Turner sums up his remarks on these discoveries as follows :

"The discovery of those horn implements proves that, when the fertile land now forming the Carse of Stirling was submerged below the sea level, the surrounding highlands were inhabited by a hardy Caledonian race, who manufactured, from the antlers of the red deer, useful tools and weapons. I have already stated that there is nothing in the form of these implements to lead one to suppose that they could be used in the chase of the whale as lances or harpoons. It is probable that the whales by the side of which they were found had been stranded during the ebb of the tide, and that the people had descended from the adjacent heights, and, with the aid of their chisels of horn, had spoiled the carcase of its load of flesh and blubber. In support of this view I may state that the three skeletons along with which the implements were found were lying in proximity to the edge of the Carse-land, where it approached the adjacent high ground."

Further corroborative evidence of these views has recently been found at the village of Causeway Head, on the south side of the Abbey Craig. While a drain leading from the village to the river Forth was being excavated numerous portions of the skeleton of a whale were dug up, and along with them a pike-like implement made of a stag's horn, and a portion of a whale rib, both of which bear certain markings which have been pronounced by

competent authorities to be due to man's hand. (See Mr. D. B. Morris, in *Stirling Nat. Hist. and Arch. Soc.*, 16th November, 1897.)

Canoes found in Raised Beaches.

The finding of canoes in the Carse lands of the Forth is well authenticated. Sir John Clerk, in *Reliquiæ Galeanæ* (*Bib. Top. Brit.*, No. II, p. 241), informs his correspondent that a "very ancient curiosity" was found in the Carse of Falkirk, in the month of May, 1726. "The washings of the river Caron discovered a boat, 13 or 14 feet under ground; it is 36 feet in length and $4\frac{1}{2}$ feet in breadth, all of one piece of oak. There were several strata above it, such as loam, clay, shells, moss, sand and gravel: these strata demonstrate it to have been an antediluvian boat. The tree of which it was made was, no doubt, very big, but still no bigger than one which is yet alive not far from that place, which is about 12 or 13 feet in diameter." To this he adds a cutting from a contemporary newspaper, in which the boat is described as finely polished and having a pointed stem and a square stern. At a later period another writer mentions that a canoe was found near Falkirk, 5 fathoms deep in the clay, and that anchors were dug up in the ground between Alloa and Stirling, which he instances as a proof that these lands were formerly under sea. (*Beauties of Scotland*, Vol. III, p. 419.)

Professor James Geikie records the discovery of a canoe in a brick-clay pit at Friarton, Perth, underneath 10 or 11 feet of clay. It measured 15 feet in length, $3\frac{1}{2}$ feet in breadth, and 3 feet in depth. This clay, according to the Professor, belongs to the second series of terraces in the Carse lands of the Tay Valley, rising from 25 to 40 feet above the mean tide mark. (*Scottish Naturalist*, Vol. V, p. 167.)

Some twenty-five canoes have been recorded from time to time as being found imbedded in the basin of the estuary of the Clyde, some of them over 20 feet above present high-water mark, and deeply buried in the estuary deposits. Two of these boats contained stone celts. (See Appendix to Smith's *Newer Pliocene Geology*, 1862; Wilson's *Pre-*

historic Annals of Scotland; Proc. Glasgow Arch. Soc., Vol. II, pp. 77 and 121; and Chambers' *Ancient Sea-Margins*, p. 206, *et seq.*)

Another locality which has yielded evidence of the same nature is Lochar Moss, in Dumfriesshire, long utilized as a storehouse of fuel for the neighbouring inhabitants. It extends to the Solway, with a fall of about 30 feet, over an area of 12 miles in length and, in some places, 3 miles in breadth.

The Rev. James Lawrie (Sinclair's *Statistical Account*, Vol. I, p. 160) thus describes the opinion current about this moss at the end of last century:—

“There is a tradition, universally credited, that the tide flowed up this whole tract above the highest bridge in the neighbourhood. In the bottom of the moss sea mud is found, and the banks are evidently composed of sea sand. A few years ago, a canoe of considerable size, and in perfect preservation, was found by a person when cutting peats, 4 or 5 feet below the surface, about 4 miles above the present flood-mark; but it was destroyed before any antiquarian had heard of it. Near the same part of the moss, and about the same depth, a gentleman found a vessel of mixed metal containing about an English quart. . . . Antiquities of various kinds are found in every part of this moss where peats are dug, even near its head, such as anchors, oars, &c., so that there is no doubt of its having been navigable near a mile above the highest bridge, and fully 12 miles above the present flood-mark. Near the manse there is a narrow gut, between two sandy hillocks, called *Collyweat*, supposed to be a corruption of Collin's boat, where it is thought there was a ferry, which indeed would be very necessary, on the supposition of the tide flowing there.”

Pennant (*Tour*. Vol. II, p. 107), in 1782, also describes the finding of two canoes in Lochar Moss, one near a place called Kilblain.

Sir Arthur Mitchell (*Proc. Soc. Ant. Scot.*, Vol. V, pp. 20–29) has put on record some very interesting observations on the ancient forest of Cree, in Galloway. According to him the Mosses of Cree, Carsegown, and Borrow, cannot cover less than 1,500 to 2,000 acres, and average 7 to 8 feet in depth. The peat lies immediately over the clay, the line of separation being sharply defined. But I cannot do better than quote Sir Arthur's own words:—

“These trees, which, so far as I know, are all oak, are found in two distinct positions—first, in the channel of the Cree, or projecting into its channel from the banks at the side, many of these last having

10 to 15 feet of sandy clay above those parts of them which are on the bank and an unknown number of feet of clay below; and secondly, under the peat, on the surface of the clay.

“The existence of this ancient Cree forest does not rest on our finding some half-dozen trunks. You may count them by the hundred, exposed in the bed of the river, between Newton-Stewart and Barsalloch; and you may reckon roots by the score where the moss has been cleared away near the mouth of Lime Burn.”

The trees are described as of great size, and specimens measuring 15 feet in girth and 50 feet in length are not uncommon. The objects which were found with them, or “in such positions as lead to the possible conclusion that they are coeval with the trees,” are the following:—Two canoes, a quern, a Roman battle-axe, a couple of stone celts, and one bronze celt, together with horns of deer and several heads of the extinct Urus. A great deer-horn was found under 12 feet of clay along with “some human bones said to have been of great dimensions.” Unfortunately the precise localities where the heads of the Urus were found, whether in the clay or in or beneath the moss, are not given. In commenting on these discoveries, Sir Arthur makes the following remarks:—

“It thus appears that very interesting remains are found in close association with the vestiges of this forest. The country appears to have been peopled when these trees were living. On the margins of this forest man paddled in his canoe, and under the shade of these mighty trees he pursued the red deer and the Urus. He cultivated corn in the neighbourhood, and ground it. He was of goodly stature, and carried formidable weapons of war. These things, at least, are possible, if not probable inferences from the facts I have detailed.”

Other Relics of Man associated with Raised Beaches.

In 1883, I contributed to the *Collections of the Ayr and Galloway Archæological Association* (Vol. IV., p. 1), “Notes on the discovery of five bronze celts of an early type, bound together with a bronze wire, in an excavation near the shore of a small bay on the Ayrshire coast.” They appear to have been concealed in a crevice in a rock, the opening to which had been subsequently covered over by sea gravel. At the present time the sea is 100 yards distant from this spot, and the high-water mark is 25 feet lower.

Mr. Alexander Gray (*Proc. Soc. Ant. Scot.*, Vol. XXVIII, p. 263) describes, in the town of Campbeltown, in Argyllshire, refuse of a flint factory some 30 feet above present sea level, and above which were deposited several layers of beach shingle.

I believe that further important information bearing on this point would be forthcoming were a careful inspection made of the flint-bearing sand dunes on our coasts. I am informed by experienced collectors that relics of Neolithic types are never found at, or near, the present sea level, but always considerably above it and sometimes at long distances from the sea, especially where the shore is flat. This is quite in accordance with the little practical experience I have gained by a few visits to the sand dunes at Irvine, in Ayrshire, and Glenluce, in Wigtownshire.

On the north coast of Ireland, along the shore of Belfast Lough, especially at Larne and Island Magee, there are raised beaches some 20 or 25 feet above the present level of the sea, probably corresponding to the 25-foot beach on the opposite coast of Scotland, in which an abundance of worked flints has been found.

Land Oscillations and Chronology.

From the above rapid survey of the phenomena of land oscillations which, were it necessary, could be elaborated to a much greater length, the two following important generalisations are brought out:—(1) Along a line passing from the north of Ireland through Central Scotland and Sweden, the land has risen during the Neolithic period; and (2) in the south of England, the extreme south of Sweden, the southern shores of the Baltic, and on through Central Europe to the coasts of Brittany, the land has been gradually sinking during that same period. Hence these later land oscillations must be assigned not to astronomical but rather to local causes inherent in the crust of the earth. Possibly the weight of the ice itself might have had something to do with depressions during the glacial periods, and, when its accumulation was extensive, there can be no doubt that it would be sufficient to sensibly alter the centre of gravity of the globe, and so cause the water, which

is a pliant medium for precise adjustment of this kind, to rise higher in the glacial regions.

Reverting now to the supposition that the last two cold epochs took place 32,000 and 11,000 years ago, it becomes an attractive problem to seek out some well-defined group of archæological phenomena which can be correlated with these dates. If two such points of coincidence could be fixed in the chronological scale, the subsequent phases of civilisation would be approximately adjusted. It is manifest that it is to the fauna of the period that we must look for guidance in such an investigation. Now the reindeer is, *par excellence*, an animal that has always been associated with a sub-Arctic climate, and it was so abundant at one time in Central Europe, that, in the writings of Lartet, Christy, Dupont and other palæontologists, it has given the name "Reindeer period" to the time when the caves and rock-shelters of France, Switzerland, and Belgium were inhabited by man. The disappearance of the reindeer from these regions is doubtless coincident with the subsequent amelioration of climate and the advent of arborescent growths, although it lingered in isolated localities, such as the north of Scotland, to a much later period. Hence the conclusion seems to me inevitable that the reindeer period was coincident with the last sub-Arctic climate which prevailed in Western Europe. And this view harmonizes with the evidence of recent archæological discoveries which tend to bridge over the so-called "hiatus" between Palæolithic and Neolithic times, by showing that men inhabited at least some portions of Europe during both periods without any break of continuity.

On two occasions, within the last few years, I have taken the opportunity of directing attention to various facts which seemed to me valid evidence in support of this view. In 1895 (*Rambles and Studies in Bosnia, Herzegovina and Dalmatia*, pp. 305-16), I discussed the "hiatus" problem in its more general aspect, in connection with some remarkable discoveries made shortly before in Bosnia, and maintained that there was no evidence against "the idea that the Quaternary men of Europe survived till the arrival of these Neolithic immigrants." Again, in 1897 (*Prehistoric Problems*, pp. 60-81), I

continued the discussion of this subject more in detail, bringing forward, as arguments in favour of my views, the results of discoveries made in the rock-shelter of Mas-d'Azil (Ariège), the cave of Reilhac (Causses du Lot), the cave of Kesslerloch, near Schaffhausen, the Balzi Rossi caves, near Mentone, the MacArthur cave at Oban, the Victoria cave at Settle, &c. To-day, though entirely in an incidental manner, the facts which I am about to lay before you will, in my opinion, give the *coup de grâce* to this *quaestio vexata*, by showing that there is no chronological interval between Palæolithic and Neolithic man, at least, in one portion of Central Europe. These facts are based on the results of the exploration of the rock-shelter of Schweizersbild, recently published by Dr. Nüesch of Schaffhausen, which, for completeness and accuracy of details, I consider one of the most valuable contributions that has ever been made to the science of archæology.

Schweizersbild Rock-shelter.

The Schweizersbild is situated in a small valley of the same name, about 2 miles north of Schaffhausen and within 4 miles of the famous Kesslerloch, a cave of the "reindeer period," explored by Mr. C. Merk in 1874. The special features which induced man to take up his abode in this locality were due to the protection afforded by an isolated lime-stone rock which protrudes through the meadow land. It rises to the height, at its highest point, of 16 m. and presents an abrupt face looking southwards. At the present time this rocky wall is only slightly overhanging, but, owing to long-continued disintegration, this feature is probably less striking than it was in earlier times. Roughly speaking it is a concave hollow, approximating along its base to a semi-ellipse, the major axis of which measures 36 m. and the greatest distance of the rock from this line is 12·5 m. The semi-elliptical area thus defined covers 207 square mètres, and the gradual accumulation of *debris* over its floor, partly from the disintegration of the overhanging rocks, and partly from vegetable mould and other sub-aerial causes, had raised

its surface to 2·5 m. above the surrounding plain. Dr. Nüesch informs us that during the day the heat within a few yards of the wall was almost unendurable, on account of the reflection of the sun's rays from the surface of the limestone rock; and hence he inferred that the shelter would remain free from snow in the winter time. Its elevation above the sea is 472 m., and as it occupies the water-shed of the valley, it was not subject to flooding. These topographical and natural advantages rendered the rock-shelter of Schweizersbild a common rendezvous to the hunters of all ages. The discovery of this fact by Dr. Nüesch in 1891 induced him to have it thoroughly and systematically explored.

Although these explorations were finished in 1893, it was not till last year that the final results were given to the world, the delay having arisen partly from the vast amount of material to be examined, and partly owing to the severe illness of the author. The work now published is enhanced by the fact that all the relics collected have been examined and reported on by specialists. Besides the explorer's description of the archæological discoveries, the work contains articles by ten other contributors, the whole forming Vol. XXXV. of the *Neue Denkschriften der allgemeinen schweizerischen Gesellschaft für die gesammten Naturwissenschaften*.

The names of Professors Th. Studer, A. Nehring and J. Kollmann, who have between them exhaustively treated of the fauna, are a sufficient guarantee that we have here set before us the most trustworthy results that modern science can produce.

Professor Nehring, who has made a special study of the characteristic fauna of the Arctic and sub-Arctic regions under the names of Tundra and Steppe fauna, finds that a corresponding series of animals formerly existed in the regions around Schweizersbild, both of which were superseded by a forest fauna, thus indicating that a gradual change from an Arctic climate and fauna to those of the present day has taken place since man appeared in the district—a transformation which is fully borne out by the stratigraphical arrangement and contents of the deposits. Accordingly we find the deposits which yielded these different remains characterised as Tundra, Steppe, Forest,

and Domestic fauna, as illustrated by the following tabular statement :—

Deposits.	Depth in c.m.	Age in years.	Characteristic fauna.
(1) Humus-bed	40-50	4,000	Domestic fauna. Iron and Bronze Ages.
(2) Grey relic-bed	40	4,000	Forest and lake-dwelling fauna of the Neolithic period.
(3) Breccia-bed. This deposit had a thin layer of dark earth some 10 c.m. thick about its middle, called upper Rodent-bed.	80-120	12,000	Forest fauna: transition from the previous. (<i>Steppen fauna</i> .)
(4) Yellow relic-bed.. ..	30	3,000	Sub-Arctic fauna. (<i>Steppen fauna</i>).
(5) Lower Rodent-bed	50	5,000	Arctic fauna. (<i>Tundra fauna</i>).
(6) Gravel-bed (glacial deposits) ..	150+	..	No relics.

The following notes may serve to give some general idea of the industrial remains of man found in these deposits, as well as of a few of the fauna associated with them; but I must at once say that they are utterly inadequate to convey to your minds the great ability and fulness with which all the details have been worked out in support of the important deductions founded on them.

The lowest stratum, according to Professor Penck, is a fluvial deposit of the last glacial epoch in Switzerland, formed just as the ice was finally retreating from the valley. It was dug into to the depth of 1.5 m. without reaching the bottom, but, as it contained no human relics, it is here of no special importance beyond determining its geological character. Subsequently, when the locality became dry, man frequented the rock-shelter, and the *Lower Rodent-bed*, No. 5, began to accumulate.

This layer was composed of yellowish earth, mixed with fragments of limestone from the overhanging rocks. Throughout its whole depth, but sparsely scattered, were found various implements of flint and worked objects of

bone and horn, such as needles, harpoons, awls, chisels, &c., all of which were recognised as characteristic specimens of the "reindeer period." It may also be noted that all the mammalian bones were broken for their marrow. Burnt bones were rare, and only one fireplace with ashes was encountered, so that, upon the whole, it appeared to have been only occasionally visited by man.

The chief interest of the layer, however, centred on its organic contents. The characteristic fauna of the Tundra, according to Professor Nehring, are the following:—Band-lemming, Obi lemming, Arctic fox, mountain hare, reindeer, and musk-ox. With these are frequently associated a number of animals of more or less migratory habits such as northern vole, water-rat, glutton, ermine, little weasel, wolf, fox and bear. Now the extraordinary fact is brought out that of these fourteen species only the Obi lemming and the musk-ox are unrepresented in the Lower Rodent Bed of the Schweizersbild. The latter was, however, found in Kesslerloch cave in the vicinity. It appears that the banded lemming (*Myodes torquatus*) and the Arctic fox are the two most persistent animals of the Tundra fauna, and their presence in the rock-shelter is alone sufficient proof that the climate of the period was of an Arctic character. In the upper portion of this deposit relics of new animals began to appear, indicating a change to a sub-Arctic climate. But these found their highest development in the next succeeding layer, viz., the *Yellow Relic Bed*, No. 4.

The colour of this deposit was due to a mixture of yellow loam, a large number of yellow-stained bones, and some stones reddened with the action of fire. It lay immediately over the rodent-bed, but in some places, where the latter was absent, it rested on the glacial gravel-bed. Evidence of man's presence was now greatly multiplied. Anvils, half buried in flint chips, wasted flint implements, hearths and stones, cracked and reddened by the action of fire, layers of ashes, broken bones, bits of charred wood, pieces of worked and unworked lignite, a large number of implements made of bone, horn, and flint, together with some specimens of the characteristic art of the reindeer hunters, are the salient features of this relic bed. A somewhat rare piece of art is a stone tablet having the

outlines of a wild ass and of a reindeer incised upon it. To show how Dr. Nüesch manipulates his statistics we may quote the following items:—14,000 worked flints, 180 fragments of bone needles, 41 reindeer whistles, 42 pierced ornaments, made of shells and teeth of the Arctic fox and glutton, etc. The whole collection of relics from this layer is typical of the latest phase of Palæolithic civilisation, such as has been found in the reindeer caves of the Dordogne.

The fauna has undergone a considerable change by the disappearance of some animals, such as the banded lemming and a number of others; while, on the other hand, new ones have taken their place, all of which changes, according to the above eminent authorities, indicate a sub-Arctic climate.

The next layer is the *Breccia-bed* No. 3. which contains, about its middle, the upper Rodent-bed. During this period there is a gradual transition to a forest fauna, the various species of which appear to be of a somewhat mixed character. The climate has become mild and damp and more favourable to arborescent growth. Man's presence was indicated by ashes, worked flints, split bones, but no implements of bone or horn were found in this layer. Dr. Nüesch thinks that only small groups of reindeer hunters occasionally visited the shelter during this period.

In the next layer (*Grey relic-bed* No. 2) we are among the remains of Neolithic civilisation, attested not only by an assortment of characteristic objects, but also by the fact that the rock-shelter now became a cemetery and contained no less than twenty-two interments. The graves were dug into the underlying Palæolithic deposits. Ten of them contained the remains of children. The fourteen adult skeletons, reported on by Professor Kollmann, show that they belonged to two distinct races, one being of fair size, 1,600 mm. (5 feet 3 inches) and more, and the other much smaller—in fact, a race of pigmies.

Dr. Nüesch thinks that the rock-shelter was then no longer inhabited by man, but only visited by him for the purpose of burying, or perhaps cremating the dead—an idea suggested by the large quantity of ashes it contained. The reindeer was now scarce in the district, and its place

was taken by the red deer. It was a true forest fauna, of which the following were represented in the Schweizersbild: Brown bear, badger, marten, wolf, fox, wild cat, mole, hare, beaver, squirrel, Hamster, water-rat, Urus, *Bos longifrons*, goat, sheep, stag, roe, reindeer, wild boar, horse, and ptarmigan. Among these, the newcomers were badger, wild cat, hare, Urus, *Bos longifrons*, goat, and sheep; while of those animals which were represented in Palæolithic times the following are wanting: Manul cat, Arctic fox, ermine, weasel, glutton, spider musk-shrew, field vole, red suslik, pica, Alpine hare, bison, ibex, maral deer, wild ass, and all the birds with the exception of ptarmigan. In short, the Steppe fauna had in its turn given way to a forest fauna, and, synchronous with these changes, Palæolithic man and the reindeer gradually vanished from the district. Dr. Nüesch, with the assistance of his collaborateurs in this great work, has clearly demonstrated that Tundra, Steppe, Forest, and Domestic Fauna have succeeded each other in chronological sequence in North Switzerland.

I do not regard the chronological deductions founded on the investigations at the Schweizersbild as *data* on which absolute reliance can be placed, as from the very nature of the subject precision is unattainable. This Dr. Nüesch fully admits, and, indeed, he himself has advanced several considerations which might considerably reduce his highest estimate (29,000 years) of the time since man began to frequent the neighbourhood—as, for example, that conclusive evidence of the presence of man in the lower Rodent-bed was not found till near its middle. But, after all allowances for possible errors are made, he thinks the date of man's first appearance in the district cannot be less than 20,000 years ago. One thing, however, is certain, as the explorer pertinently remarks, that *hundreds of thousands of years* cannot have elapsed since the Reindeer period and its civilisation flourished at the Schweizersbild.

How far this order of climatic and organic changes can be correlated with analogous changes in Britain can only be dimly outlined. At the beginning of the transformation scene which followed the gradual retreat of the glaciers, clays, sands, and gravel would be washed into

all the hollows left on the surface of the *moraine profonde*, but as the ice vanished the streams would be less muddy. Clear water, fed by calcareous streams, were the most favourable conditions for the development of the great beds of shell-marl which form the basis of the peat in nearly all the lake-basins of Western Europe. To this period can be assigned the first great forest growths of pines and oaks which spread over the uplands of Scotland. Then come the peat-bogs which may be correlated with the 50-foot submergence of the land in Scotland.

The third and last glacial period in Switzerland would appear to correspond with that which occurred in Scotland when the land was submerged to the 100-foot level. (Geikie's *Fourth Glacial Epoch*.) According to astronomical *data*, the maximum amount of cold would be reached 32,000 years ago; but as it is probable that, in all these successively recurrent cold and warm epochs, the full effect of their respective climatic changes would only be experienced some centuries later, for the same reason that, in the succession of the seasons, the greatest cold of winter, and the greatest warmth of summer, are not felt in December and June, but a month or six weeks later. We may therefore assume that the subsequent amelioration of climate in Western Europe would begin some 30,000 years ago. How many centuries rolled by before the country around the Schweizersbild was in a condition to afford sport, as well as the means of livelihood, to the reindeer hunters we can only conjecture. From Dr. Nüesch's calculations it would be not more than 29,000 years, and not less than 20,000 years ago—say 24,000 years—a date which synchronises with the astronomical calculations to marvellous nicety.

The gradual amelioration of the climate would continue, on the astronomical basis, for 10,500 years, during which the country would pass through the climatic conditions that would permit of a Tundra and a Steppe fauna. Towards the close of this period, in obedience to the climatic and meteorological environments, great forests and a luxurious vegetation would spring up and cover the surface of the land. That transformation would bring us well on into the period of his Breccia-bed in

the Schweizersbild, a date which, according to both methods of calculation, would be 18,000 or 19,000 years ago. Similar arborescent growths had spread over the British Isles which, by this time, had risen from an insular condition to be part of the Continent. Meantime, not only had the Tundra fauna given place to the Steppe fauna, but this latter had now to struggle with a new set of animals which the forest growths had attracted hither, or perhaps called into existence. This was a period of transition and of long duration; in the Schweizersbild it is represented by the Breccia-bed, which, according to Dr. Nüesch, covers a period of 12,000 years.

But now another astronomical cycle had come round, bringing with it a second cold period as well as a re-submergence of Britain to the extent of 50 feet in Scotland. The corresponding climate, however, even at its maximum, was by no means of Arctic severity. Although cold, damp, and foggy, it did not greatly modify the conditions of life of the forest fauna. The flora of this period, however, underwent considerable modifications, especially in the direction of developing peat-bogs and marsh plants. This condition of the environments culminated in the destruction of arborescent growths on the higher lands—but still admitting of forests in the lower districts—and a partial recrudescence of glaciers in the mountain valleys of Scotland. The maximum effect of this reversion to a cold period would be experienced about 10,000 years ago. 2,000 years later we find a new civilisation had supplanted Palæolithic man and the reindeer at the Schweizersbild, both of which had apparently vanished from the district. If Neolithic man appeared in northern Switzerland 8,000 years ago, as Dr. Nüesch's calculations indicate, we may suppose that he was an occupant in southern lands long before this. At any rate, previous to this date the country was inhabited by a people who cannot be regarded as typical representatives of either the old or the new Stone Age men. In regard to this transition period we have much yet to learn of the character and civilisation of the people before the *hiatus*, which undoubtedly exists between the two civilisations, can be fully explained. One thing, however, which appears to be demonstrated

by Dr. Nüesch's investigations is that Man was a continuous occupant of North Switzerland since the days of the reindeer hunters to the present time.

We have no means at present, as far as I know, of dating the first appearance of Neolithic man in Britain. We have noted the remains of his handiworks in the submerged forest at Barnstaple, and other localities in the south of England, and in the raised beaches of Stirling and Oban. But, although it is very probable that it was the same land oscillation that depressed the one and elevated the other, we cannot identify this earth movement with any other physical event which can be dated. All we can venture to say is that in Scotland this movement was subsequent to the appearance of man in the district, but prior to the Roman occupation of Britain.