

2. *On some RECENT DISCOVERIES in the SUBMERGED FOREST of TORBAY.* By D. PIDGEON, Esq., F.G.S. (Read November 5, 1884.)

AMONG the numerous examples of submerged forests which occur at intervals all round the English coast, there is none, perhaps, better known than that of Torbay. This has been described by De la Beche, Godwin-Austen, and many other geologists, but more particularly by Pengelly, who has given considerable attention to it and speaks \* of it as follows:—

“Considerable accumulations of vegetable matter, with stumps and roots of trees, firmly fixed in bluish clay, and evidently the remains of a forest which once grew on the spot, exist in all the inlets of Torbay. The most important and best known is that which, at very low water, is more or less exposed at Torre-Abbey sands . . . . the greater part of which is commonly concealed by sand and shingle, but is occasionally laid bare by a heavy sea. In these and similar deposits of Goodrington and Broad Sands have been found the bones of various animals, among which are the red deer, the wild hog, the horse, the long-fronted ox, and the mammoth, the last, if not the last two, being certainly extinct.”

The character of the evidence in favour of the mammoth having roamed the submerged forest of Torbay is well known. Many years ago some Brixham fishermen trawled a tooth of *Elephas primigenius* (which is now in the Museum of the Torquay Natural History Society) near the entrance of the bay, and neither Dr. Falconer, who identified it, Sir Charles Lyell, Mr. Godwin-Austen, nor Mr. Pengelly, who closely examined it, had any doubt that this molar is a true forest-fossil, which was torn by the trawl out of a submarine extension of the forest.

“It is probable therefore,” continues Mr. Pengelly, “that the remains of the ancient forest occupy the greater part of the Torbay area. Nor is this merely a modern opinion, since Leland, in his ‘Itinerary,’ says ‘Fisschar men hath divers tymes, taken up with theyr nettes yn *Torrebay* Musons of hartes, whereby men judge that yn tymes paste it hath been forest grounde.’”

From all which considerations, the author in question concludes:—

1. That the country must have been at least forty feet higher during the forest-era than at the present time; the depth of water in which the mammoth’s molar was dislodged being from five to six fathoms.

2. That, subsequently to the forest-era, there was a general subsidence to the amount of forty, and perhaps of many more feet.

3. That the forest was of sufficient antiquity to have sheltered the mammoth and long-fronted ox.

\* Trans. Dev. Assoc. vol. i. pt. iv. p. 30.

4. That the successive changes of level were, at least, tolerably uniform and were effected gradually.

The relics of man hitherto discovered in the submerged forest of Torbay are very few. They consist of two horns of red deer, found by Mr. Ardley in 1852, which exhibit undoubted marks of human workmanship, and of a single flint implement found by Mr. Watson, on Torre-Abbey sands, in 1883 \*. Both of these finds have been fully described by Mr. Pengelly, and they sufficiently demonstrate that man must have witnessed that submergence of the forest area for which this author contends, while at the same time they raise the interesting question whether this submergence took place since or before the period of authentic history.

It has been considered a sufficient answer to say that Dr. Barham of Truro, in a paper read in 1825 †, has fully established the identity of St. Michael's Mount, near Penzance, with the Ictis of Diodorus Siculus, who, writing in the year 9 B.C., or nearly 2000 years ago, assigns to this island exactly the same level relatively to the sea as that which it has to-day. "Ictis" ‡, says Diodorus, "is left dry at low tides, at which times the inhabitants of Belerium, or Cornwall, transport thither, in carts, the tin which they produce on shore. Here the traders buy it from the natives and carry it to Gaul, over which it travels on horseback to the mouths of the Rhine."

Further reasons for believing in the persistence of the existing coast-levels through long periods of time are to be found in the fact that an embankment of Roman, if not of pre-Roman, age, situated in the Wash, stands upon the same horizon with a similar structure which has been built in its neighbourhood during modern times; while all the early English chroniclers, from Bede downwards, take their stand, so to speak, on the present levels of the country.

Mr. Pengelly's latest expression of opinion with regard to the age of the submerged forest of Torbay is as follows §:—

"It seems highly probable that the era of the forest growth was of great duration, extending from times before the extermination of the mammoth in Devon down to the introduction of the sheep and the goat. Be this as it may, while there are reasons for believing that the forests under consideration are more recent than the deposits which in the neighbouring [Kent's Hole and Brixham] caverns have yielded palæolithic tools interosculating with relics of several extinct mammalian species, there seems no reason, on the other hand, for doubting that they extend back to palæolithic times in Devonshire."

Such being the conclusions of the distinguished geologist who is, perhaps, better acquainted than any other investigator with the submerged forest of Torbay, attention will this evening be drawn to certain facts which seem to indicate that, while some of the so-called peat-beds of the forest are not older than Roman times,

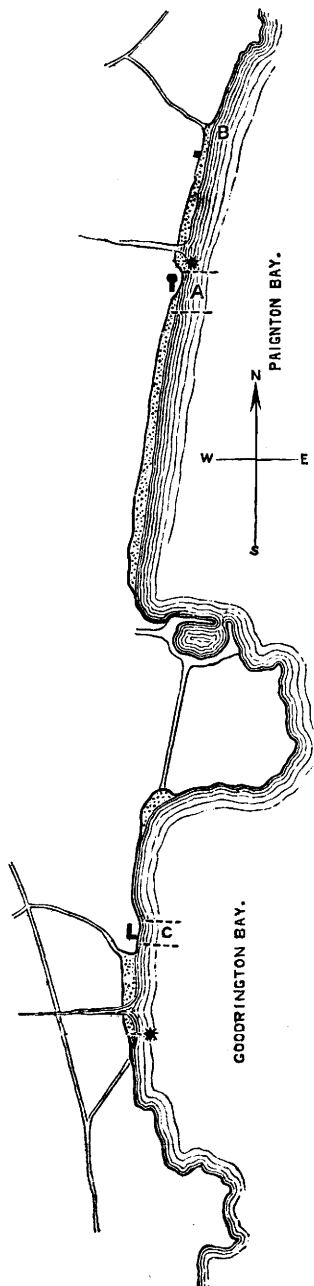
\* Trans. Dev. Assoc. vol. i. pt. iv. p. 36, and *ibid.* vol. xv. p. 137.

† Trans. Roy. Geol. Soc. of Cornwall, vol. iii. p. 86.

‡ Astronomy of the Ancients, p. 452.

§ Trans. Dev. Assoc. vol. xv. p. 138.

Fig. 1.—*Map of Paignton and Goodrington Bays.* (Scale 3 inches to 1 mile.)



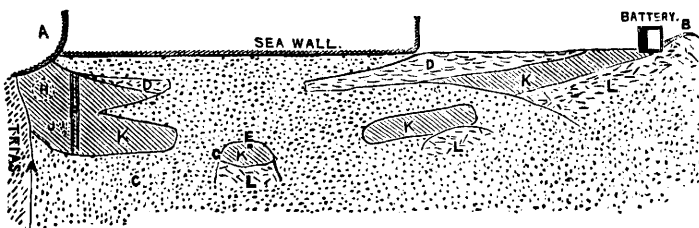
The stars indicate the spots where the finds have been made.

the clays in which the forest is rooted are either coeval with, or younger than, the bronze age in Britain.

The map, fig. 1, exhibits that part of Torbay which is occupied by Goodrington, Paignton, and Preston Sands, upon the first and last of which the finds which are about to be described were made. Referring, in the first place, to Preston Sands, these fringe a flat marshy valley, which, excavated in Triassic sandstones and conglomerates, and falling seaward with an extremely gentle slope, extends from Redcliffe Towers at A to Preston Lane at B (fig. 1).

The gales of December 1883 and February 1884 stripped nearly all the shingle off the upper half of the tidal strand between these two points, A & B, exposing the outcrops shown upon the plan, fig. 2. The forest-clay, K, was then seen to extend in a continuous

Fig. 2.—*Plan of Outcrops observed on Preston Sands (A to B on fig. 1), December 1883 to February 1884. (Scale 340 feet to 1 inch.)*



sheet of no great thickness from Redcliffe Towers to Preston Lane, while its seaward edge, instead of extending beyond low-water mark, as in the neighbouring inlets of Goodrington, Torre Abbey, Paignton, and Broad Sands, has been truncated by the action of the sea and is now confined to the limits shown upon the plan.

Inland the clay bed forms a flat basin, whose northern lip, rising with the flank of the valley, thins out to nothing at B, about seven feet above high-water mark, while its southern lip has been denuded, together with the Trias rock upon which it rests, to the level of the sea. Of the inland lip of this basin more hereafter.

The clay reposes directly upon the Trias at A (figs. 1 & 2), while, further north, it lies upon a somewhat remarkable breccia or "head" (L, fig. 2), which caps the Trias conformably from about the point C for a considerable distance northwards of Preston Lane. This breccia, which, together with the forest-clay underlying Preston Sands, has been minutely described by Mr. Pengelly\*, consists of unstratified, angular, and loosely aggregated stones, packed, without order or arrangement, in a clayey matrix. The stones have nearly all been derived from a neighbouring hill of Devonian sandstone, whence

\* Trans. Dev. Assoc. for 1878.

they have travelled to their present position along slopes which are, for the most part, so slight that it is difficult to suppose existing natural agencies to have been concerned in their transportation.

This breccia is, in all probability, an example of those deposits which, going by the name of "head" in the west of England, attain a great development in the maritime districts of Southern England and Northern France, and which Sir A. Ramsay and Prof. James Geikie have considered to be the equivalents of true glacial deposits, such as the till, but formed in districts which were not covered by the continental ice-sheets.

That the clay bed, which thus rests either upon the Trias rock or the breccia which caps it, forms the soil in which a portion of the submerged forest of Torbay is rooted, there is no sort of doubt. It is crowded with roots of all sizes; while here and there, the trunks of trees, whose roots branch through the clay in all directions, still stand erect and show themselves above the surface of the shingle whenever this is thinly strewn over the tidal strand. It is further covered, as shown on the map, with a mass of so-called peat, D (fig. 2), which is nearly three feet thick in some places.

Towards the end of December 1883, the sea exposed the area of clay and underlying "head" shown at E, fig. 2. E itself represents the trunk of a large tree about whose roots, which were partially denuded, the clay was several feet thick, and whence it thinned away to a feather-edge where it met the "head." Here, resting immediately upon the breccia at G, two pavement-like aggregations of stones were observed, each about two feet across, and of irregular outline, but both presenting the appearance of having once been united. These quasi floor-fragments consisted of well-rolled beach stones, the counterparts of certain trap pebbles, derived from the Trias, and very numerous on the present beach, but differing totally in character from the angular Devonian stones in the "head" on which they lay. That these were no heaps of pebbles shot down from a cart for some purpose, during a previous exposure of the breccia, as might well have seemed the case, was clear from the fact of their being everywhere interpenetrated by fibrils of the forest roots. A close examination revealed the curious fact that these trap pebbles were all cracked and traversed in every direction by minute fissures, so that the stones, usually difficult to break, even with a heavy hammer, could be pulled apart by hand. The fractures were of such a kind as forcibly to suggest that the stones had been heated; and some trap pebbles from the beach, upon being placed in the fire, soon exhibited similar fissures, and became cracked in exactly the same way as those forming the heaps in question. The interstices of the hearth, as the structure now began to be considered, were crowded with fragments of charcoal, easily distinguishable from the dark-coloured and decomposed vegetable matter furnished by the adherent rootlets.

But if the seeming floor were really a hearth, the question at once arose—Why should its builders have gone afield for materials when there was plenty of Devonian sandstones ready to hand in the

"head"? Why did they not light their fires upon it? On trial, however, it was found that such fragments of Devonian rock as the breccia contains fly to pieces with great violence on being heated, and were therefore quite unfit for the construction of fire-places. Finally, the floor-like structure, the heat-cracked stones, the presence of apparently true charcoal, and the proved unfitness of the breccia for hearth-building, suggested the conclusion that man had roamed in Torbay at some period subsequent to the deposition of the breccia capping the Trias, and prior to the deposition of the clay in which the submerged forest is rooted.

The discovery of a presumptive hearth raised hopes that some utensils of human origin might ultimately be found; nor was this anticipation disappointed. Towards the end of February 1884, a heavy gale bared the strand very widely, the junction of the forest-clay with the underlying Trias being well displayed at the point marked A in figs. 1 and 2. A large area was here uncovered, and the clay soon yielded several trap pebbles, cracked as if by fire, and fissured in exactly the same way as others which formed a part of the presumed hearth. This suggestive find was carefully followed up and the forest-clay thoroughly searched from A to B, after every tide, so long as the exposure lasted. The following articles were discovered, and are all exhibited on the table:—

1. An ingot of copper, found lying on the surface of the forest-clay. Although not actually imbedded, its position and appearance left no room to doubt that it had been disinterred by the last tide.
2. A portion of a similar ingot, also found lying on the surface of the clay, but having a few minute rootlets clinging to one of its crevices.
3. Numerous pieces of rude pottery, made of dark-coloured, unburned clay, mixed with small fragments of stone.
4. Three fragments of granite grinding-stones, originally of circular outline, and about ten inches in diameter.
5. A curiously shaped piece of whetstone.
6. A piece of glass.
7. A large number of angular stones consisting, according to assays made by Messrs. Henry Bath and Sons, the eminent tin- and copper-brokers of Swansea, of tin slags containing a small quantity of that metal.
8. A quantity of triturated tin-slag, without metallic contents.
9. A number of angular flints, among which are many having a decidedly artificial character.
10. Three or four flint implements, in some cases worn by use.

All these objects, with the exception of the copper, were actually disinterred from the clay, and were found either interpenetrated or embraced, according as they had or had not fissures, by fine rootlets, such as everywhere crowd the clay itself. Everything, except the whetstone and one flint implement, which occurred near Preston Lane, was found closely associated within the space of a few square yards, and at the spot marked H on the plan (fig. 2), or just where the forest-clay makes a junction with the Trias.

It is worthy of remark that the spot in question forms the natural point of discharge for water accumulating in the valley A B, and that water-rolled gravel occurs in the clay, quite close to the spot where the modern pipes F, which drain the low marshy land of the valley, have been laid down.

A word must now be said with regard to the position of these various articles vertically in the clay. This, together with the Trias ridge upon which it rests, has been greatly denuded within the limits of the tidal strand. A number of truncated posts were observed at J, and several of these were drawn. They consisted of tree-stems, four or five inches in diameter, and roughly pointed; but, in no case did more than five or six inches of their original length remain, proving that some feet of clay had been denuded since the posts were driven. The wood of these piles had its larger vessels threaded with the rootlets of other plants in exactly the same way as the forest-wood itself, which, whether prostrate or erect, is always interpenetrated by the roots of subsequent vegetation. The present tidal strand has therefore been a land surface since the posts were driven.

The Trias ridge upon which the forest-clay rests has been pared down *pari passu* with the latter, above which it projects only a few inches. The clay thickens rapidly from its junction with the Trias outwards, and is from three to four feet thick under the drain-pipes F. Assuming that the piles were originally driven not less than two feet into the clay, and bearing in mind that the objects on the table were found nearer the junction than the drain-pipes, it is probable that they occupied a position about midway between the original surface and the bottom of the clay bed at this point.

Reviewing the above facts, the conclusion seems inevitable that tin was smelted and bronze probably made on the spot in question at some time prior to the deposition of the forest-clays, and that the land surface supporting this early metallurgical establishment was the Trias rock. That the objects obtained from the clay were entombed during its deposition, is shown by the fact of their interpenetration by the rootlets for which that clay subsequently formed a soil; and, unless work was carried on within a pile-dwelling, the bronze-makers must have been antecedent in time to the forest-clay. If the platform of cracked stones found seated upon the "head" be accepted as the remains of a neighbouring smelting-hearth, then there is no question but that the suggested sequence of events is correct. Not only, then, was man living in Torbay at some period prior to the deposition of the forest-clays, but he was already acquainted with the art of smelting and a worker in copper and tin—facts which allow no escape from the conclusion that the soils in which the submerged forests of Torbay flourished were deposited since the beginning of the bronze age in Britain.

This, according to Dr. Evans, did not probably extend more than twelve or fourteen centuries backwards from the commencement of the Christian era, a period agreeing fairly well with M. Morlot's well-known estimates, which give 3800 years as the present age of

the bronze period in Europe. Sir John Lubbock has, indeed, advanced reasons for believing that the Phœnicians traded with Britain for tin fully 1500 years before our era ; and, if this be so, we must suppose that the inhabitants of Belerium had been acquainted with the art of smelting for very many years before that date, there being nothing to suggest that the Britons were taught metallurgy by the Phœnicians. That the present coast-levels of England have persisted for at least two thousand years past seems to be fairly established ; and, this being so, it follows that the subsidence, if subsidence it were, that placed the primitive smelting-works lying under Redcliffe Towers beneath the tidal waters of Torbay, must have occurred at some period prior to the Roman occupation, or during the 12, 15, or more centuries which, according to Dr. Evans, M. Morlot, or Sir John Lubbock, elapsed between the beginning of the bronze age in Britain and the coming of Julius Cæsar to our shores.

This question may be left for a moment in order to inquire how far a comparison of the objects found in the clay with other early works of human art supports the conclusion that the soils of the Torbay forest are of comparatively recent date. It will be observed that the fragments of pottery are similar in character to both British and Swiss lake-dwelling pottery, of which the former may be of any age from 1500 to 3000 years. The copper ingots have their exact counterparts in others now in the Natural-History Museum which were found in the black mould, or uppermost layer of Kent's Cavern ; while whetstones and querns, similar to those taken from the clay, are not uncommon in Romano-British finds. Granting that the flint implement found by Mr. Watson, lying on Torre-Abbey sands, is a true forest-fossil, this in no way militates against the conclusion which is sought to be established. Not only have such tools been found associated with bronze implements in the Swiss lake-dwellings and elsewhere, but there is evidence of such association on the table this evening. The horn implement found by Mr. Ardley in the peat of the Torbay forest supports the ideas which have been advanced ; for no one examining this tool with a critical eye can avoid coming to the conclusion that it has been shaped with something very much more effective for cutting-purposes than a stone hatchet.

It is well known that the Torbay forest is of later date than the cave-earth of the neighbouring Kent's Cavern, and later than some portions, at least, of its stalagmitic covering ; for both these deposits contain the bones of certain extinct mammals whose remains are not found in the forest. The fauna of the latter is, indeed, the fauna of to-day, consisting for the most part of the red deer, the ox, hog, sheep, and goat, creatures whose bones are also found in the black mould of Kent's Cavern. There is some evidence, it is true, that the mammoth roamed in Torbay during the forest-era ; but it is not conclusive, and it will be time to believe that *Elephas primigenius* was a contemporary of bronze-making man in Devonshire when its remains have been found in actual association with the works of the latter. This subject will be again referred to in the sequel ; it is needful now to pass on to the description of



another find recently made by the writer's son on the tidal strand of Goodrington Bay (fig. 1).

This inlet has much the same general character as that which has already been described, and consists of wide and gently sloping sands, crowned with a prominent ridge of beach, behind which the ground is low, flat, and marshy, having been reclaimed from swampy conditions only in recent years.

Fig. 3 exhibits a section of the tidal strand taken through the spot where the "find" in question was made, and it will be observed that the forest-clay is here nowhere visible. At the bottom is a bed, E, consisting entirely of prostrate trees and vegetable debris; above that is another, A, composed of the stems of the water-bistort (*Polygonum amphibium*) standing as they grew; next, a stratum of silt and vegetable matter, D; then a thin layer of red clay, F, and lastly a bed of much-abraded reedy debris, C, upon which the beach, B, appears to rest. The thickness of the lowest bed is unknown, while that of the others is altogether about eight feet. Borings made by the Great Western Railway Company have shown that there are at least seventy, and it may be many more, feet of vegetable debris in the marsh immediately behind the beach, where it is crossed by the line carried on a high embankment.

On November 18th, 1883, the writer's son disinterred from the *Polygonum*-bed, A, fig. 3, two large pewter vases, one of which is now on the table, while the other has been presented to the Museum of the Torquay Natural History Society. These vessels

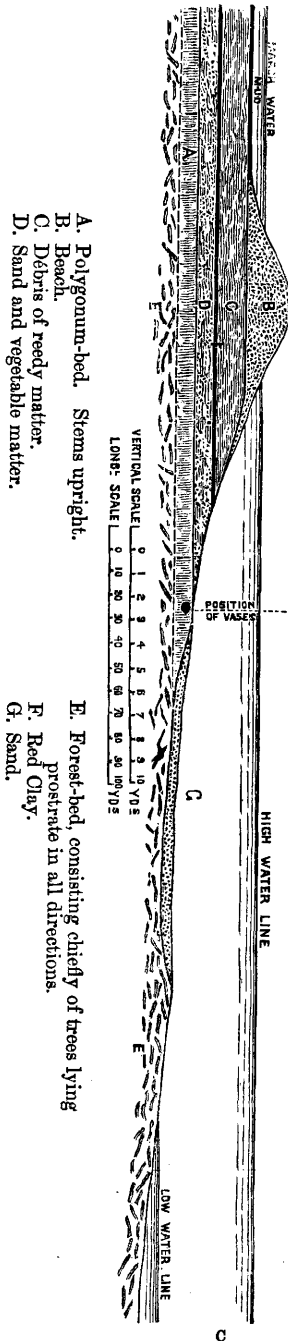


Fig. 3.—Approximate Section of Goodrington Beach, showing undrained Marsh in rear, and position of Vases.

lay in contact, one above the other, were unmistakably imbedded, were full of fine vegetable débris, totally free from any admixture of marine deposits, and were crushed flat by long-continued gentle pressure. The metal of which they are composed has been found to consist of 10 parts of tin to 1 part of lead, and they have been pronounced by Mr. Franks of the British Museum to be almost certainly Roman. The bed in which they were found is about 10 feet below high-tide line, and vertically lower than the point at which the relics of bronze-making man were discovered in the clay bed of the adjoining inlet. This fact alone suggests the necessity of caution in coming to conclusions on the general question of subsidence.

Old maps of Torbay, such as those of Speed, dated 1610, Saxton, 1675, and Donne, 1765, demonstrate immense encroachments of the sea in this neighbourhood during comparatively recent times. The ordnance survey of 1809 shows that a road then traversed Goodrington Sands where the tide now flows; while the earlier surveyors whose names have been mentioned demonstrate a very considerable seaward prolongation of the land in Torbay within the last three centuries. There is little room to doubt that the Roman vases in question were lost in Goodrington Marsh at a time when the beach which dammed its waters was far seaward of its present position and of the spot where the vessels were found. Since that time, the beach, receding before the advancing sea, has passed over the vases, which the waves have, finally, disinterred from the foreshore.

The vertical position of the vessels, 10 feet below high-water mark, may be explained by supposing that the fallen trees and vegetable detritus, filling the Goodrington valley to a depth of at least 70 feet, formed a very compressible mass, and as this became gradually consolidated, the reedy beds growing above the prostrate forest gradually settled and carried any enclosed objects down with them.

The same bed of clay which underlies the forest on Preston Sands, is also present at the same levels at Goodrington, where, however, it is generally covered with sand and shingle. In the centre of the bay there occurs a reef of Devonian shale, C, fig. 1, which is covered at high, and exposed at low water. Upon either side of this reef the clay reposes, just as it does upon the Trias reef immediately below Redcliffe Towers in the neighbouring bay. Thence it dips rapidly on either hand, and is soon covered with a thick layer of peaty matter, as is also the case on Preston Sands. There is, however, nothing to show whether this bed of clay passes continuously from the reef under the great depth of forest-deposits which the Great-Western borings have shown to exist at the lowest part of the Goodrington valley.

With regard to the character of the forest-clays Mr. Godwin-Austen\*, writing in 1842, says that the submerged forest of Torbay rests on lacustrine mud, which at Broad Sands contains shells of *Paludina impura* in great abundance; while at Goodrington also

\* Trans. Geol. Soc. ser. 2, vol. vi.

there are traces of lacustrine marl. The writer, on the other hand, while totally failing to find any freshwater shells in either of the inlets, has met with *Scrobicularia*, *Hydrobia*, *Littorina*, and *Melampus*, the three former abundantly, in a single but very limited exposure of the clay only a few hundred yards south of Redcliffe Towers. Of these shells, the *Hydrobiæ* formed a bed several inches in thickness, and would have given the idea of their having lived and died during the accumulation of the clay, but for the fact that they occur at precisely the same horizon as living shells of the same species would do. It is quite impossible to suppose that an estuarine bed of clay which has been elevated to form the soil of a forest should, upon subsequent subsidence, sink to exactly the same horizon as it occupied before its elevation; and it is probable, therefore, that the marine shells in question flourished where they were found during some recent but prolonged exposure of the clay, while the shifting of derived mud during that time might give them the appearance of being bedded. The clay itself, when not charged with vegetable matter (which gives it a blue tinge), or stained at its margins by the red rocks upon which it lies, is almost white and of an extremely fine, butter-like consistency. To this excessive fineness must probably be attributed the fact that the clay is white, while the surrounding drainage-area is composed chiefly of red rocks. Not the slightest evidence of marine action is exhibited by the lip which, as already stated, can be traced around portions of the shallow basin in which the clay accumulated; and, in view of this fact, of Mr. Godwin-Austen's positive observation, and of the possibility of explaining away the rare presence of marine shells in the deposit, it is probable that the clay is of lacustrine origin.

It is time to consider the question of the supposed subsidence of the area under consideration in the light of the following facts:—

1st. That the forest-clay of Preston Sands contains relics of bronze-making man.

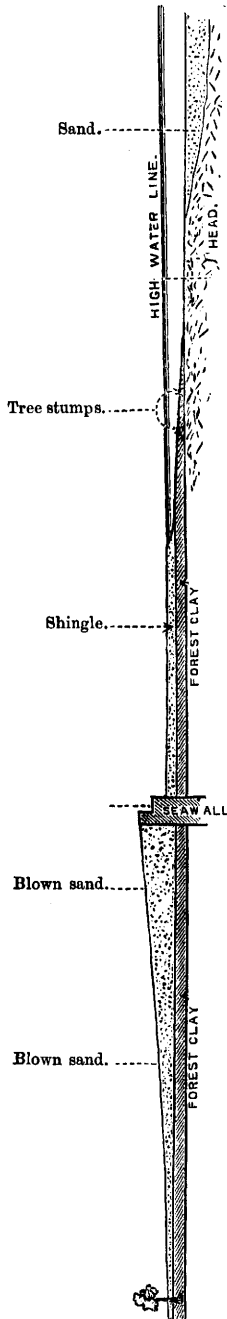
2nd. That the upper, peaty beds of the submerged forest of Goodrington have yielded Roman remains.

It has been suggested that the shores of Britain have probably remained at their present levels for at least 2000 years past; and if Dr. Evans', M. Morlot's, and Sir John Lubbock's views may be relied upon, the bronze age in Britain is not older than 4000 years. But if, as Mr. Pengelly suggests, Torbay stood at least forty feet higher than now during the forest-era, it becomes necessary to believe that, at some time within the twenty centuries preceding Roman times in Britain, the Trias rocks of Preston Sands have been:—

1. Submerged for the deposition of the forest-clay.
2. Elevated to a height of at least 40 feet.
3. Depressed to their present level.

That a coast which has remained stationary for the last 2000 years should have made such active use of the preceding twelve or twenty centuries for the purposes of oscillation, is rather hard of belief. Either the bronze age must be of unsuspected antiquity, or the

Fig. 4.—Section of the Exposure at Redcliffe Towers, April 22, 1884. (Scale 60 feet to 1 inch.)



objects to which attention has been directed this evening must have been lodged where they were found while the land stood at existing levels.

In attempting to answer this question attention will be strictly confined to the Paignton-Preston inlet, a section of which is shown in fig. 4. The clay-bed is here only just below high-water mark at that part of the marshy land most remote from the sea. It passes seaward with a very slight inclination to at least 750 feet from the shore, that being the length of the Paignton Pier, whose piles were all screwed into the clay. It is covered, inland, first with coarse sand, among which are found many large cockle-shells and occasional patches of shingle; while, over all, is a layer of blown sand, the surface of which is some two feet above high-water mark. Its seaward margin, being unprotected by a beach, is in course of truncation and destruction by the waves; but behind the beach such plants as the water-bistort (*Polygonum*) are growing luxuriantly, while willows are extensively cultivated in the swampy soil. It is noteworthy that most of the trees found prostrate in the forest-clay are also willows.

The basin in which the clay lies has a lip which is distinctly visible in the cliff near Preston Lane, and whose position on the slopes of the neighbouring hills is well known to the village builders. This stands about seven feet above high-water mark, and its margin (as already mentioned) gives no evidence of having ever been fringed by a marine beach, while the extreme fineness of the clay itself attests its deposition in still and scarcely turbid waters.

The evidence in favour of extensive encroachment of the sea in Torbay is conclusive. Large tracts of land, houses, and roads have disappeared within the memory of man; while maps less than 300 years old show, with more or less accuracy, a shore-line hundreds of feet in advance of the present one. It seems probable therefore that the Paignton-Preston inlet was once barred by a beach, distant at least 750, and probably very many more, feet from the present beach, behind which the land-water accumulated to a height of about seven feet above the high-tide level, and that in the lake, or mere, thus formed the forest-clay was laid down. By the breaking down of the dam, the sea was admitted, covering what is now Paignton Marsh with coarse sand, to be followed by blown-sand deposits, and in this way the sea was again expelled to the limits of the present coast-line. Meanwhile the willows and marsh-plants whose débris and roots form the greater part of the so-called peat-beds overlying the clay took possession of the low-lying ground.

Man, as we have seen, was present in the Paignton-Preston inlet either before the lake in question was formed, living on the "head," or inhabiting a pile-dwelling during the deposition of the clay, or even, if the lacustrine conditions were intermittent, settled on the clay itself; but, in any case, the suggested explanation makes it unnecessary to suppose that the bronze-makers of Redcliffe Towers were witnesses of those wide oscillations of level which have heretofore been associated with the physical history of the submerged Torbay forests. The topmost beds of these deposits have been shown to be no older than the Roman occupation of Britain, while their base dates from the bronze age. If the molar of *Elephas primigenius* which has already been referred to was really derived from a seaward extension of the forest lying exposed between tide-marks in Torbay, then it must be concluded that the mammoth survived in Devonshire almost down to Roman times, and that he was certainly contemporary there with bronze-making man.

But it is not necessary to suppose that the same bed of clay and the same forest were continuous for great distances seaward in Torbay. Buried forests are, elsewhere, almost always found in tiers, sometimes, as in the Fenland districts, four or more one above another. At Blackpool, only a few miles from Torbay, Mr. A. R. Hunt\* has given reasons for believing that one submerged forest rests upon another; and these forests might, of course, differ vastly in age. Similarly there may be forest-beds beneath the waters of Torbay older than those which are visible on Torre-Abbey, Paignton, Preston, and Goodrington Sands, and the mammoth's tooth may have come from one of these. In any case, the submerged Forest of Torbay, and possibly therefore other submerged forests fringing the English coast, are even more truly things of yesterday than has hitherto been supposed.

\* Trans. Dev. Assoc., A. R. Hunt, July 1881.

## DISCUSSION.

Dr. H. WOODWARD said that it was interesting to find that the copper ingots exhibited by the author closely resembled ingots of the same metal obtained by Mr. Pengelly from Kent's Cavern. The pottery from the two localities was also similar.

Prof. T. RUPERT JONES doubted the palæolithic age of the flint-flakes. Similar flakes have been found on the surface in many parts of southern England, and are by no means of palæolithic age.

Prof. T. M<sup>C</sup>K. HUGHES said that one of the most interesting points connected with the paper was the explanation of a "submerged forest" without the necessity for any submergence. He quite agreed with the author that the damming back of the sea and the growth of trees below high-water mark behind the dam, furnished a probable explanation of the phenomena. The occurrence of the two clays described might indicate two different periods, and submergence might have occurred between them. The evidence of the chips was not of much value, as they might be of any age. The pottery appeared to be British.

Mr. BLANFORD agreed with the author in his main views, but wished to point out one difficulty. The supposed tin-smelting hearths were some 10 feet below high-water mark, and the ground must have been too wet for smelting, if not actually below water.

Mr. TOPLEY expressed his general agreement with the author; but remarked that similar opinions, as to the recession of shingle-beaches and the formation of "submerged forests" without subsidence, had been put forward by Mr. Yates, Col. Greenwood, and others. Where the forest-growth, however, extended to or below low-water mark, he thought subsidence must have occurred.

The AUTHOR thanked Dr. Woodward for his remarks, and for the access he had given him to similar ingots in the Natural History Museum. He had used the term "palæolithic" merely to indicate the type of the flint fragments. He stated that his paper answered Mr. Pengelly, who thought that there had been a submergence of 40 feet. With regard to the hearth he admitted the difficulty pointed out by Mr. Blanford, for there was no doubt that this was resting on head.