

REPORT ON THE BURIED CLIFF AT SEWERBY, NEAR BRIDLINGTON.
BY G. W. LAMPLUGH.

INTRODUCTION.

During the course of my enquiries into the geology of this neighbourhood, I learnt that the tusk of an elephant had once been found in the cliff near Bridlington Quay by some fishermen, and I sought out one of the men, and questioned him as to the discovery. He told me they found the tusk in a bed of soft sand at the bottom of the cliff near where the chalk ends, about two miles east of Bridlington Harbour, opposite the village of Sewerby; but, when I came to examine the section, I could find no bed like that described, though I noticed that the chalk ended very abruptly, and also, that though the lower part of the cliff was much obscured by slipped drift, there were indications of beds between the boulder-clay and the chalk. I called attention to the discovery in a paper on "The Speeton Shell-bed" (in *Geological Magazine*, Dec. II., Vol. VIII., p. 174), and suggested that the remains had been obtained from some unexposed bed which underlay the boulder-clay.

The lower part of the section remained masked by slips till the winter of 1883-4, when the sea cleared away much of the displaced stuff, and revealed the long-looked-for bone-bed. I was first apprised of this by one of the fishermen who had made the previous discovery, who came to tell me that there were two bones in the cliff. I examined these bones, and thought that the greater part of a skeleton might lie concealed, and, not then having leisure myself to excavate the bed I acquainted my friend Mr. J. R. Mortimer, who at once sent workmen to extricate the remains. The bones, however, proved to be isolated and disconnected, and not members of a series; nor were they, as I had surmised, the bones of the elephant whose tusks had been found, but were referable to *Bos*, or *Bison*.

No further exploration was made at this time, but a few months later Mr. Clement Reid of the Geological Survey, who was at work on the Holderness drifts, visited the section, and finding it of

importance, had a cutting made, to show the sequence of the beds. He afterwards gave a sketch and short description of the place in his most admirable Memoir on Holderness,* which is, so far as I know, the first and only published account.

Acting on Mr. Reid's suggestion, that further investigations should be made, the Yorkshire Geological Society granted last spring the sum of £10 towards the expenses of more extended excavation; and it has been my very agreeable duty to assist my friend and neighbour, Mr. Thomas Boynton (late of Ulrome), in the superintendence of this work.

Before we could commence, it was necessary to obtain the permission of the Lord of the Manor and owner of the land on the adjacent cliff, the Rev. Yarburgh Lloyd Greame, of Sewerby House, and the warmest thanks of the society, and of all interested, are due to that gentleman for his courteous acquiescence in our scheme.

We started to excavate with two workmen on the 20th of July last, and with two more on the 25th, and worked on until the 6th of August, when the section was visited by the members of the society. We first cut a trench from the shore-line into the cliff at right angles, so as to show as complete a section as possible, and then excavated, for the space of about 40 feet, the deposits and talus which were banked against a buried cliff of chalk, revealing a very clear and instructive section, as shown in the sketch (Fig. 2). During the course of this work a very large number of bones, teeth, and other remains were unearthed, which, by a vote of the society, have been presented to the Museum of the Yorkshire Philosophical Society at York, on condition that they be kept together in a separate case as "The Sewerby Collection."

AN ANCIENT SHORE.

The chalk which forms the bold headland of Flambro', ends abruptly on the south-west in an ancient sea-cliff. This cliff makes no feature at the surface, for the boulder-clays and gravels which lie so thick above the chalk on the south side of the headland, sweep on and obliterate the escarpment, so that, were it not for the coast-

* Geological Survey Memoir: Holderness: pp. 47-49.

section, we should remain ignorant of its existence. It is easily traceable, however, in the cliff near Sewerby, and, under favourable conditions when the slipped drift which obscures the section is washed away, there is to be seen, banked against the buried cliff, a series of deposits older than the boulder-clay which lies above the chalk. These beds contain a profusion of mammalian and other remains, and differ from anything known elsewhere on the coast. The series comprises, in ascending order, A. an old sea-beach. B. an old land-surface. C. a mass of blown sand; and these will be separately described. The sea is now cutting back obliquely into the ancient shore-line, the recent chalk-cliff joining the old chalk-cliff at a slight angle, but, as in the new so in the old, there have evidently been many little bays and recesses, so that the trend is by no means regular, and may at any time change.

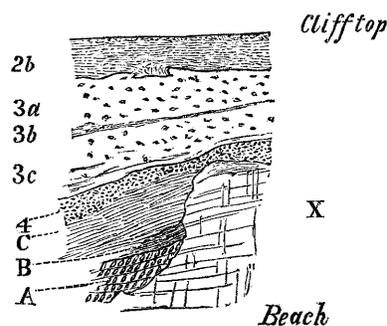


Fig. 2. Section of Cliff at Sewerby.
Scale, 60 feet to 1 inch.

Top Soil	2 to 3 ft.
2b. Well-bedded Chalk Gravel, "The Sewerby Gravel," about	12 "
3a. Brown Boulder-clay	15 "
3b. Stratified Seam of Silt and Gravel	1 to 2 "
3c. Dark Boulder-clay	12 "
4. Rough Chalk Rubble	1 to 2 "
C. Clean Blown-sand... ..	about 25 ft.
B. Clayey Chalk-wash: an old land-surface	5 "
A. Old Sea-beach of rolled chalk pebbles	5 "
X. Ancient Cliff of Chalk —	35 "

The total height of the present cliff at this place is about 75 feet, but the buried chalk cliff has a height of only about 35 feet, the remaining 40 feet consisting of the overlying glacial beds. These beds are not clearly exposed, but seem to be as in the preceding complete section (Fig. 2), wherein are shown the beds from top to bottom of the cliff.

The beds lying above the old cliff need not be more particularly described in this report, but I shall have occasion to refer to them again in considering the age of the underlying deposits.*

A. THE OLD SEA-BEACH.

In our excavation we always found, at the bottom, resting on a floor of solid undisturbed chalk and abutting against the base of the old cliff, a sea-beach of rolled blocks and pebbles of chalk with a little sand, having a thickness of from 3 to 5 feet. Where it lay lowest the bottom of this bed was just below the present high water mark, so that its upper layers were generally slightly above the level of the highest tides, but only so slightly that a stormy sea might yet overwhelm it. I think, however, that a slight elevation of the land or withdrawal of the sea is indicated, for the waves seem, in old times as now, to have reached to a higher level than the shingle, the cliff being sea-worn for two or three feet above the beach. In one place we uncovered a short shallow cave, a little over a foot in diameter and three or four feet in length, which the waves had hollowed out in the face of the cliff. Among the shingle were many rolled bones both of mammals and of fish, these being most plentiful close to the cliff-foot, whither, being lighter than the stones, they had evidently been flung by the breakers of a rough coast. A few marine shells were found in the sandy layers (see list below), and many of the chalk blocks were perforated by *Pholas*, *Saxicava*, or *Cliona*, but the shells had in all cases decayed out of the boring.

Though the chalk of the adjoining cliff contains no flint, nor do the cliffs anywhere on the south side of the headland, there was a

* For a fuller account of these beds, see Reed's "Holderness," or my papers in *Proc. Yorksh. Geol. Soc.* for 1881, 1882, and 1883.

scattering of flint pebbles among the chalky shingle; but all the flints we found had come from the Yorkshire chalk, and among them there were none of the foreign red and black flints, such as occur plentifully in our boulder-clays, so that the pebbles have no doubt drifted along the coast from the north side of the headland, or have been brought by fresh water down the Boynton valley. Foreign pebbles were not, however, absent, for at rare intervals we threw out worn fragments of sandstones, quartzites and basalts; but these erratics were very scarce, forming only an infinitesimally small proportion of the whole, and the largest was no larger than a child's clenched hand. Fragments of a black carbonaceous shale, such as occurs in some of the estuarine beds of the Oolite, were rather more plentiful, and we rarely passed a day without finding three or four pieces of it; this, being very light, may have drifted along the coast.

B. THE OLD LAND-SURFACE.

Resting on the old beach was an irregularly stratified mass of marly clay, with sub-angular lumps of chalk and thin streaks of sand, evidently talus and rain-wash from the impending cliff. This indicates that the sea no longer reached the cliff, the change having been very gradually brought about, as was shown by the way in which the lower part of the rain-wash intercalated with the old beach. Bones were rarer in this deposit than in the beds below, but occurred here and there in the clayey layers, along with numerous small land-shells and obscure traces of vegetation. Remains of fish were of course absent, but we found a tooth of a small rodent, probably the vole, and several birds' bones, besides the remains of the larger mammals.

The thickness of this bed close to the old cliff was from four to six feet, but it thinned rapidly as it left the cliff, and, at a distance of from 5 to 10 yards, generally disappeared by dovetailing into the blown sand, into which it also passed gradually upwards. It has evidently accumulated in the sheltered hollow between the sand-dunes and the cliff, and is of peculiar interest as affording us the only land-surface yet known in our Yorkshire coast-sections.

C. THE BLOWN-SANDS.

A mass of clean yellow sand without admixture, save for a few angular blocks of fallen chalk, and an occasional bone, overlapped the chalk-wash and was banked up against the old cliff to its full height, even passing in places over its brow. In this mass there were obscure bedding-planes which dipped down towards the cliff, showing that the sand at first accumulated as a high dune fringing the cliff, but afterwards filled up the hollow and drove on over the sloping wold. As in the old beach, so here, there were evidences of violent and persistent storms from the south, or from some quarter between south-west and south-east. The sand has been driven against the hard chalk for so long and with such force that the whole face of the cliff has been beautifully smoothed and rounded, as I have attempted to show in my sketch. Mr. Reid has already pointed out how striking is the contrast between this smooth outline and the rugged angular features of the adjoining recent cliff. I think that the action of a sand-laden blast would not alone produce this difference, unless there were also a more or less complete absence of frost, but to this I shall revert later.

These blown sands may once have been much thicker, and perhaps have extended for some distance over the surface of the chalk, but they are now cleanly cut out at the top of the cliff by the chalky rubble (4) which is nearly continuous over the chalk and seems to form the base of the drifts.

The glacial beds above the blown sands contain no contemporaneous fossils—unless indeed a few fragmentary shells in the boulder-clay be so considered.

THE FOSSILS.

Among the fossils found the following have already been recognized, and it is possible that when the collection has been put in good order, and thoroughly examined, additions may be made to the list.

The asterisks in the columns indicate in which bed the fossil was found.

The only fossils before recorded are *Cervus megaceros*, and *Bos* or *Bison*, by Mr. C. Reid.

My thanks are due to Mr. Clement Reid, and to Mr. H. M. Platnauer, for their kind assistance in making this list.

FOSSILS FROM THE SEWERBY CLIFF-BEDS.		Old Beach.	Chalk Wash.	Blown Sand.	REMARKS.
<i>Elephas (primigenius?)</i>	The Mammoth.	*		*	Four molars, three from the old beach, and one from the blown sand; one molar seems to belong to the Mammoth, the others probably to <i>E. antiquus</i> .
<i>Elephas antiquus.</i>	The Elephant.	*			
<i>Rhinoceros, sp.</i>	Rhinoceros.	*			Three or four molars, and portion of a lower jaw
<i>Hippopotamus, sp.</i>	Hippopotamus.	*			A badly preserved tusk.
<i>Equus, sp.</i>	The Horse.	*			A single tooth.
<i>Cervus (megaceros?)</i>	The Irish Elk.	*	*	*	Teeth, lower jaw, &c,
and perhaps another.					
<i>Bos primigenius.</i>	The Urus.	*	*	*	Many bones.
<i>Bison? sp.</i>	...	*	*	*	Do.
A small rodent: probably the Vole.	...	*	*	*	An incisor.
A Carnivor, perhaps Hyena	...	*	*	*	Indicated by gnawed bones.
Birds	...	*	*	*	Three or four limb bones
A Snake	...	*	*	*	Portion of a jaw.
Teleostean Fish	...	*	*	*	Vertebrae, and bones of the head abundant.
LAND MOLLUSCA.					
<i>Helix hispida</i>	...	*	*	*	
<i>Helix pulchella</i>	...	*	*	*	
<i>Pupa muscorum</i>	...	*	*	*	
MARINE MOLLUSCA.					
<i>Purpura lapillus</i>	...	*	*	*	
<i>Littorina litorea.</i>	The Periwinkle.	*	*	*	
<i>Ostrea edulis</i>	The Oyster.	*	*	*	
<i>Mytilus edulis.</i>	The Mussel.	*	*	*	
<i>Pholas</i>	...	*	*	*	Indicated by borings only. Do.
<i>Saxicava</i>	...	*	*	*	

The bones, except when from the drier parts of the blown-sand, were very soft and friable, and were generally so crushed and fractured that it was very difficult to remove them. This was no doubt in part due to the quantity of fresh water which has flowed out of the chalk and percolated through the lower part of this section on its way to the beach, where it yet forms a series of fine springs on the foreshore. In the old beach the bones were generally water-worn and rounded, as might be expected, and this was also sometimes the case

in the chalk-wash, but in the blown-sand they were frequently quite unworn, and in one or two instances had their finer angles and delicate muscular markings so beautifully preserved that I am inclined to think they must have been protected by flesh when embedded. We did not, however, except in one doubtful case, find articulating bones lying together; on the contrary they occurred sporadically in all the beds, and were nearly always fractured, with portions wanting. Though no identifiable remains of carnivorous animals have yet been found, the marks of their teeth could be traced on several of the bones from the blown-sand, and it seems to me that we are probably indebted to them for the presence in the midst of an æolian deposit of heavy fractured isolated bones too weighty to have been carried by the wind. There could be no more suitable habitat for beasts of prey than the sand-dunes and cave-worn cliffs of a coast-line abandoned by the sea.

The fish remains which occurred so plentifully in the old beach consisted chiefly of vertebræ and head-bones, the latter often lying loosely together in such a way as to show that they had been held together by ligaments when thrown up by the waves. The marine shells were very scarce, and badly preserved, but this did not surprise me, as, even under favourable conditions, it is not often that many shells are found at high-water mark on a rough stony beach. The list is too short to be of much palæontological service, but the presence of *Ostrea*, which does not occur in the arctic shell-beds of the Basement Clay at Bridlington Quay, shows that the climate was temperate. The land-shells are such as now live on sand-dunes, and have no especial interest, except that they show how complete has been the withdrawal of the sea.

Careful search was made for any evidence of man's presence, but no recognizable trace has yet been found, though the situation is a not unlikely one, and the fauna is that with which he is elsewhere associated.

AGE OF THE BEDS.

In discussing the age of these deposits I can at present add very little to what has already been advanced by Mr. Reid, though I am inclined to demur at his placing the beds under the heading of

Interglacial, as I think the evidence tells strongly towards their *Preglacial* age—that is, if the term *Preglacial* may be applied to beds older than the oldest truly glacial deposit known in East Yorkshire.

There is this serious difficulty in understanding the stratigraphical relations of the beds ;—the boulder clay which rests on the chalk or chalk-rubble in the cliff-sections east of Sewerby, has always been considered to belong to the lower division of the Purple clay : and it is this clay which, as I have recently found, passes down over the blown-sands to the foot of the cliff west of Sewerby. But at Bridlington Quay a still lower boulder-clay, with well-marked lithological and palaeontological peculiarities, known as the “Basement” clay, is seen, and can be traced in the cliff eastward for a short distance and then disappears beneath the beach.—Now, these bone-beds, though they are undoubtedly older than the Purple clay, are they also older than the Basement clay? And if so, what has become of the Basement clay? Is it entirely absent from our section?

There is so much slipped ground and obscurity in the cliff between Bridlington Quay and Sewerby, that one cannot be quite positive that the boulder-clay (3c. of Fig. 2) which overlaps the bone-beds is not the Basement clay that has re-appeared, especially since boulder-clays in general show such a noble disregard for levels and horizons. But I do not think this to be the case, and am inclined to believe that, if the Basement clay is present at all, it is represented by the band of chalk-rubble (4) which also passes down from the top of chalk to the shore, thickening very materially as it sinks. This rubble seems to have resulted in some way from the action of ice on the surface of bare chalk, and its formation may well have been contemporaneous with that of the Basement clay on the lower ground. This is a point which I hope to elucidate in our next year's excavations, and I will withhold further comment on it till then.

Had there been any pre-existing glacial beds in the neighbourhood when the old beach was being formed, they could scarcely have escaped erosion, and would have yielded a plentiful scattering of erratic pebbles in the ancient shingle just as in the recent beach,

but we find instead that stones of any kind except of chalk, are so few and far between that it required a thorough and systematic process of excavation to find them.* A single stranded mass of ice might yield far-travelled pebbles enough for miles of such a beach.

Both the sea-beach and the blown-sand seem to indicate that the prevalent wind of the period came from somewhere between south-east and south-west; and that a mild climate resulted is shown not only by the presence of oysters among the shingle, but also by the state of the old cliff-face, to which attention has already been called. Its sand-worn surface is so unbroken that anyone who has studied the rugged broken features of the present cliff, or has watched for himself the effect of even a slight frost on a chalk escarpment, will at once be convinced that there can have been very little frost when this cliff was carved out.

The fauna itself, as at present known, does not aid us much in determining the exact age of the deposits. There seems to be nothing in it to prove whether the beds are pre-glacial, glacial, or post-glacial, though it shows that they cannot belong to the older Tertiaries.

The shell-bed at Speeton,‡ though at a much higher level above the sea, is probably of approximately the same age as these deposits, and there are also certain valley-beds at Danes Dyke, and at two or three other places on Flambro' Head that hold similar positions between the glacial beds and the chalk, but no animal remains have yet been obtained from them.§

The preservation of this little triangular patch of incoherent beds beneath the boulder-clay is one more proof, if that were needed, of the southerly flow of the ice over the headland during glacial

* Not reckoning the fragments of carbonaceous shale, we never came across more than three or four foreign pebbles in a day, and I think I could have carried away all we found in my pocket.

Since this was written the winter frosts have come, and the exposed portion of the old cliff has completely lost its smooth outline.

‡Supra cit. *Geol. Mag.*, sec. ii., vol. viii., p. 174.

§ A steep cliff of chalk with angular gravel banked against it, has also recently been exposed in the deep railway cutting north of Flambro Station, but this seems to be a valley wall of late glacial or post-glacial times, the gravel containing many drift pebbles, and probably forming a continuation of the "Sewerby gravels."

times. If this old shore could be followed I suspect we should find the deposits cut out wherever the cliff line trends north and south, and preserved only where it runs east and west so as to afford a "lee-side." Pre-glacial cliff-and-valley-escarpments in the neighbourhood which face north or north-east, often show signs of displacement and surface contortion.

CONCLUDING NOTES.

At the period when these beds were being deposited Flambro' Head was already in existence as a bold headland of chalk-cliffs, and the stormy billows of an open sea already beat upon it. But it formed a far more striking feature than at the present day, for not only did it then reach out further to seaward, but the sea also ran far inland under its flanks, the whole of Holderness being under water, and the chalk cliffs instead of ending with the headland as at present, stretched on in a long line that followed the sweep of the Wolds across Yorkshire and Lincolnshire, broken only by a few shallow creeks running into the land and by the deeper estuary of the Humber. The climate was mild and equable, but now and again a stray mass of ice from afar may have drifted into the bay, telling of changes to come.

Then there came a slight alteration in the level of the land, or, it may be, only in the set of the tides, so that the waves of the sea could no longer reach their former bounds and a long sandy beach began to form in many places at the foot of the cliffs. And sometimes the wind at low tide seized this sand and drove it up in eager clouds to build up a growing line of sand-dunes under the shelter of the abandoned cliff; and bye-and-bye these sand-dunes topped the cliff, and the sand drove on over the sloping wold.

Then, in later times the ice came down, filling the sea-bed with its huge glaciers, pressing hard against the coast till it reached the northern face of the headland and there, piling itself higher and higher, it over-rode the great cliffs and poured over into the bay, and and coalesced with other masses that had come far from the north-east. And in its course it passed smoothly over these sheltered beds, preserving them for our study under its rough mantle.

Such is one chapter in the great history of the headland, and now the sea is slowly coming to its own again, and as it marches to

its old place at the Wold-foot, Holderness, that relic of the ice-age, is gradually vanishing, and its clays and gravels are somewhere going to make the foundations of a newer land.

REFERENCES TO PLATE No. 21.

- | | | |
|---------------|-------------------|----------------------|
| A. Old Beach. | C. Blown Sand. | X. Old Chalk Cliff. |
| B. Rain Wash. | S. Slipped Drift. | Q. Bridlington Quay. |
- (About one mile distant, South-West.)

NOTE ON A FOSSIL SPECIES OF CHLAMYDOSELACHUS.

BY JAMES W. DAVIS, F.G.S., ETC.

Some years ago a Selachian was obtained by Prof. H. A. Ward, which had been caught off the coast of Japan. It was purchased for the Museum of Comparative Zoology at Harvard College; and in January 1884 Mr. S. Garman, of that Museum, gave a preliminary description of the fish in the "Bulletin of the Essex Institute," vol. xvi., in which he recognized it as belonging to a new family and instituted for it the genus *Chlamydoselachus*.

I had the pleasure of describing this fish and giving a historical resumé of the various opinions respecting it in the proceedings of this society, at a meeting held in 1885.* Until the month of June in the present year, no fossil representative was known. Whilst visiting the Natural History Museum at South Kensington, I came across a fossil representative of the genus closely resembling the recent one.

It is extremely interesting to find that ten years ago a fossil representative of *Chlamydoselachus* was actually discovered and figured by the late Robert Lawley. The specimen is from the Pliocene beds of Orciano in Tuscany, and is described as very rare; the teeth figured are possessed of three sharp, slender, backwardly-curved denticles, with a base forming a broadly-expanded plate divided at its posterior extremity into a pair of prongs, which doubtless extended, as in the existing species, beneath the succeeding tooth, thereby gaining additional firmness and strength. The figures indicate a tooth twice the diameter of the anterior teeth of the existing species. The author knew of no living or fossil representative of the teeth, and gave the figure with a short notice, without

* Proc. Yorksh. Geol. and Polyt. Soc., vol. ix., p. 98.