

reach of denuding actions, are of a softer and more destructible kind than those that overlie them.

There are three facts that seem to confirm the theory that the channel in the rear of the Chesil Bank has been formed since the heaping up of the shingle:—they are (1) that the isolated part of the bank is also the largest and strongest, the best able both to withstand the sea, and to stop the streams from flowing directly into the sea: (2) that the very irregular shape and cliffless character of the shore of “the Fleet” are not such as one would expect to be caused by the action of the sea along such a coast, whilst they are just what should be produced by the action of streams: and (3) that *the Channel ends where the streams end*. Westward of Abbotsbury, where there are no streams, the beach is not separated from the land; eastward of Abbotsbury, where there are streams, the beach is separated from the land.

Whether there may have been a slight rising or sinking of the land during the formation of the beach, would we think make little difference, on the theory which we have brought forward. Whilst we are far from asserting dogmatically that the Chesil Bank must have been formed in the way described, yet we think that our theory, or explanation, involves less supposition, and tallies more with observed facts, than any other does, and that, therefore, it should be accepted until replaced by a better, or disproved.

Lastly, we wish to draw attention to the confirmation given to the theory of *Subaerial Denudation* by our explanation of the origin of the Chesil Bank. It was not until we were convinced of the truth of the former that we saw our way to the latter; but when we began to see how great has been the share of rain and rivers in wearing away the land, and in cutting out hills and valleys, then we were enabled, by the new light thus gained, to explain the origin of a very uncommon phenomenon, which before we could not understand or account for. What had previously been a mystery, and looked like a freak of nature, became clearly intelligible, and was seen to be the natural result of ordinary causes and existing agencies.

Postscript.—In the discussion of this paper, Mr. J. Evans, F.R.S., “suggested that tidal action may have assisted materially in the formation and widening of the Fleet.” This we are far from denying, although we omitted to notice in our paper the assistance that may have been given by that action when it was enabled to come into play.

II.—ON A RAISED BEACH AT PORTLAND BILL, DORSET.

By W. WHITAKER, B.A. (Lond.), F.G.S., of the Geological Survey of England.

[PLATE XIV.]

[A paper read before the Geological Society of London, May, 26, 1869.]

IN 1850, Mr. H. W. Bristow recorded, on sheet 17 of the Geological Survey Map, the existence of “conglomerate” and “recent stone” at Portland Bill.—(See Plate XIV. herewith.)

In 1852, Mr. C. H. Weston,¹ noticed the occurrence of a "marine shingle-bed" on the top of the cliff, in the following words: "This remarkable bed consists of beach-pebbles (with a few chalk-flints), rounded by continued sea action. The quarrymen said it extended about a quarter of a mile north of the Bill."

In 1860 this shingle was again noticed in Mr. R. Damon's "Handbook of the Geology of Weymouth and the Island of Portland,"² and the occurrence of "comminuted shells" recorded.

Mr. Bristow has suggested to me that the shingle-bed may have been formed by the sea dashing up pebbles from the shore below, as he has known it to do in stormy weather; but I doubt whether that action is enough to cause so large a deposit. At all events it will not do so altogether, as the shingle is in part protected from such action by a thick covering of subaërial origin. Mr. Bristow tells me that, as far as he remembers, there was no good section of the deposit at the time of his visit, which must have been before 1850.

The southern side of "Cave Hole" is the most northerly point of this beach, which is there thirty or forty feet above the sea, and about three feet thick, being capped by a good thickness of angular "head" (the waste of Purbeck and Portland beds), and consisting of pebbles of limestone, flint, and chert. Just southward is a projecting cave-worn ledge, with a rounded water-worn surface of Portland Stone bared of the old beach. The next projection shows a little of the same, but with pebbles and shells conglomerated together into a hard mass adherent to the surface of the stone, the shells being chiefly *Littorina littorea*, but *Littorina littoralis* and *Patella vulgata* also occurring.

Further southward there is less of the "head," indeed hardly any, but there are remains of very small shallow pits, most likely dug for sand, as a small hole close by passed through two or three feet of clayey soil and more than three feet of coarse sand with shells, which, as far as one can judge from position, overlies the shingle.

The old beach ends, after a course of less than 250 yards, before reaching the slight headland, where however there are traces of it in the soil.

Continuing my southerly walk, just before getting to the Beacon at the Bill, I found shells (of the same species as those mentioned above, and also *Purpura lapillus*) jammed in with limestone-rubble at the top of the low cliff (as noticed by Mr. Damon).

At the Bill there is a little shingle, which increases after turning westward, when the cliff rises a little. At one place a pit six feet deep shows that this shingle is sandy and bedded, whilst near by it is conglomerated into a hard mass at the top of the cliff, and further inland another pit has been dug to a depth of eight feet. Close by, at the cliff a little higher up, the shingle is covered by yellowish-brown loam (calcareous?) with bits of stone and with land and freshwater shells (*Bithinia*, *Pupa*). A little further the latter thickens and the former thins, but both end off at the projecting spur of rock.

¹ Quart. Journ. Geol. Soc., vol. viii., pp. 117, 8.

² 12mo. Lond., p. 141. Reprinted in 1864.

I believe that it is only to the part noticed in the last paragraph that Mr. Weston's remarks refer.

Postscript.—In the discussion of this paper, Sir C. Lyell said that he had found in this raised beach more species of shells than those above mentioned; and Mr. Prestwich said that at one spot the number of young shells was remarkably great as compared with that of older shells.

III.—ON THE OCCURRENCE OF *MACHAIRODUS* IN THE FOREST-BED OF NORFOLK.

By E. RAY LANKESTER, B.A. Oxon.

[PLATE XVI.]

A SPECIAL interest has always attached itself in this country to the remains of that rare and bizarre carnivore, the Sabre-toothed tiger. For as yet it has only been indicated to us on this side of the Channel by the most fragmentary and unique specimens—the two teeth, incisor and canine, obtained by the Rev. Mr. MacEnery, from Kent's Hole, Torquay, the authenticity of which have even been doubted. Whilst, however, palæontologists have pretty generally come to the conclusion that these two isolated teeth are really the remains of a Devon Sabre-tooth, no further specimens have, I believe, been recorded from other caverns in this country.

The forest-bed of Norfolk, which furnishes remains of *Rhinoceros Etruscus* in some abundance, and of *Ursus Arvernensis*—and other forms associated in central France with species of *Machairodus*—has hitherto not given up any remains of that carnivore to the energetic collectors of Norfolk. In July, by the kindness of the Rev. John Gunn, I was enabled to see some of the matters of geological interest in Norfolk, and in looking through the very beautiful collection of mammalian remains from the Forest-bed in the possession of Mr. Jarvis, of Cromer, I observed the portion of a tooth figured here. Suspecting its nature, I begged the loan of it from its owner, who very courteously complied with my request. I have since carefully compared it with the casts and specimens of the canines of *Machairodus* in the British Museum, and determined it as a fragment of the right upper canine of a species of that genus. The only doubt which one could possibly have about such a specimen as this, with its characteristic serrations and outline (see Plate XVI.), was that it might belong to a large *Megalosaurian* whose remains had been brought down from more northern Jurassic beds, and cast on the Norfolk shore.

Two eminent Palæontologists to whom I shewed the fragment, suggested this account of its origin to me, whilst two others agreed in the view that it belonged to *Machairodus*. The known teeth of *Megalosaurus* are, however, smaller, and of a much more sharply curved outline, than is indicated by this specimen,