

of the Wey and Mole; part from the gorge through the Chiltern Hills which flood Oxford and the soft Oolitic valleys. But for the sea-shore, let Mr. Kinahan examine Romney Marsh, the Delta of the Rother, formed by the wash down of the very highest part of the Weald Hill, Crowborough Beacon, 800 feet high. At Hythe, Dungeness, and Pevensey, he will find the flints with which he would require "the whole area" of the Weald to be covered. But from the top of Crowborough Beacon, the centre of the Weald, how many hundred feet of Hastings sand, Weald clay, Greensands, Gault, Chalk marl and flintless Lower Chalk have been washed away by rain and rivers since the last speck of upper flint-bearing chalk vanished? The flints which remain "on the newer beds" of the Weald (except those from the more recent denudation of the face of the chalk slope) have been *caught* on the low flat soft valleys of the Weald clay behind the hard gorges of the Greensand, and in the soft valleys of the Gault behind the hard gorges of the Chalk. When the beds of these gorges were lowered, the sides of the alluviums, no longer overflowed, were denuded, and the alluviums cut back into terraces. But their flat tops remain till the terraces are entirely cleared away. The formation of these terraces has been always going on at heights decreasing directly as the lowering of the beds of the gorges and valleys. That it is going on now may be seen from the deposit of new alluviums with drift gravel at the levels of the present overflows of the rivers. The same thing may be seen on the *opposite side* of the Greensand hard gorge below Farnham, where the Wey runs *into* instead of *out* of the Weald, and deposits vast quantities of drift gravel and alluvium in the soft valley of the Gault. This, also, is going on now. Rivers are the roads which gravels travel to the sea, though they may be arrested for thousands, nay millions, of years in passing alluviums. Witness the terraces of the Fraser River, etc., which are only gigantic effects of what caused the Medway terraces. That is, throughout the wide wide world, atmospheric disintegration and the erosion of rain form a flat valley in the soft strata behind each harder stratum. Every flood is then checked at the gorge of the hard stratum, and overflows and deposits on the soft flat. When the bed of the hard gorge is lowered, the bed in the soft valley behind is also lowered, and the flooded river, instead of overflowing, cuts back its alluvium, which remains as two terraces. Messrs. Foster and Topley mistake in supposing (pp. 470, 471) that a rise of the land is necessary for the deepening of the river-bed. It would only be necessary for those parts of rivers whose beds are at the level of the sea.

GEORGE GREENWOOD, Colonel.

BROOKWOOD PARK, ALRESFORD.

SUBMERGED FORESTS.

SIR,—Submerged forests and the facts connected with them are important, as offering indications of the latest geological changes. Colonel Greenwood's theory, to which he recalls attention in your last Number, is an attempt to account for them without any sinking

of the land or rising of the sea. He thinks that the formation of a bar of shingle across the mouth of an estuary would admit of the surface behind it being dry, although it should be below high-water mark; and that a forest might grow there. One sees marsh land in such positions, but unless there are instances of trees of the same kind as those found in submerged forests now growing below high-water mark, it seems doubtful if they grew there formerly. But the important question is, what have been the relative movements of land and sea since these forests were green? Can we correlate changes of level indicated by other phenomena with such as must have raised or depressed these forest lands. Mr. Godwin-Austen, in his paper "On the Superficial Accumulations of the Coasts of the English Channel, and the Changes they indicate,"¹ arrives at the conclusion, from marks impressed upon the hard rocky margins of the Devon and Cornish coast, that there has been "a change of level, which, so far as elevation is concerned, is necessarily the most recent which has taken place on this section (Dartmouth), and which we may estimate at eight to ten feet." A depression of that amount, he remarks, "would convert the valley of the Exe into a salt-water estuary, and account for the beds of *Mastra*, *Tellina*" (quæ *Scrobicularia*) and *Cardium* found at Alphington." And he states that this movement has been a uniform one throughout, and extends over the area of the German Ocean. Now the remarkable thing is that we have, in every case that I have seen, evidence of such a depression wherever a submerged forest exists. The stumps of the trees are always enveloped in, or covered by, a mud, full of dead shells of *Scrobicularia piperata*, *Cardium*, and other estuarine shells; generally of large size. This deposit is laid bare by the erosion of the waves at the present day, *pari passu* with the uncovering of the forest itself, as the beach is thrust forward over the marshes. This clay, under the name of "Buttery clay," with its usual shells, extends over a great part of the fen land of this neighbourhood, where they spread it over the peaty soil to give it consistency. Beneath it are the remains of forest trees of large size, which sometimes, as the soil sinks through the effect of drainage, protrude above the surface, so that they require to be dragged out by horse power; otherwise they obstruct the plough. There is a detailed account of a submerged forest at Porlock Bay, by Mr. Godwin-Austen, in which the points usually connected with these deposits are excellently brought out.²

Colonel Greenwood's theory will not explain the, I believe universal, presence of the *Scrobicularia* clay covering the old fossils; while this answers exactly to the depression since balanced by the 8-10 foot elevation established on other grounds by Mr. Godwin-Austen. That elevation has brought the forests with their estuarine envelopes to the level of present half-tide. But they have been eight or ten feet lower than they are now, and consequently fully "submerged." It seems to me, then, that they are justly entitled to their old appellation, and that it is a mistake to suppose that they

¹ Journ. Geol. Soc. vol. vii. p. 118.

² Journ. Geol. Soc. vol. xxii. p. 1.

occur without any sinking of the land or rising of the sea. And I, for one, agree with Mr. Kinahan, that they are "submerged" at the present day, in so far that they are below the level suitable to the growth of trees, of the kinds of which they consisted. A singular fact about these old forests that requires explanation is their almost universal occurrence at a certain uniform level of flat land. It might otherwise have been expected, under these circumstances, that they would have grown upon a surface of silt, deposited by water action. But, as far as my observation goes, they usually grew upon the clay, which forms the bed rock of the locality. At Selsey it is distinctly weathered.¹ How came these tracts of uniform level to exist at so many localities?

At some places, however, there is a gravelly bed beneath the forest, and, in such, at Barnstaple occur flint knives.

There is a submarine forest at a much lower level indicated in Mr. Godwin-Austen's paper first referred to (section no. 1, pl. vi.), which must, I think, belong to a period antecedent to that of the forests of which I have been speaking.

I would take the liberty of referring upon the above and kindred topics to my paper on "The Warp," in the *Journal of the Geological Society*, vol. xxii. p. 553.

O. FISHER.

HARLTON RECTORY, CAMBRIDGE.

A VOICE FROM THE PAST.

SIR,—I suppose there has been no more thorough and accurate observer of geological phenomena than the late Prof. Sedgwick. On going through his papers of nigh half a century ago, on the English Lake District, I am constantly struck with his minuteness of investigation, and his careful and logical deductions. Had he been blessed with a good ordnance map, there would have been comparatively little general work left for the Geological Survey to accomplish. The following extract from one of the late Professor's letters, dated May 24th, 1842, is interesting in the present day, when land-ice is supposed by some to have been equal to any task:—"No one will, I trust, be so bold as to affirm that an uninterrupted glacier could ever have extended from Shap Fells to the coast of Holderness, and borne along the blocks of granite through the whole distance, without any help from the floating power of water. The supposition involves difficulties tenfold greater than are implied in the phenomenon it pretends to account for. The glaciers descending through the valleys of the higher Alps have an enormous transporting power: but there is no such power in a great sheet of ice expanded over a country without mountains, and at a nearly dead level."

The various Arctic voyages made of late years have shown that the drifting of pack-ice is more often due to winds of constant direction acting upon the many slight irregularities of the ice, than to currents affecting great thicknesses of the watery strata below.

¹ See the writer's paper on Bracklesham Bed, *Journ. Geol. Soc.* vol. xviii. p. 74, note.