

In this paper, which forms a sequel to their description of the Glaciation of the Shetland Isles, the authors, after sketching the geological structure of Orkney, proceeded to discuss the glacial phenomena. From an examination of the various striated surfaces, they inferred that the ice which glaciated Orkney must have crossed the islands in a north-westerly direction, from the North Sea to the Atlantic. They showed that the dispersal of the stones in the Boulder-clay completely substantiates this conclusion; for in Westray this deposit contains blocks of red sandstone derived from the island of Eda, while in Shapincha blocks of slaggy diabase, occurring *in situ* on the south-east shore, are found in the Boulder-clay of the north-west of the island. Again, on the mainland, blocks of the coarse siliceous sandstones which cross the island from Inganess to Orplin are met with in the Boulder-clay between Honton Head and the Loch of Slennis.

Moreover, they discovered in the Boulder-clay the following rocks, which are foreign to the island:—chalk, chalk-flints, oolitic limestone, oolitic breccia, dark limestone of Calciferous-sandstone age, quartzites, gneiss, etc., some of which closely resemble the representatives of these formations on the east of Scotland, and have doubtless been derived from thence. From this they infer that, while Shetland was glaciated by the Scandinavian *mer de glace*, Orkney was glaciated by the Scotch ice-sheet, the respective ice-sheets having coalesced on the floor of the North Sea and moved in a north-westerly direction towards the Atlantic.

They also found abundant fragments of marine shells in most of the Boulder-clay sections, which are smoothed and striated precisely like the stones in that deposit. They conclude that these organisms lived in the North Sea prior to the great extension of the ice, and that their remains were commingled with the *moraine profonde* as the ice-sheet crept over the ocean-bed. From the marked absence of shell-fragments in the Shetland Boulder-clay, they are inclined to believe that much of the present sea-floor round that group of islands formed dry land during the climax of glacial cold.

CORRESPONDENCE.

DR. CROLL'S ECCENTRICITY THEORY.

SIR,—My letter in your March Number has not elicited any explanation from Dr. Croll, but has one from Mr. Wallace; in reply to whom I would observe that Mr. Croll not only admits that the eccentricity would be inoperative on climate but for its causing a diversion of the ocean currents, but he endeavours in great detail to show that the most important of all these currents, and the one on which the difference between the climates of Western Europe and Eastern North America depends, the Gulf Stream, was totally diverted and turned southwards along the coast of South America so as not to enter the North Atlantic at all.

The modification of Mr. Croll's theory which Mr. Wallace now offers we shall be better able to understand when his book appears; but to speak of the influence of the Polar extension of North

America on its climate is only to express in another form the influence produced by the currents, for it is simply because of this extension that the Gulf Stream does not reach the eastern shore of that part of America to which the comparison with Europe applies until it has passed through the refrigerator of the Polar Basin, and issued therefrom as the Polar, or Labrador current. Land not lofty, such as is most of that which forms the Polar extension of North America, has of itself no more refrigerating effect than sea which ameliorates climate only when warmed by equatorial currents, as the condition of the great Antarctic expanse of ocean sufficiently proves. I venture indeed to think that it has less so. Before Mr. Wallace can appeal to any ameliorating influence exerted on the climate of Europe by the Mediterranean (an influence to which the isothermals lend no countenance) as contrasted with America, he should show that the valley of the Mississippi was not submerged during the Glacial period. Some American geologists, as *e.g.* Dr. Newberry, insist that it was; and if so, not only would those conditions, on the absence of which Mr. Wallace relies, be present, but their influence be more considerable than any produced by the Mediterranean, because the water of the Gulf of Mexico, of which such submergence would form an extension, is hotter than that of the Mediterranean.

In testing Mr. Croll's theory, however, we may confine ourselves to North America alone. Owing to the Gulf Stream leaving the eastern shore where these differences begin, and to the Labrador current hugging it down to that point, while the western shore is throughout washed by the warm water of the Pacific, the climate north of the 40th parallel presents on the eastern and western coasts contrasts similar to, though not quite so great as those which obtain between the West of Europe and East of America. Now the glaciation on the eastern and western sides of America follows these existing differences of mean temperature just as it does in the case of Western Europe and Eastern America. Turn where we will, both in the northern and southern hemispheres, the climate of the Glacial period appears to have been a uniform diminution of mean temperatures as they now exist by virtue of geographical conditions and ocean currents; and it is this which in my mind points so strongly to that period having resulted from a cosmical cause wholly unconnected with these conditions, that is to say, to a diminution in the heat-emitting power of the sun.

SEARLES V. WOOD, JUN.

July 9th, 1880.

P.S.—In my first letter I should have instead of "winter cold," said *mean temperature*, as it is this which regulates glaciation.

GLACIAL AND POST-GLACIAL.

SIR,—In answer to the geological questions set by my friend Mr. Dalton in the July Number of this MAGAZINE, I would remark that I know nothing in the brief notice of his "Geology of Colchester" that can be gainsaid. The statement that the *Bison*, *Elephas antiquus*,