

## THE GLACIAL DEPOSITS OF CROMER.

SIR,—Knowing the great objection that geologists have to long papers, at least to those of other people, I tried in my account of the Glacial Deposits of Cromer<sup>1</sup> to condense into eleven pages the main results of four years' work, and of several thousand notes. I am afraid that in so doing I have omitted to make sufficiently clear my reasons for arriving at conclusions very different from those of previous observers.

I must thank Mr. O. Fisher for his courteous and unbiassed references to my paper, and observe that others also have drawn my attention to the insufficient explanation given of the supposed action of the ice-sheet.

The thick mass of contorted beds near Cromer I consider to be quite a local phenomenon, as will be seen by my paper, and I think Mr. S. V. Wood, jun., is quite unjustified in trying to saddle me with the absurd theory that the "ice has shoved Norfolk out of its place." I stated that "the mound of contorted beds pushed up by the ice still remains and forms the high land near Cromer."

The contortions near Norwich, in the Waveney Valley, etc., were, I think, formed by the sliding of the ice over the beds, or perhaps ploughed up on the first advance of the ice-sheet. The mound at Cromer seems to have been pushed along by the ice from the N.E., till the mass of contorted beds reached such a thickness as, for a time at least, to entirely stop the flow, and allow the smaller flow from the chalk hills to follow the slope of the ground independently of the larger sheet. The Contorted Drift is beds of any age contorted at the time of the formation of the Chalky Boulder-clay, and I ought to have given a distinct name to the probably sedimentary and slightly contorted Boulder-clay also called "Contorted Drift;" but from the way that any bed may pass laterally into Contorted Drift, I found it in practice often difficult to separate them.

My difficulties in accepting Mr. Fisher's view, that the contortions were formed by the dead weight of masses let down from above, are firstly—that I cannot find a single case where uncontorted beds have been deposited over the contorted ones, though at first sight many sections have that appearance; and, secondly, that no weight we can imagine possible could drive up the solid chalk at Trimmingham in a ridge three-quarters of a mile long from N.W. to S.E., and apparently about 250 yards wide, this disturbance, it must be remembered, affecting not merely the chalk, but 200 feet of overlying clays and sands. It was from observing this and similar ridges that I came to the conclusion that the contortions must have been formed by slow, steady, lateral pressure from the N.E. On first examining the coast, the impression given by the contortions is, that they are hopelessly confused; but after two years' work at the sections and maps, I found that they resolved themselves roughly into a series of folds with the longer axes parallel with the coast.

With regard to the curious hollows in the Trimmingham chalk mentioned by Mr. Fisher, I have examined several, and they seem

<sup>1</sup> GEOL. MAG. Dec. II. Vol. VII. p. 55.

to be owing to the sharp folding of the chalk, causing irregular cavities to open in various places, these cavities being subsequently either filled with material from above, which would naturally be stratified, as is often the case with cave deposits, or, as in one instance that I examined, apparently always empty. The folding of the chalk shown in my woodcut can now be easily examined; but in 1868, as shown by Mr. Fisher, the beach was much higher.

The diagram, Fig. 4, of my paper, was only intended to give a general idea of my theory: of course in practice soft beds would take much more complicated folds, though their general direction is still distinctly traceable. Unfortunately, there are only short sections to be seen at right angles to the folds.

The extreme shallowness of the North Sea is such that ice even 250 feet thick would be more than sufficient to dam out all the water in the southern part, and supposing a submergence of 200 feet at the time of the Chalky Boulder-clay, about 500 feet of ice would do the same. At the same time the beds immediately below both the Till and the Chalky Boulder-clay are fresh-water and not marine. Nowhere in the south or east of England have I been able to obtain evidence of a contemporaneous marine fauna in any Boulder-clay. With regard to the so-called "Great Submergence," East Anglia has at present yielded no trace of it; and if it had affected this district, one would naturally expect to find remains of deep-water deposits in such a flat country.

CLEMENT REID.

#### THE TERM "SCHIST."

SIR,—The question raised by Dr. Callaway in the last number of the GEOLOGICAL MAGAZINE will doubtless elicit many answers embodying various shades of opinion. Be these opinions what they may, the word *Schist* has in one respect a definite signification in common with the word *schism*.

A schism is a split of some kind, it may be large or small. A fault is a schism; a joint-plane is a schism; cleavage is schismatic, and foliation and lamination also give rise to schismatic or schistose tendencies in the rocks in which they occur. I think, therefore, that Mr. Allport is perfectly justified in using the adjectives *schistose* and *fissile* synonymously.

The only restriction which long usage appears to have imposed upon the term "schist" is that, whether a foliated or a laminated rock, the planes of fission (if planes they can be called, for they are often small and irregular surfaces of parting) should coincide either with the direction of lamination or with that of foliation. Foliation and lamination are not always coincident.

It seems no reason that because the chief foliated rocks are spoken of as "crystalline schists" that therefore, no other rock, no matter how fissile, should be excluded from the benefit of a term to which its structure may quite well entitle it.

To express my own opinion, I should say that I fail to appreciate Jukes's definition, and that in common with Mr. Allport I use *schistose* and *fissile* as convertible terms when the fission is not of that