

phosed. I write, however, less as a critic than an inquirer; and for any petrological autocrat or parliament who will fix our nomenclature, I will, as in duty bound, for ever pray. C. CALLAWAY.

WELLINGTON, SALOP, *March 4, 1880.*

THE GLACIAL DEPOSITS OF CROMER.

SIR,—If Mr. Reid had extended his observations he would possibly have suppressed the paper which appeared in your pages of last month. Geologists will find the refutation of it in the structure of the Wensum Valley by Foulsham, Guist, and Fakenham, where the beds of the Cromer Cliff have been cut through by this valley, into which the chalky clay in its unmistakable form has come, resting on the Middle Glacial (a later part of it than that which caps the Cliff section), near the valley bottom, but wrapping over this and lying upon the Till and Contorted Drift direct on the higher slope of the valley. The instances, however, of the excavation of valleys through the older Glacial beds and Crag, and their infilling by the gravel and chalky clay, are universal wherever the Contorted Drift extends, and occur as far south as the southern border of Suffolk.

The gentlemen of the Survey, confined by their duties to very limited areas, form some of them very decided opinions upon the whole subject of the newer Pliocene formation from what they find there. Thus from a gentleman employed in Cambridgeshire and West Essex we have been presented with one theory of the Glacial formation; from another who was employed in the neighbourhood of the Fen country we have a most elaborate theory of it, which in most respects is the exact contrary of the former; and now we have Mr. Reid's. From gentlemen unconnected with the Survey we have had that of Mr. Gunn, who finds everything—upper, lower, middle, “the great laminated series,” and I do not know what besides,—in the Cromer Cliff; that of Mr. Geo. Maw, who made out that the beds of the Cromer Cliff were posterior to the chalky clay, and analogous in position to that part of this clay which Mr. Harmer showed, in 1866, lay in valleys cut through its general outspread; and that of the late Mr. Belt, which was so vast and extraordinary as to be beyond definition here; and besides these, there are my own more moderate views. The principal result of this excogitation must be that geologists in general infer that we are all quite in the dark, and I suspect are, many of them, laughing at us.

Dr. Croll has in your pages insisted that the Glacial Clay of Holderness, which is without contortions, and contains numerous horizontal beds of sand or gravel, is the bed of the North Sea between England and Scandinavia shoved bodily over Yorkshire by the Scandinavian ice; and this, moreover, without disturbing the Chalk floor. Mr. Reid now has it that this ice has shoved Norfolk out of its place (still without disturbing the Chalk floor) and crumpled up the county. Beside, and in contrast with these hypotheses, we have Mr. Geikie and Mr. Skertchley insisting that the morainic clay, which is seen for miles overlying sand and gravel in the North Suffolk cliff, has been dragged thus over by the ice, without even the layer of sand actually in contact with it being disturbed. These things are so far beyond

my feeble powers of comprehension that all I can do is reverentially to take off my hat to these several gentlemen, and subside; maintaining, nevertheless, that the delineation given by Mr. Harmer and myself in 1871 of the beds of the Cromer Cliff is (subject to the clearing up of what may be involved in the unconformity in the midst of the Lower Glacial of the cliff at Hasborough, and eastwards of that place, to which we called attention by sections and remarks) quite correct, Mr. Reid's many subdivisions notwithstanding; as is also the age and position of the beds of the Cromer Cliff section, relatively to the chalky clay that we assigned to them. As regards the mode in which the morainic clay was laid over the sand, I have in a paper sent in to the Geological Society, and now awaiting its turn for reading, given my view.

SEARLES V. WOOD, jun.

DR. CROLL'S ECCENTRICITY THEORY.

SIR,—May I be allowed to suggest to Dr. Croll that he should offer some explanation how the glaciation of North America, as compared with that of Europe, is to be reconciled with his theory. The difference between the Eastern side of North America and that of the west of Europe is admitted to be the result of the ocean currents now existing; but the glaciation of the two regions was merely an equal increase of the cold in both, without change in their relative proportions; the same differences which now exist being shown by the limit to which glacial evidences extend in both regions to have obtained during that glaciation.

This, as I have on more than one occasion observed, appears to me to be a conclusive objection to Dr. Croll's theory, which he admits to be baseless unless there were a complete diversion of the warm ocean currents from the hemisphere glaciated; and its satisfactory removal would to my mind be worth any amount of those subtle reasonings on the physics of heat in which Dr. Croll is so fertile, but which seem to me to be obnoxious to the reproach often levelled at figures, viz. that they may be made to prove anything.

SEARLES V. WOOD, jun.

ECCENTRICITY AND GLACIAL EPOCHS.

SIR,—Dr. Croll in his article in February last speaks of an erroneous assumption, that if the annual receipt of heat be far more than sufficient to melt the annual snow-fall, then such snow must be melted.

He does not point out wherein the error lies, and I feel very doubtful whether I understand what he is referring to. The assumption, he says, is totally opposed to the known facts of Greenland. This statement seems rather too strong. He quotes Meech's calculation that the heat received there, neglecting that cut off by the atmosphere, is enough to melt 50 feet of ice. We must make allowance for the great thickness of air traversed by the sun's rays, and for the loss of heat by the great obliquity of reflexion. A very rude calculation, with no pretence to accuracy, brings out that these reduce the heat received by the ground, to sufficient for melting only some 16 feet of ice. Since to vaporize ice requires $7\frac{1}{2}$ times as much heat as to melt it, this would dissipate by evaporation only little more than two feet