CORRESPONDENCE.

DR. CROLL'S EXCENTRICITY THEORY.

SIR,—In your last number Mr. Searles V. Wood advances what he considers to be "the conclusive objection" to Dr. Croll's theory of excentricity as a cause of the glacial epoch, viz. that North America was glaciated further south than Europe, in proportion to its *present* difference of winter climate, while Dr. Croll admits his theory "to be baseless unless there was a *complete diversion* of the warm ocean currents from the hemisphere glaciated."

I do not myself remember that Dr. Croll ever made such an admission, and it is certainly not necessary for the application of his theory. But whether there was a *partial* or a *complete* diversion of the Gulf-stream from the coasts of Europe, the result anticipated by Mr. S. V. Wood—a complete *similarity* in the extension of ice over the two continents—was not be expected, *because they are subject to very different conditions*, independently of the action of ocean currents.

Europe is interpenetrated by seas having a southward opening, while the mass of land in Western Europe is trifling compared to that of North America. Transfer the Mediterranean to America and you have a sea entering south of Cape Hatteras, and extending quite across the continent to the Sierra Nevada of California, with northward branches reaching to Lake Huron! The influence of such a sea receiving the waters of one of the largest tropical rivers (the Nile), together with the broken form of the western coast of Europe and the narrowness of the land, must be alone sufficient to give Western Europe an insular climate as compared with Eastern America. But at the same time we have on the American side conditions tending in the very reverse direction. The enormous ice-bearing masses of Greenland and Grinnell's Land immediately to the north and north-east, and the Highlands of Labrador in the latitude of the Germanic plain, combined with the great *cul-de-sac* of Hudson's Bay, to receive icebergs from the north, and pile them up in its southern inlet, almost in the latitude of London, must have tended to lower the climate of North America during the Glacial epoch as much as the Mediterranean and the Bay of Biscay must have ameliorated that of Europe.

These causes of difference of climate depend on broad geographical facts, which we have every reason to believe existed during the Glacial epoch as they do now, and they appear to me amply sufficient to account for the 10° or 12° further southward extension of the ice in America than in Europe, even if the Gulf-stream were "completely diverted." But I do not believe it was completely, but only partially diverted and also diminished in intensity, and it therefore still exerted *some* differential action on the climates of the opposite coasts of the Atlantic. I would also point out that the difference between the latitudes of points with the same *winter* isothermals in West Europe and East America averages about 20°, which is much greater than the difference of the

limit of glaciation in the countries, and this would show that some equalizing effect *was* produced by the diminished and partial diverted Gulf-stream, as Dr. Croll's theory requires.

Having recently been subjecting the whole of the evidence on the subject of "geological climates" to a careful examination, I may state, that I have arrived at an important modification of Dr. Croll's theory, which will, I believe, obviate the chief objections that have hitherto been made to it. The subject will be fully discussed in a volume I am now engaged in printing.

CROYDON, *April 18th*, 1880. ALFRED R. WALLACE.

PERMIAN ROCKS.

SIR,—The investigation at present occupying the attention of Messrs. Teall and Wilson is, I believe, one connected with a most important geological question,—a question that hereafter must engage more attention than it does at present. These inquirers however are in advance of their age, and have much up-hill work before them. Nevertheless I suspect that hereafter geologists will have to allow that the rocks of the so-called "Permian Formation," are only "passage-beds" between Carboniferous and Triassic formations,—palæontologically allied to the first, but stratigraphically to the second. Before this is accomplished, a great deal of work will have to be done in collecting and arranging in tabular form all the evidence in connexion with the rocks of this so-called formation; and thus prove the *hiatus* said to exist in different places to be imaginary.

In Ireland there are only small exposures of Permian rocks, yet they appear to be very important, as they point to the true character of the rocks that have been elevated into a "formation." They are as follows:—

Permians of Armagh.—These rocks are in the vicinity of Armagh town, and apparently are the conglomeratic basal beds of the Trias. There is no evidence to prove an unconformability between them and the Trias.

Permians of Benburb.—These are exposed in the Blawater valley on the nearing of the counties Tyrone and Armagh. They undoubtedly belong to the Carboniferous, as they lie conformably on a true Carboniferous limestone, while in the centre of the group is a bed carrying typical Carboniferous fossils.

Permians of the Lagan Valley.—Those near Moira are of a somewhat similar type to those of Armagh, and here, as there, seem to be at the base of the Trias; while those at Cultra would have been classed with the associated Triassic beds but that they carry fossils similar to those of the Durham Permians.

Tullyconnell Permians.—These rocks, although apparently belonging to the Trias, carry fossils similar to those in the Cultra beds. In one locality (Templereagh) they are very instructive; here, while sinking a coal-pit, a dolomite 16 feet thick was found, stratigraphically belonging to the Trias, but palæontologically to the Permian. The Permians of Tullyconnell and Cultra, although