

Geological Climates

I HAVE read with much interest Mr. Starkie Gardner's letter in NATURE, vol. xxiii. p. 53.

It is not necessary for me to discuss the question whether I am right in requiring an increase of 20° F. mean annual temperature at Bournemouth in Eocene times, or whether he is right in demanding an increase of only 14° F. to 15°, for I am able to show that the one increase is as *impossible* as the other, on the principles held by Lyell and his followers.

Mr. Starkie Gardner's ideas on the subject of oceanic circulation and its effects upon climate are expressed in the following words:—

“The general cooling effect of incessant oceanic circulation between the North Pole and the Tropics is, I think, scarcely taken into sufficient account; and although it may be contended that conversely the northerly flow of the Gulf Stream mitigates climate, I think that its action in Europe is chiefly in fending off the ice-laden currents from our coasts,” &c., &c.

This statement, to my mind, involves so complete a misapprehension not only of the physical causes of oceanic circulation, but also of the whole problem of geological climate, that I shall ask your permission to lay down a few elementary propositions on the subject, which are capable of demonstration.

1. The Gulf Stream of the North Atlantic, so far from acting the part of a policeman in “fending off” imaginary cold water streams from the Polar regions, is the *cause of their existence*. If there were no Gulf Stream there could be no Labrador current of cold water running south. The same statement is true of the Kuro-Siwo of the North Pacific, of the Brazilian current of the South Atlantic, and of the Mozambique current of the Indian Ocean.

2. If the globe were covered with water, or in the condition of an archipelago pretty uniformly distributed, there would be no exchange of currents between the Tropics and the Poles, and consequently no effect upon climate. Within the Tropics there would be a broad, slow current of warm water moving from east to west, and producing no effect upon climate. In the temperate zones there would be in the northern hemisphere a feeble interchange of south-westerly and north-easterly currents, and in the southern hemisphere a similar interchange of north-westerly and south-easterly currents, both incapable of affecting climate to any sensible degree.

3. If a north and south barrier be constructed to the westward of a locality like the West of Europe; such a barrier as North and South America affords, a gulf stream is, at once, formed, and a corresponding Labrador current running in the opposite direction.¹ The effect of the Gulf Stream is to raise the temperature of the West of Europe to its *maximum*, and the effect of the Labrador current is to depress the temperature of the east coast of North America to its *minimum*.

4. It is *impossible* to suggest any rearrangement of land and water which shall sensibly raise the temperature of the West of

¹ The earth's rotation compels the Gulf Stream to impinge on the west coast of Europe, and the Polar current on the east coast of North America.

Europe, or sensibly depress the temperature of the east of North America.

Mr. Gardner makes the following hypothetical redistribution of land and water :—

“Supposing, as all evidence tends to prove, that Northern Europe and America were connected by continuous land in Eocene time, would not the mere fact of shutting off the Arctic seas cause a general and perhaps sufficient rise of temperature?”

My answer to this is that such an arrangement of land and water in the North Atlantic would raise considerably the present *minimum* temperature of the east coast of North America, but would produce little or no effect in raising the already *maximum* temperature of West Europe, which already receives the full benefit of the Gulf Stream, and suffers none of the injuries of the Labrador current.

It seems to me not possible to raise the mean annual temperature of Bournemouth 15° F. or 20° F. without supposing an *increased Gulf Stream*; in other words, an *increased sun-heat*, which is contrary to the ideas of Lyell and his followers.

I must again ask Mr. Duncan to name the *species* of bamboo that flourishes so luxuriantly at Cooper's Hill under the disadvantageous conditions he has so well described.

If he decline to do so I have no other remedy than to go to the Indian Engineering College on my next visit to London, and inspect and report on the bamboo myself.

Trin. Coll. Dub., November 23 SAML. HAUGHTON