

"Geology in Nubibus." An Appeal to Dr. Wallace and others.

IN his timely and important letter to you, Dr. Wallace congratulated us all on having got rid of a *real* glacial nightmare by sweeping away the tropical glaciation which has been favoured

by some high authorities, including himself, Mr. Darwin, and Mr. James Geikie. While we may all share in this congratulation, it must be remembered what it involves.

It has been the fashion with an extreme and aggressive school of glacialists to postulate an excavating tendency in ice to which the formation of lake basins and valleys-without-outlets in mountain districts has been attributed. They will not allow that rock basins are due to any other cause than "omnipotent ice." They scoff at explorers of the mechanics of ice in Alpine countries, like Prof. Bonney and Mr. E. Hill. They jeer at those who have devoted much patience to unravelling the mysteries of Plutonic action, like Prof. Judd and others, who attribute a large number of lakes to dislocations and to foldings of the subjacent rocks. It is no use, in arguing with them, to refer to mechanical difficulties like those involved in conveying thrust of more than a certain amount through a substance like ice, which is known to crush under a moderate pressure, nor to produce any number of mechanical arguments against the capacity of ice to erode lake basins such as those in question; nor is it any use appealing to the stupendous geological difficulties against their conclusions which have been accumulated by quite a number of skilled geologists at home and abroad. All these efforts are futile, for we are told that the ice to which appeals must be made is quite a different thing to any ice we can experiment upon or examine, and that it must not therefore be measured by the ordinary laws that govern ice such as we know it, and this appeal to transcendental ice is considered to be orthodox science in the nineteenth century, an age when induction is supposed to have become a supreme law to us all, and when *a priori* postulates are generally discarded from the realm of physical research. Let this pass, however, and let us test the question in another way. Let us test it, in fact, by this very case of Brazil.

There has never been a glacial period in, nor are there traces of glacial action in the highlands of, Brazil, we are told by Dr. Wallace. Granted. How then can Dr. Wallace, and those who agree with him in this matter, explain the existence on the plateau of Bahia of perhaps the largest and most remarkable collection of rock basins in the world, rock basins existing, too, in close juxtaposition with most perfect examples of giants' cauldrons on the largest scale. This is assuredly a dilemma for the transcendental school of geologists.

Let me quote from Mr. Allen's graphic descriptions of these rock basins. Speaking of the plateau of Bahia, he says: "Over this whole region there is an almost entire absence of loose materials on the surface . . . slight knolls and shallow basins alternate which rarely differ more than 20 or 30 feet in elevation. In the rainy season many of these basins become filled with water, forming shallow lagoas varying in area from less than one to more than 50 acres, from most of which the water evaporates in the dry season . . . So numerous were these lagoas for more than 50 miles that it seemed natural to speak of this region in my notes as the "Lake Plain." Almost everywhere the elevations are evenly rounded, indicating that the rocky crust has been exposed to rain and probably long continued abrasion. But the absence of abraded materials seemed most remarkable; very rarely were even loose boulders observed, though a few such were repeatedly noticed. At frequent intervals there were irregular holes in the rocks, usually nearly filled with water, to which the inhabitants give the name of 'caldeiraos.' These caldeiraos are of frequent occurrence. . . . Nearly all of the considerable number examined proved to be genuine pot-holes, and some of them were of great size. The largest one I measured was elliptical in outline, 18 feet long, 9 or 10 in width, and 27 deep, with smoothly worn sides. . . . These pot-holes often occur out on the plain, far away from any high land, and they are sometimes found excavated on the summits of slight bulgings in the plain, or even on the top of a hill."

I would ask, in all seriousness, whether, if phenomena like these had been described from the Alps or from Nova Scotia, they would not assuredly have been pointed to by extreme glacialists as the unerring footprints of great ice-sheets, and yet Dr. Wallace, who is a champion of the school, repudiates the former glaciation of Brazil altogether.

What is to be said in regard to this dilemma then? It is quite clear that either the facts must be disputed (and who is to dispute them?), or else the champions of ice at-all-hazards must concede that rock basins and giants' cauldrons can be made by other agencies than ice. If so, they can be made as well in one

place as in another. If they could be made by other causes on the plateau of Bahia, why not in the highlands of Tasmania?

I am bound to say I was taken aback by Dr. Wallace's comments on a letter from one of your correspondents, which appeared in NATURE a short time ago. That gentleman professed to make an exploration of certain parts of Tasmania with another experienced geologist. They were both champions of the glacial theory. They both went prepared to find traces of glacial action there, and certainly in our latitudes no evidence seems more easily discriminated, and they came back convinced that in the districts where the rock basins of Tasmania abound, there are no traces of glacial action to be seen. They could find none. Mr. Johnstone, who has written an elaborate and detailed geological memoir on the island, and who has explored it in many directions, could find none either, save on the western flanks and in the valleys of the Tasmanian Alps in the western part of the island, where it has been long known that traces of former local glaciers exist. There is absolute unanimity among the native geologists that nothing in the shape of ice-sheets existed there, and there is no ice-spoor in the central districts where the great Tasmanian lakes occur. Dr. Wallace's answer to all this was certainly unexpected. He has not himself visited the island, and yet he disputed not only the inferences but the facts and the observations. Why should the voice of Esau be listened to and approved in Brazil, and that of Jacob be repudiated in Tasmania? Mr. Johnstone and the other observers in Tasmania are assuredly to be trusted in such an issue quite as much as Prof. Branner. I cannot see on what ground the discrimination is made, except the desperate inconvenience of postulating a glacial nightmare in the tropics.

Assuredly the whole difficulty lies in championing a theory of the origin of lakes, unknown in geology until introduced by Ramsay, whose extravagance at times may be measured by some of his phrases addressed to the British Association when he presided over the geological section. From all sides there comes a revolt against this theory, which is based on no empirical evidence, and is at issue with the mechanical properties of ice so far as we know them, and with the observations of practised observers of the first rank. I am bound to say that those geologists who habitually make appeals to forces in Nature, and to properties of matter which are purely hypothetical and unwarranted by experience, are leading us back to times when Aristotle and deductive reasoning dominated European thought, and when Bacon had not yet taught us better things.

My attention has been called to an oversight in my previous letter. Among those who many years ago did good work in dissipating the particular glacial monster that was generated in the valley of the Amazons, was my old friend Dr. Woodward, whose papers on the subject in the volume of the *Ann. and Mag. of Nat. Hist.* for 1871, pp. 59 and 101, I had overlooked.

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