A Palæozoic Ice-Age.

THE account by Dr. Wallace in NATURE (p. 55) of glacial deposits recently discovered in Australia is a most important and welcome addition to our knowledge. But to us the surprising circumstance is that Dr. Wallace appears quite unaware of the fact that this is only an addition to a great series of discoveries, by no means confined to Australia, affording evidence of a Palæozoic ice-age. That the deposits near Sandhurst are Palæozoic may, in the absence of any indication to the contrary, be assumed, since they are clearly similar in position and character to the well-known boulder beds of Bacchus Marsh, and these have been correlated with the strata containing ice-borne fragments, amongst the marine beds west of Sydney and also at Wollongong to the southward, and in Queensland to the northward. All these beds have been shown to be upper carboniferous. A good account of the facts known up to 1886 may be found in Mr. R. D. Oldham's paper on the Indian and Australian coal-bearing beds (Rec. Geo. Surv. Ind. xix. p. 39).

It is scarcely necessary to refer to the fact that extensive Palæozoic glacial deposits, of the same age as those of Australia, have been found in several parts of India, some as far within the tropic as lat. 18° N., others in the Salt Range of the Punjab, that the famous Dwyka conglomerates of South Africa are similar and in all probability contemporaneous, and that boulder beds of very possibly the same geological date have been observed in Brazil. We should not have mentioned these but for the fact that the idea of a Palæozoic ice-age is apparently novel to Dr. Wallace. We do not think, however, that the reason why so well-informed a naturalist is unacquainted with geological data long known to many is any mystery. It has become an accepted article of faith amongst most European geologists (there are, of course, exceptions) that no ice-age occurred before the last glacial epoch, just as it is part of the geological creed that the carboniferous flora was of world-wide extension, and as it has become the prevailing belief that the deep oceans have been the same since the consolidation of the earth's crust. Now the discoverers of glacial evidence in the carboniferous beds of India and Australia also assert that the carboniferous flora of those countries differed *in toto* from that of Europe and resembled the jurassic flora of European regions, and some of them add that the great southern flora of South Africa, India, and Australia must have inhabited a vast continent, part of the area of which is now beneath the depths of the Indian Ocean. Partly from Indian and Australian geologists being regarded as heretics geologically, partly from other causes, the evidence of ice action in India and Australia has been generally ignored. No better proof could be afforded of the fact that European geologists in general have omitted to notice the series of discoveries in the southern hemisphere and in India than the publication of Dr. Wallace's paper.

The glacial evidence as it now stands is extremely interesting and perhaps transcends in importance that of the Pleistocene glacial epoch. For as the effects of the carboniferous ice-age were felt within the present tropics, either the earth's axis of rotation must have shifted considerably, or else the refrigeration of the surface must have been due to a cause distinct from that supplied by the late Mr. Croll's theory, even when supplemented by Sir R. Ball's amendment.

Our own interest in the whole subject is chiefly due to the circumstance that we happened in 1856 to be the first who met with the ancient boulder-bed in India, and suggested that it might be explained by the action of ice. The discoveries in Australia and South Africa were of course quite independent of those in India, but were, we believe, slightly later in date.

November 20. W. T. BLANFORD.
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