

growth, at the expense of the nutritive properties of the blood, and by perversion of those chemical changes necessary to the maintenance of the life of the infected animal. That the germinal matter exists in a state of extreme minuteness, the following experiment shows :—A cat being with young was inoculated with the poison, and dying in three hours, her four kittens were removed from the womb. They were all dead, and their blood contained the foreign cells, as did that of the mother. To pass from the cat to the kittens, the germinal matter must have penetrated the delicate membrane covering the tufts of the foetal vessels. If the poison of serpents can thus readily be traced through the body, and from parent to offspring, why should not the path of all infections be tracked? Some months ago, it was stated that it was conjectured that a child had been bitten by a snake. No doubt need ever exist for the future; a drop of blood will always furnish the necessary evidence. I trust the subject will call forth other investigators in Victoria, for it will assuredly be taken up at home. It has been to me a matter of surprise that while this colony very properly appoints men to survey her coasts, explore her skies, and the ground beneath her feet, no one systematically explores her diseases, a subject in which the rich and poor, the living and those about to live, are equally and deeply concerned, and in comparison with which many other subjects that excite her people are trifles. I cannot conclude without thanking Dr. Gummow, of Swan-hill, for having sent me such a fine supply of snakes, nor without expressing my acknowledgments to Messrs. Lawrence and Ashworth for their ready assistance in my many experiments.

ART. XXI.—*Notes on the* REV. J. E. TENISON WOODS' paper "*On the Glacial Epoch of Australia.*" By JULIUS HAAST, PH. D., F.R.S.

[Read 14th October, 1867.]

In the "Transactions of the Royal Society of Victoria," part 1, vol. viii., which I received a few weeks ago, I find an interesting and suggestive paper written by the Rev. J. E. Tenison Woods, "*On the Glacial Period of Australia,*" and read March 4th, 1867, on which I beg to offer a few observations; the more so, as the author, when alluding to New Zealand, does me the honour to refer to my labours.

Mr. Woods states that I have found extensive evidence of glacial action in New Zealand, but that my observations are rather too limited to allow conclusions to be based directly therefrom.

As I have traced glacial action, during the last seven years, over the whole length and breadth of the south island of New Zealand, with the exception of its most southerly portion, which I have not yet visited, I do not consider my observations too limited for generalisations on that important subject.

Before entering into the consideration of the main argument of Mr. Woods' paper, I wish to point out that the expressions glacial action or glacial deposits, are rather vague, as they do not convey a definite explanation of the phenomena to be described, and I therefore propose to call these deposits which are of glacier origin, glacier accumulations, and the time in which they are formed, the glacier epoch; whilst I wish to restrict the expression glacial action to those forces produced by the moving of icebergs through aërial or marine currents, and the expression glacial deposits to the beds originally formed on the bottom of the sea, and derived from the stranding or melting of icebergs. Thus, for instance, it will at once appear important to express clearly if certain striæ or rocks are made by glaciers on land or by icebergs on the sea bottom, by designating the first, glacier, the second, glacial, striæ.

Consequently, glacier accumulations are of subaërial, glacial of submarine origin.

Having thus stated what I consider to be of great importance, when considering the nature of accumulations deposited during the post-pliocene age, I may add that all the iceborne deposits in New Zealand are of glacier or subaërial origin.

As no glacier accumulations are found close to the sea along the east coast of this island, any geologist when travelling through that district, and examining the nearest tertiary marine beds, will come necessarily to the conclusion (if he judges only from negative evidence), that no glacial or glacier epoch has ever occurred there, the more so as the newest tertiary marine beds seem to indicate that the tertiary pliocene sea, even towards the close of its era, had a somewhat higher temperature, than the sea water of our day possesses near that coast.

On following the sequence of these our youngest pliocene

beds, it becomes at once evident that a rising of the land took place, although probably of only small vertical extent, immediately after their deposition, and that the glacier epoch then began, succeeded at once by that era in which the quaternary beds proper were formed, if we call so all beds of the recent era, or at least those deposited since our great glaciers retreated to their present position.

Thus although great and important changes in the physical condition of New Zealand have taken place while these beds were being deposited, for which a long lapse of time was necessary, nevertheless when compared with the geological record in general these three last changes occupied but a moment in the earth's history, and gave but little time for the extinction and reproduction of new species, if we except the extinction of our gigantic wingless birds, due principally I think, to human agency.

However, I believe that during the glacier epoch of New Zealand, the most of the New Zealand marine species travelled northwards, and only partly returned when the great glaciers retreated, and the present physical conditions entered into existence, of which there is ample evidence to be found in our youngest tertiary beds.

But what would the geologist, who had travelled along the east coast observe, were he to advance some thirty miles inland towards the Southern Alps? He would find all the lower mountains which form the outrunning species of that gigantic chain, iceworn, innumerable roches-moutonnées standing along or even in the courses of the former immense glaciers, the lower end of which, during their greatest extension, had reached very often fifty miles below their present terminal face; huge terminal and lateral moraines generally encircling and forming our picturesque Alpine lakes; miles and miles of ground covered by morainic accumulations, broad and straight river beds, the former glacier channels sometimes three miles wide, filled with shingle-beds, in which the muddy glacier torrents flow in numerous channels, and by which, without encountering any serious obstacle, we reach the existing glaciers.

And, considering the size of the Alpine chain, even the present New Zealand glaciers are of enormous dimensions when compared with the European Alps, so that to find an explanation to this phenomenon, we have to examine the climatological conditions of New Zealand, its insular position, and the direction of its Alps, principally in refer

ence to the equatorial currents, before we can find a *vera causa*.

But it is evident that the geologist who on examining the youngest marine III. beds along the east coast, had pronounced that no such epoch ever existed in New Zealand, would come to a different conclusion after making a journey inland; the more so if he should happen to travel along the western coast of this province, where, for more than one hundred miles, morainic accumulations, from either continuous walls or bold headlands, against which the sea has for ages continued its work of destruction and rearrangement.

Doubtless the observations of the Rev. J. E. Woods are exceedingly valuable and interesting, but they are, in my opinion, of a purely negative character only, and do not show that when the lower portions of the New Zealand glaciers during their greatest extension reached the sea, and were washed off and carried away in the form of huge icebergs, into the Pacific Ocean, the climate of the southern portion of Australia, and of the neighbouring seas, was not similarly affected as that of New Zealand.

That peculiar climatological conditions exist even at the present time, by which glaciers in temperate regions can reach the sea, has been conclusively proved by Darwin, who traced glaciers producing icebergs, in deep fiords and bays on the west coast of South America, in latitudes corresponding to Stewart Island, and which descend from mountain ranges much less elevated than our New Zealand Alps.

It is in those bays and along the coast of that interesting region, where very valuable data are offered to us, showing how far the refrigerating influence of huge icebergs detached from the terminal face, affects animal and vegetable life when compared principally with bays and coasts of the same country, where no glacial action is going on.

The dredge will doubtless prove satisfactorily that a more antarctic or stunted fauna exists in the bays or in the open seas of South America, which are under glacial influence, than in those portions of the east Pacific Ocean near the same coast, but which is not traversed by icebergs, although both are situated in the cold antarctic or Humboldt current. Let us hope that future explorers of these regions will devote some time to the investigation of such a highly important subject, which will no doubt offer us some curious facts for comparison.

I have elsewhere ("Report on the Formation of the Can-

terbury Plains," Press office, Christchurch, 1864. "On the causes which have led to the excavation of deep lake basins in hard rocks, in the Southern Alps of New Zealand," vol. xxi. "Quarterly Journal of the Geological Society of London,") treated on some of the causes by which that remarkable glaciation of New Zealand originated, and will therefore not repeat here the same arguments on which my theory has been based. But I wish to point out that during the glacier epoch in New Zealand, it is possible that Australia was also rising, and that thus no evidence of the fauna of that epoch is accessible to us for examination; its exuviae, and the beds of littoral origin formed during its duration, having been buried still deeper, or submerged, when the country sunk again towards the close of the glacier epoch.

Therefore if we want to find evidence of a glacier epoch in Victoria, we must look for it in the Australian Alps, where morainic accumulations may have been preserved round the lakes, and along the valleys; and where striae, rocks, moutonnées, and other physical features peculiar to glacialised countries may be found. Although from the altitude of the Australian Alps, the position and extent of these glacial indications can be expected to be of small dimensions only, even if they exist at all.

I wish once more to point out that the principal reason why I take the liberty to lay these few notes before the Royal Society of Victoria, was simply to show that all the observations made by me point towards the conclusion that no glacial epoch, during which the lowlands were buried below the sea, and rose again afterwards above it, has existed in post-tertiary times in New Zealand; and that consequently no beds derived from icebergs, or deposited in a refrigerated sea, could be open to our inspection, because this island during that epoch was either stationary, or was raised above the present sea-level.

Of course we have no evidence of the amount of emergence during, and subsidence after, the glacier epoch, which may, however, have been of various degrees in different localities. As far as I am aware the physical features of Australia are in that respect similar to those of this island.

And may we not safely assume that by such rising of the land in the southern seas, however slight it may have been in the temperate zone, an antarctic continent made its appearance, of larger dimensions than that of which the outlines are partly known to us; and that large islands between it

and Australia and New Zealand were formed from the smaller islands now existing in those regions, such as Auckland, Campbell, and Macquarrie Islands? The volcanic region, mostly submarine, which stretches from the antarctic volcanoes Erebus and Terror to New Zealand, may in some respects, be connected with such changes in the level of the land during post-tertiary times.

It is obvious that larger tracts of land than at present exist near the South Pole, must have had a remarkably refrigerating effect upon the climate of Australia, especially if by such rising the warm equatorial currents which now surround us on all sides, and even extend their favourable influence as far south as Macquarrie Island in 50° latitude, were driven back by polar currents. If these cold currents reached the southern shores of Australia, surrounding, perhaps, New Zealand, as the South Australian current does at the present day, and which, without doubt, is the cause of the fine climate of the latter; it is easy to account for any physical changes in both countries.

I have been led to forward to you these few, and I fear somewhat desultory observations, in order to draw the attention of Australian geologists to the study of the physical and surface geology of the Alps, which would, I have no doubt, reveal important facts, and assist us in connecting the glacial epoch with New Zealand, and in unravelling some of the causes by which such a remarkable extension of its glaciers has been effected.

ART. XXII.—PART I.—*The Mineral Waters of Victoria.*

By J. COSMO NEWBERY, B. Sc., Analyst to the Geological Survey of Victoria.

The analysis of mineral waters is a subject of so much interest to those engaged in scientific and economic pursuits, that I propose to bring before you, from time to time, the results of my investigations in the mineral waters of Victoria. Before speaking of the subject of the present paper, the analysis of waters from a spring at Ballan, and from some of the mines of the Maldon district, it may be as well to make a few general remarks upon the chemical action of water on the crust of the earth. A certain proportion of



Haast, Julius von. 1868. "Note on the Rev. J. E. Tenison Woods' paper "On the glacial epoch in Australia"." *Transactions and Proceedings of the Royal Society of Victoria* 8(1), 273–278.

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