PROFESSOR GEIKIE ON THE GLACIAL PERIOD.

ON Nov. 12 the Edinburgh Geological Society held its anniversary meeting, at which Professor Geikie delivered his presidential address, the subject being, "Supposed Causes of the Glacial Period." The lecturer began by remarking that, although the subject of his address had frequently been canvassed, the last word had not yet been said. The question of the cause or causes of the Ice Age was indeed a hard one, and he was not going to advance any novel speculation or hypothesis on the subject. His object was rather to examine certain views, which, after having been abandoned as untenable, had again been put forward to account for the phenomena of the glacial period. Before attempting to criticise these views it was obviously necessary to ascertain, in the first place, what conclusions had been arrived at with regard to the climatic conditions of glacial or Pleistocene and post-glacial times. We must first have an adequate conception of those conditions before we could estimate the value of any theory of their origin. The climatic conditions of the Pleistocene were then considered. It was shown that at the climax of the so-called glacial period the line of perennial snow in Europe was depressed for not less than 3,500 feet on an average. To bring about such a depression the mean annual temperature must have been lowered 10° or thereabout.

Full consideration of all the glacial phenomena led to the following conclusions: (1) That the cold of the glacial period was a general phenomenon due to some widely-acting cause — a cause sufficient to influence contemporaneously the climate of Europe and North America. (2) That glaciation in our continent increased in intensity from east to west, and from south to north. (3) That where now we have the greatest rainfall, in glacial times the greatest snowfall took place. (4) That in the extreme south of Europe, and in North Africa and South-western Asia, increased rain-precipitation accompanied lowering of temperature — from which it might be inferred that precipitation in glacial times was greater, generally, than it is now.

The remarkable climatic changes of the glacial or Pleistocene period were next considered. It had been proved that the period was interrupted certainly once — perhaps, as many geologists maintained, at least twice — by what were known as inter-glacial conditions. The evidence of this was treated in considerable detail, and the character of the inter-glacial climate was described as being markedly temperate and genial. There could be no doubt whatever that the Pleistocene period was characterized by great oscillations of climate — extremely cold and very genial conditions alternating. The evidence of the post glacial beds showed likewise that these had been accumulated under similar, but much less marked, alternations of cold and temperate climates. Lastly, attention was directed to the fact that both in Pleistocene and post-glacial times changes in the relative level of land and sea had taken place.

Any suggested explanation which did not fully account for these various climatic and geographical conditions could not be satisfactory. The view which had met with considerable acceptance, especially by American geologists, was that which attributed the phenomena of glacial times to great movements of the earth's crust. Professor Geikie then proceeded to examine that "earth-movement hypothesis" in detail. He pointed out that in the first place there was not the least evidence of great continental elevations in the northern hemisphere, such as the hypothesis postulated. Next, he showed that even if the desiderated earth-movements were admitted, they would not account for the phenomena. Each of the several applications of this earth-movement hypothesis was criticised in succession, with the result that they were all found inadequate. Neither great elevation of the northern lands alone, nor such elevation accompanied by submergence of the Isthmus of Panama and the deflection of the Gulf Stream, would account for the peculiar conditions of the Ice Age. These changes, no doubt, would profoundly affect the maritime regions of North America and Europe, but they would not reproduce the conditions that obtained at the climax of the Ice Age. Another objection to the earth-movement hypothesis was this, that it did not account for inter-glacial conditions. The advocates of that hypothesis imagined that those conditions would supervene when the highly-elevated northern regions were depressed to their present level, and when the Isthmus of Panama reappeared. But these were precisely the conditions that obtained at the present time, and yet in spite of them the climate was neither so equable nor so genial as that which obtained in inter-glacial times and during the mild stage of the succeeding post-glacial period. The earth-movement hypothesis must be rejected, not only because it was highly improbable that such wonderfully rhythmic elevations and depressions of high northern lands and of the Isthmus of Panama could have taken place, but chiefly because it did not explain the conditions of the glacial period, while it practically ignored those of inter-glacial times.

Professor Geikie next considered the proofs of former submergence which are so abundantly met with in temperate and northern latitudes, and discussed the various views which have been advanced to account for the facts. He concluded his address by considering an objection which had been urged against the physical theory of the glacial period as advocated by the late James Croll. This objection was based on certain estimates of the rate of erosion of river-valleys, the accumulation of alluvial deposits, and so forth, from which it was sought to show that only some 7,000 or 10,000 years had elapsed since the close of the glacial period. The consideration that, if this contention were true, it would bring the close of the Ice Age down to the dawn of civilization in Egypt was rather startling, to say the least. The fact was, however, that all such estimates, however carefully made, were unreliable. Dr. Croll's theory might some day be supplanted by one more satisfactory, but it would not be overturned by niggling and inconclusive measurements of that kind. That theory holds the field in giving the simplest and most consistent interpretation of the climatic vicissitudes of the Pleistocene and post-glacial periods, while it is the only one that throws any light on the very remarkable conditions that obtained during inter-glacial times.

LETTERS TO THE EDITOR.

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The editor will be glad to publish any queries consonant with the character of the journal.

The Loup Rivers in Nebraska.

PERMIT me to submit through your columns to Professor Hicks the following questions and comments on his acceptable account of the Loup and Platte Rivers in *Science* for Jan. 29 last.

The topographic maps of the region in question are too incomplete for one to learn much from them concerning the present condition of the river valleys; but from general descriptions of that part of the country and from the brief mention by Professor Hicks of the "channels excavated from fifty to two hundred feet