SCIENTIFIC RESULTS OF NANSEN'S JOURNEY ACROSS GREENLAND.

DR. FRIDTJOF NANSEN, at a meeting of the Geographical Society of Berlin, Nov. 8, 1890, read a paper on his journey across Greenland, with special reference to the scientific results of the same. By this expedition it is shown ("Proceedings of the Royal Geographical Society," London) that the whole of Greenland south of about 75° north latitude is covered by an immense unbroken coating of inland ice. How far this covering extends over northern Greenland is not yet accurately known. That it must go beyond 75° is evident from the mighty glaciers which project into the sea along the whole of the west coast of Greenland. Of these, the immense glacier at Upernivik shows a movement of as much as 99 feet in 24 hours. Such glaciers must of necessity be fed by an unbroken ice-covering in the interior, because otherwise they would not have sufficient material for their enormous production. Although under 80° north latitude there are large glaciers, like the Humboldt glacier, still the latter appears to have no important motion; and, inasmuch as Grinnell Land also is not completely covered with ice, it is quite possible that the extreme north of Greenland, in consequence of the atmospheric precipitation being too insignificant, is no longer wholly overlaid with this ice-covering.

The highest point reached by the expedition exceeded 8,915 feet, and lies about 112 miles from the east coast and 168 miles from the west coast. But the highest part of the ice does not lie so near to the east coast as might appear from the foregoing: for, in the first place, the route of the expedition was not at right angles to the coast, but inclined to the longitudinal axis of the country, the direction being first north-west and then west-south-west; and, secondly, the land in the interior rises from the south to the north. Consequently the highest point of the ice lies, in fact, nearer the middle of the country than would appear from the route. The periphery of the ice-covering corresponds pretty much to the segment of a circle of about 6,450 miles diameter. The Jensen journey into the interior gives a circular periphery with a radius of 5,560 miles; and Nordenskiöld's journey, one with a radius of 14,530 miles. It follows that the upper side of the inland ice forms a remarkably regular cylindrical surface from one coast to the other, although the radii of this cylinder increase cousiderably from south to north. The underlying land is certainly, as the numerous fiords prove, just as mountainous as Norway. But the fact that the surface of the ice is so regular is due to the pressure of the plastic ice-masses, and the surface of the ice reaches its highest level just where the resistance to this force is greatest. The watershed of the underlying land lies nearer to the east coast than to the west; then the resistance to the pressure of the masses of ice will also be greater on this side than on the west coast, and the high ridges of the ice-covering will also be found to lie between the middle axis of Greenland and the water-divide of the land buried beneath the ice.

The thickness of the Greenland ice, Nansen estimates at from 5,000 to 6,000 feet over the valleys of the underlying land. The pressure of a glacier 6,000 feet high upon its base would amount to at least 160 atmospheres: the ice-masses must therefore exercise a strong moulding influence upon the land. The inland ice at a short distance from the coast is composed of fine dry snow, on the top of which the sun in summer only is powerful enough to form a thin melting crust. The ice-poles six feet long could be driven into these masses without striking firm ice.

The daily variation in the temperature amounted, in the month of September, to from 36° to 45° F. The annual variation must be enormous. The moisture of the air is very great: with few exceptions, it amounted to between 90 and 100 per cent. The number of days of atmospheric precipitation is also large. Of the forty days occupied by the expedition in crossing the ice, four were rainy, snow fell on eleven, and hail on one. Inasmuch as there is now no melting of the ice in the interior of Greenland, and evaporation also is almost *nil*, the chief factor in preventing the further increase of the ice-masses, apart from the great part which is played by the movement of the ice-masses in the direction of the coast, is apparently to be found in the "terrestrial heat." Given the mean annual temperature on the surface of the inland ice at −22 F., and the geo-thermic scale of depth of the ice at about 55½ feet per 1° F., the temperature of the ice would, even at 3,000 feet, stand at melting-point. In any case, an active melting process goes on at the bottom of the ice, and rivers pour forth into the sea from under the ice in winter as well as in summer. Nansen himself had the opportunity of observing this during the most rigorous winter. These streams, which must flow under the enormous pressure of the ice-masses, are powerful eroding agents. The formation of the "asar" in Sweden, and of the "kames" in Scotland, England, and Ireland, are apparently to be accounted for in this way.

LETTERS TO THE EDITOR.

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What caused the Obliquity of the Ecliptic.

IT is difficult to bring the mind to believe that there ever was a time when there were no seasons, — spring, summer, autumn, and winter, — as now. In attempting to account for natural phenomena, we have nearly always assumed that the axis of the earth was orignally inclined to the plane of the ecliptic at an angle of 23½°, as we now find it, and of course we in consequence have formed in our minds the idea of the annual recurrence of the seasons through all geological time; but the elimination of the seasons from the early history of the earth has been forced upon us by the accumulation of facts from the geological record. There is abundant evidence to prove the existence of tropical or sub-tropical animals and plants in Arctic latitudes as late as the tertiary. In Professor Dana's "Manual of Geology" (third edition, p. 352) that author says, "If we draw any conclusion from the facts, it must be that the temperature of the Arctic zone differed little from that of Europe and America. Through the whole hemisphere, and we may say world, there was a genial atmosphere for one uniform type of vegetables, and there were genial waters for corals and brachiopods." Scarcely any one now, who is conversant with the facts, will deny that the early history of the earth was marked with a uniform, or nearly uniform, temperature, in all latitudes, prior to and including most of the tertiary. The main difference of opinion existing now among scientific men is how to account for such uniform, world climate.

So of the glacial period. Every one admits that the great array of facts justifies the conclusion that the poles of the earth were, since the tertiary, covered with great ice caps or sheets several thousand feet thick, and reaching down to the 40th parallel of latitude, constituting the great glacial epoch. There is a wide divergence of opinion, however, as to the origin or cause of this glacial cold. Mr. Croll, in his "Climate and Time," has formulated a theory, derived from the secular changes in the eccentricity of the earth's orbit, through which he finds a place for the glacial period; but this theory, if true, must provide for alternation of warm and cold periods at the poles throughout all geological time. Professor James Geikie of Scotland, in his "Great Ice Age," indorses this theory, and attempts to find evidences of former glacial action, not only in the tertiary, but also in mesozoic and paleozoic times. But the weight of the evidence seems to be against this theory, and Mr. Geikie himself admits that much of his "evidence" is "not very convincing."

The best and most satisfactory explanation of the warm and cold periods at the poles has been made by Professor C. B. Warring, in a paper read by him before the New York Academy of Science, and published in the *Popular Science Monthly* for July, 1886. This paper merits a much more extended notice than it has apparently received, for its author has very strongly fortified his several propositions. Briefly, his argument is this: The existence of tropical vegetables in Arctic latitudes cannot be supported upon the theory of a warm temperature only. Light was as necessary as heat; and this light must also have been uniform