

SUMMARY OF THE GLACIAL PERIOD.

The facts presented in the preceding sections, together with others of a similar nature not here recorded, show that in Central Turkestan there are many evidences of a Quaternary glacial period, although all records of glaciation are confined to high levels. Wherever old moraines are well developed they indicate that the glacial period is divisible into two or more subdivisions; and where the valleys are large and reach high enough still to contain glaciers the number of these subdivisions is five, marked by successive moraines, each of which is smaller and at a greater altitude than its predecessor. Two theories present themselves as worthy of consideration in explanation of these facts. According to one there was but a single glacial advance and retreat. The retreat was not accomplished uniformly or rapidly, but by successive steps, after each of which there was a long pause that gave opportunity for the accumulation of a moraine; thus five moraines were formed by each glacier and those now in process of deposition belong to the sixth step of the same long retreat. According to the other theory, each moraine represents a distinct glacial epoch, during which the glaciers first advanced and then retreated. Under this theory the intervals of retreat were as warm as or warmer than the present and the ice retreated far into the mountains during each of them.

For fifteen out of the twenty-four glaciated valleys examined the first theory is sufficient, but it will not explain the other nine. In eight of these nine valleys one or more of the older moraines lies upon a topography different from that of to-day, so as to suggest that the moraines and the floor on which they rest have been trenched by a valley of stream erosion. In this valley lie the younger moraines, leaving the older moraines as terraces which extend beyond the later moraines both up-valley and down-valley; the up-valley extension of the morainic terrace gives a minimum measure of the retreat of the glacier during the interglacial epoch. In the ninth valley a detached portion of an older moraine lies far up-valley from its successor and even above the main part of the modern moraine. These facts are to be explained only by supposing a glacial retreat and advance in each interglacial epoch, and hence a warmer interglacial epoch between colder glacial epochs. Another sort of evidence of a warmer interglacial epoch is found where one moraine lies upon its predecessor in an attitude which indicates that before the deposition of the younger moraine the older one was first an area of erosion and later of deposition. All these facts accord with the theory of successive advances and retreats, and thus warrant the division of the glacial period into several glacial and interglacial epochs. In one place or another signs of an interglacial retreat are found between each successive pair of the four earlier moraines, while the fifth moraine stands apart from the others, except at Kan Su, where the time during which there is evidence of retreat may be either between the third and fourth or fourth and fifth advances of the ice. Everywhere the climate of the successive glacial epochs seems to have grown less severe, and the duration of the interglacial epochs seems to have diminished in the same ratio.