

language as the peoples of Uhu and its neighbourhood. The migration, then, would seem to have taken place previous to the visit of the Spaniards. The *ware ni hau* was found commonly among the peoples of Big Mala as far as the dividing channel.

The Marau man taken to Ulawa had relations at Uki. This would point to a long residence on the part of his people at Marau Sound. A picture showing several *ware in hau* appears in my 'Dictionary of Sa'a and Ulawa Languages,' published by the Carnegie Institution of Washington.

With regard to Gallego's statement that water was found on the Three Sisters, the Ulawa people have a salutation which would seem to show that the water there has always been brackish.

## THE BIAFO GLACIER

Capt. B. K. Featherstone

THE Biafo glacier, one of the largest in the Himalayas, is about 30 miles long and runs from the Hispar pass (17,475 feet) south-easterly to the valley of the Braldu river. The Geological Survey of India made a preliminary survey of glaciers in the Kumaon, Lahaul, and Kashmir regions, as reported in the 1907 Records of the Geological Survey of India. Unfortunately, the area covered did not include either the Biafo or the Baltoro glaciers, so that we are dependent on previous travellers for their records. These reports cover a period of over sixty years, and it will be of interest to recall their notes before giving the result of my own observations.

The first European to leave any record would appear to be Godwin-Austen, in 1861, who reported that the glacier was wedged against the opposite bank or left flank of the Braldu valley. The Braldu river, formed by the emissary streams of the Baltoro and Punmah glaciers, was entirely covered, and flowed under the Biafo glacier through a tunnel. Sir Martin Conway in 1892 took observations on July 31 and September 5, which enable us to determine the average daily movement of the glacier between these dates. These observations clearly show that the glacier had retreated since 1861, and was in active process of doing so.\* The Braldu river in 1892 flowed in open daylight, the foot of the Biafo glacier being about a quarter of a mile short of its old position in 1861. It is reasonable to infer that in 1892 the glacier must have been shallower than in 1922, when I saw it, as Sir Martin Conway estimates that during the month of August the extremity receded a further quarter of a mile, leaving uncovered a wide moraine of earth and vegetation. By 1899, according to the Workmans on the occasion of their first visit, the Biafo

\* The rate of recession comes out about 36 feet a day: sufficiently remarkable to invite inquiry whether anything like it has been observed elsewhere.

glacier had so shrunk that it barely reached the outlet into the Braldu valley at all. During the next three years this shrinkage in volume must have been arrested and an increase set in ; for Guillardmod in 1902 reported that the glacier had again advanced as far as the right bank of the Braldu river, driving before it a low frontal moraine. He further states that the ice was 600 feet thick, and that the Braldu river was being squeezed into a narrow bed. Six years later, the Workmans on their second visit in 1908 found it practically in the same position as in 1899, and it must therefore have shrunk again. In 1909 the Abruzzi expedition recorded that the steep front of the glacier showed no trace of frontal moraine, and that the river was flowing through a narrow gap between the valley wall and the steep front of the glacier ; this obviously indicates an increase in volume between 1908 and 1909.

In 1922 I made as complete a reconnaissance as possible in the circumstances. Proceeding directly from the rock at Korophon to the river's edge, I found the glacier abutting thereon, but of no great height. I climbed on to it and made my way in a westerly direction across it, keeping parallel to the river. It was impracticable to pass between the glacier and the river except in a few odd places where the river did not wash the edge of the glacier. About halfway across I reached two large pools of foaming water, some 20 feet in diameter, adjoining the river ; there was a ring of shallow water except in the actual centre, where it was impossible to judge the depth. From the middle of these pools the water rose in foam some 2 or 3 feet, like a fountain, indicating clearly the junction, with the river, of two streams flowing from the body of the glacier. These two streams were the same water which I had previously crossed, flowing in places on the surface, when I was making my way eastward to Korophon, some distance north of the river. They had found their way under the surface of the glacier until they joined the river in the manner described ; these holes were distinct outlets, and a considerable volume of water was issuing from both of them.

When about three-quarters of the way across I sighted the main snout and decided to make a bee-line for it, the ice looking practicable. Up to this time I had been picking my way fairly near to the foot of the glacier, and had met with no difficulty, but my short cut proved a very different proposition. The surface was wholly broken up into hillocks, which were separated by deep depressions of varying shape and size according to the intensity of the causative pressure. Now and then there would be caves with walls of dark-green ice, whose size it was impossible to judge owing to darkness. The hillocks are generally covered with detritus consisting of immense boulders or rocks or sharply broken fragments of rock *débris* ; at times it is so thick as completely to conceal from sight the ice beneath. It has sometimes incorrectly been claimed that the formation of these hillocks is due to unevenness in the glacier-bed, but the Workmans, amongst others, have shown that they are

caused by pressure of an affluent stream of ice joining the main trunk. Once formed they are carried downward for many miles, not changing their order, and even after some 15 to 20 miles they are just as thickly covered as when they were newly formed. In this case particularly, owing to the widening of the Braldu valley, the irregularities in the glacier-bed, and the pressure due to the entrance of several tributary streams, the hillocks were broken up into a confused mass without order, with deep crevasses here and there.

After climbing with difficulty over the uneven and rough surface, I found myself on a ridge of ice about 100 feet high, just above the main snout. At first sight it looked as though ropes would be required, but my porter went ahead, and we managed to find a way down with the aid of our alpenstocks. The descent was rather dangerous owing to loose rocks, and we did the last 10 feet or more on our sides and elbows. It is curious to note how rocks have a way of remaining fast on steep icy slopes such as this without sliding to the bottom, as one would have thought that the ice, being melted by the sun, might release them. It has been suggested that these rocks have been pushed up from below, but examination of those on the Biafo glacier shows this to be hardly possible. If they had been forced up from below they should be rounded and polished by friction, but the moraine on all the glaciers I saw was of rough, uneven, and splintered rocks, obviously having undergone no friction whatsoever. They must therefore have been deposited on the surface of the glacier, and not have been forced up thereto.

The snout or end of the glacier was a large irregular cavity formed by the glacier on one side and a wall of rock on the other, which was part of the side of the valley. A considerable volume of foaming water dashed out, and the inhabitants said that there was an excessive quantity of water that year, which might tend to show that the glacier was advancing. From this point down to the river stretched a moraine-like surface, over which I picked my way until the western extremity of the glacier was reached; I then retraced my steps, past the two pools, to Korophon.

To sum up, at the date of my visit in 1922 the Biafo glacier was advancing, its end being right up to the Biafo river, and according to the natives it had been so for two years. They also stated that the glacier was forcing the river to cut into the opposite bank, causing great landslides; in the event of a landslide on a sufficiently large scale, temporarily to block the river, the adjacent villages in the Braldu valley would be too high to be affected by the resulting flood, but those in the Shigar valley might suffer. I am inclined to the opinion that it is quite possible to ascribe some of the apparent variations in the observations of this glacier to their having been taken from different points. In front of the main outlet of the glacier to the river was a stretch of about 300 or 400 yards of the moraine-like surface, and the remainder of the glacier abutted directly on the river.

The latest reference to the Biafo glacier is taken from the 'Additions and Corrections to Routes in the Eastern Himalayas, Kashmir, etc., vol. 1, no. 1, January, 1925,' published by the Survey of India, and is as follows: "Mr. R. O. Egeberg of Indiana reports that in 1923 the Biafo stream could be crossed below the snout of the glacier, owing to the retreat of the glacier, by two enormous boulders and along the new moraines." It is difficult to draw any definite conclusion as to the glacier from this report: as regards the crossing of the Biafo stream, this would depend to some extent on the hour of the day.

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### SOUTH-WESTERN ANDALUSIA AND THE TARTESSOS PROBLEM

Südwest Andalusien. Beiträge zur Entwicklungsgeschichte, Landschaftskunde, und antiken Topographie Südspaniens, insbesondere zur Tartessosfrage.— Otto Jessen. (Ergänzungsheft 186, *Petermanns Mitteilungen*.) Gotha: Justus Perthes. 1924. 11 × 7½, pp. 84. *Illustrations*. 7.60 M.

THE first appearance in the long series of Petermann supplements of a monograph on a purely Spanish subject is an event of some importance to the student of Western Mediterranean geography: it would have been of still greater importance had the motif of the monograph been more purely geographical.

Dr. Jessen tells us in his Introduction that he went to Spain first in the summer of 1922 in the company of Professor Schulten in order to make a geomorphologist's contribution to the determination of the site of Tartessos, and it appears from a remark on p. 54 that he returned to Spain in the same company during the summer of the following year. The Tartessos problem thus furnished the initial stimulus of this monograph, of a considerable section of which it forms the leit-motif; it directed Dr. Jessen's inquiries, too, into a channel which made it natural that, when he moved out of the immediately relevant area, he was still principally attracted by one type of geological phenomenon. As a corollary to his preoccupation with a coast-line in which there are considerable breaches of continuity, his monograph is divided into separate and somewhat water-tight sections.

So far as the Tartessos section is concerned we must distinguish carefully between Dr. Jessen's contributions to our knowledge of the morphological development of the area, which have a value of their own apart altogether from the problem of Tartessos, and that body of evidence, totally distinct in nature and in value, which is adduced by scholars from the texts.

In the former category we have an admirable account of the tract of coast lying between the Huelva Bar and the mouth of the Guadalquivir, which the student of dune formations will read with interest, and which must be taken as superseding entirely Mr. Bonsor's somewhat popular description published in the Hispanic Society's monograph 'Tartesse.' Professor Schulten's hypothetical (and *a priori* most improbable) north-western arm of the Guadalquivir, entering the sea at Torre del Oro, is shown to have had no existence, while the confirmation of Mr. Bonsor's north-western arm, marked to-day by a line of lagoons reaching inland from the curious summer settlement of Matalascañas,