On Observations of Glacier Movements

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succeeds like success; his marauding and conquering ramifications extended far and wide. He conquered the large district of Wassulau. He gained recruits from every quarter; small chiefs that were afraid of him voluntarily surrendered, and in self-defence placed themselves under his banner. He became a terror to all, and his influence extended far and wide, from towns on the right bank of the Niger to countries bordering on Futa Jallon. There was one particularly rich town he desired to possess, named Keniera, eastward of the Niger, occupied by a chief named Bagoba. Bagoba resisted, and sought assistance from the French. From that date up to the present Samory, as the French call him, may be said to have come in contact with that nation. It would appear he made some treaties with the French, which he is accused of repudiating, and for some years past he has been at war with them, endeavouring to stop their advance into his territory. I see by a recent account in the *Times* newspaper he lately met with a severe repulse from French arms at or near Segu, but that he personally escaped. His intention was, I believe, to carry war through the Limba and other countries adjoining Sierra Leone, right down to Port Lokko; but this the Sierra Leone Government was evidently fortunate in stopping, through the timely and successful visits of Major Festing in 1887, who died on the return journey, and of Mr. Garrett, who has given us to-night an account of his journey to the country occupied by the Sofas, of whom Samodu was the head. The country and tribes surrounding Sierra Leone are full of interest; the latter are very numerous and frequently inclined to be troublesome, necessitating a continuously watchful and observant policy on the part of the Government with sometimes a resort to force. I do not know that I need detain you any further, but the two accounts in the paper to-night are to me full of interest. There are a great many minor points, but it appears to me that these two journeys are the most important.

The PRESIDENT: Mr. Griffith has supplied us with exactly that information which is required to bring into full relief the importance of the journeys performed by Mr. Garrett. Mr. Garrett has, I think, very great reason to be obliged to him; and we have very great reason, I think you will agree, to be obliged to them both. I see by your applause that you will instruct me to thank Mr. Griffith, and to thank Mr. Garrett also. I believe his son is present, and I trust he will convey to his father the pleasure he has given to the Royal Geographical Society by the account of his journey, which if it had any fault it was only this—that he did not say enough about his own achievements.

On Observations of Glacier Movements.

By M. DE DÉCHY, HON. CORR. F.R.G.S.

IN a recent number of the 'Alpine Journal' there appeared an interesting article upon glacier observations by Captain Marshall Hall, F.G.S. The author first describes shortly how things stand as regard actual observation of glacier advance and retreat in Central Europe; he then complains of the "sublime indifference" as to the history of glacial movements shown by travellers outside the "playground of Europe." Captain Hall mentions the numerous glaciers in British territory—in the Himalayas, in New Zealand, in the western portions of the British possessions in America—from which, "if there be records, probably no connected accounts exist." A large series of facts can easily be ascertained by every traveller, says the author further, and if this had been done for a very few years past in North

America, New Zealand, the Andes, the Himalayas, and the Caucasus, an excellent foundation for valuable results would have been laid.

Captain Hall's remarks are only too true, and we will hope with him, that with the extension of mountain exploration outside Europe the subject will receive adequate attention. It is true that if the exploration of the highlands of Central Asia and the ranges of western North America is to be thorough, "travellers must take with them some knowledge of glacial phenomena, they must be at the pains to acquire at least the rudiments of the mountain craft"—to quote the words of Mr. Freshfield in the Royal Geographical Society's 'Hints.' It has been the absence of these qualifications that has prevented many in other respects excellent travellers from advancing our knowledge of the mountain ranges they visited in any but a purely topographical sense.

For the present I wish only to give, after a short mention of some easy methods to be followed in glacier observations, some records made by me during my Caucasian travels, and to invite future visitors to these mountains to continue these observations, which may lead to the tabulation of useful data. I will only refer here to such observations regarding advance and retreat, increase or diminution of volume in the ice, as are likely to correspond with and to supplement my own observations. Leaving out of question elaborate trigonometrical methods, such, for instance, as have been carried out on the Rhone Glacier in Switzerland, the following plan gives very valuable results, and demands no other instruments than a small jar of paint, a brush, and a measuring tape. To ascertain the recent retreat of a glacier, measure the distance from the end of the ice in front of the longitudinal axis of the glacier to the most advanced terminal moraine, where vegetation first shows itself. The bare ground recently left by glaciers is easily recognisable. The diminution of volume is best measured by ascertaining the height of bare soil left on the sides of the lateral moraines in the portion of the glacier within the zone of vegetation. All photographic representations of the glacier end, and of the ground which has been freed from the glacier ice, are of great value.

It is very important to investigate the state of neighbouring glaciers, as regards advance or retreat, as it happens that neighbouring glaciers (see the Hintereis and Vernagt glaciers in Tyrol, the Asau and Terskol glaciers in the Caucasus) furnish very different results in this respect.

To examine the actual movements of glaciers, it becomes necessary to fix the actual state of the ice at the end of the glacier with the greatest accuracy, if possible at several places. Two methods can be employed for this purpose, which may be selected accordingly as circumstances are more or less favourable to either of them. Paint some signs on large boulders, not too far from the ice end, and measure their distance from it by a tape (Richter's system), or build a low wall of stones of a few yards in length and say 15 to 20 inches in height, some distance from the ice end, and measure this distance (Gosset's system). It is to be recommended that the stones of these walls should also be painted. Either of these methods is easy, and cannot be enough recommended to travellers in far mountain ranges. If the traveller himself returns after some interval—even after only two or three weeks—he will be able to judge of the movement of the glacier, and he will have laid down the ground for future observations by future travellers.

In 1885 I laid down some marks at the end of several Caucasian glaciers. Those revisited in 1886 showed the following results:—

At the Cei Glacier of Adai Khokh group (side valley of the Ardon) the boulders painted with the signs A, B, and D, showed a retreat of 23 feet, 15 feet, and 20½ feet respectively.

In the Upper Baksan Valley the glaciers Asau and Terskol descend from

the same reservoir of *névé* under Elbruz. The glacier of Asau is a glacier of the first order; the Terskol Glacier, although filling up the end of a small side valley, ends by a fall over a sudden break in its bed, and may be classed as a glacier of the second order. On the Asau Glacier, the wall built near the end was destroyed, the advance of this glacier was clearly shown by many evidences, and also the photographs taken from the same standpoint (indicated by paint) in 1885 and 1886. On the Terskol Glacier, on the contrary, a retreat not very great and hardly measuring 3 feet was proved. It may be noted that the Terskol Glacier has a steeper course than the Asau, and that steep glaciers move more rapidly in their oscillations than those the beds of which are less inclined: the Bossons Glacier and Mer de Glace are good examples.

On the Adish Glacier, under Tetnuld, valley of Ingur, Svanetia, a glacier of the first order, and descending in an extraordinary ice-fall, a wall was built in 1885 at the end of the ice, at distances of 8 feet and 18 feet. In 1887, two years later, when I visited this glacier in company with Mr. Freshfield, the wall was destroyed. Amongst the blocks, that marked E with paint, an enormous block measured in 1885, at a distance of 43 feet from the end of the ice, was found in 1887 at a distance from it of only $6\frac{1}{2}$ feet. Thus a considerable advance was proved.

It would be very interesting if future travellers would look at these four glaciers, and, if possible, find my blocks, and measure their distances from the end of the ice, noting their marks, and address their results either to me or to the Secretary of the Royal Geographical Society, who will, no doubt, gladly publish them. All new observations on other glaciers, either in the Caucasus, the Himalayas, the Andes, or in Central Asia, should likewise be published, to promote a continuation of these observations and a registration and connection of the results gained, very important ones regarding the history and actual state of glacier phenomena in the mountain ranges of the whole world.

M. Jukoff, of the Russian Survey, has also measured (see 'Proc. R.G.S.' for February last, p. 111), several of the Caucasian glaciers, and thus furnished a further basis for future observers.

*A Journey in Benin.**

By HIS EXCELLENCY GILBERT T. CARTER, C.M.G., Governor of Lagos.

WITH reference to the brief notice of Governor Carter's discoveries in Benin, in our May number ('Proceedings,' p. 321), the following extract from a despatch by His Excellency to the Colonial Office, kindly forwarded to the Society by Lord Knutsford, acquires special interest. The journey extended from Lagos to Ondo and Ilesha. The Governor writes as follows:—

"It may be said that the whole of the country between Makun and Ilesha is one vast forest, with hardly a town of any consequence to relieve the monotony of the journey. The so-called "road" is merely a forest track of the narrowest description, in which a hammock is seldom

* The journey may be followed to some extent on the map accompanying Mr. Millson's paper, in 'Proceedings,' 1891, p. 644.