

CHANGES IN THE RHONE GLACIER.¹

WE are indebted to Swiss naturalists for initiating a careful study of glaciers, and this has been extended, as we learn from the *Zeitschrift für Gletscherkunde*, to many of the most important regions on the earth's surface. In the majority of these their history, prior to the last few years, is a blank. That their glaciers have advanced and retreated is obvious, but when and at what rate is unknown. In the Alps, however, traditions exist which preserve a fairly trustworthy account of the more notable movements for at least two centuries, and the volume now issued by the Swiss Natural History Society, to which M. P. L. Mercanton is the principal contributor, gives, with some mention of these, the results of careful observations of the Rhone Glacier since 1874.

As two well-known passes, the Furka and the Grimsel, command magnificent views of this glacier, it has for long been noticed by travellers, and is represented in illustrations to books before the days of photography, the earliest which has any value dating from 1777. Besson says that the glacier was then advancing, and had four distinct terminal moraines, one at 216 ft., another at 269 ft., a third at 551 ft., and the last at 771 ft. Shepherds told him it had been retreating for twenty years. In September, 1826, there were about four well-marked terminals, besides two or three others less distinct. But it must have advanced rapidly between this date and 1834, for in that year its end was near a newly built auberge, and the swollen aspect of the lower part of the glacier suggests that it was still moving forwards. In 1848 this tongue covered half the Gletsch valley, but there were still four distinct terminal moraines in front of it, which in the next year had been reduced to two.

A more complete record exists, as might be expected, for the two well-known glaciers at Grindelwald, and as they are only about twenty-

five miles distant in a straight line from the Rhone Glacier, their phases are likely to correspond. In 1540 these had greatly shrunk, but they made an equally marked advance from 1575 to 1600, and attained, during the next two years, the greatest extension on record. A retreat then began, which became important between 1661 and 1686, but the glaciers advanced again in 1703 and retired in 1720. From 1743 to 1779 was a period of marked advance, which culminated in the latter year, and was followed by a retreat, which, if the shepherds of the district can be trusted, had already set in with the Rhone Glacier. But in 1819 the Grindelwald glaciers had again become large, though they had not reached the limit of 1602. Then came a period of retreat, but between 1840 and 1855 they again moved forward, like the other glaciers of the



FIG. 1.—The Rhone Glacier in August, 1849. From a daguerreotype.

Alps, though not to their former limit; then, in the latter year, the recession began, which lasted, with slight oscillations, not always in correspondence, until 1912, when both glaciers moved forward. But this retreat was at first very slow, for in 1858 the torrent from the Lower Glacier issued from an ice-cave on the bed of the main valley, and the deep gorge, now made accessible, was wholly hidden by the ice. In that year also the Rhone Glacier had a swollen end, and in the following one the writer saw the Gorner Glacier at Zermatt ploughing up the turf in front. But two or three years later the retreat became rapid, so that by 1870 the gorge and the old marble quarry at Grindelwald had been exposed.

It is difficult to account for these variations in the size of glaciers. The information collected during recent years indicates that, as a rule,

¹ "Vermessungen am Rhonegletscher, 1874-1915." Geleitet und herausgegeben von den Gletscher-Kommission der Schweizerischen Naturforschenden Gesellschaft (Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft). Band lii. Pp. 190 + maps and illustrations. (Bâle, Geneva, and Lyons: Georg and Co., 1916.)

diminution has affected a wide area, and thus suggests a cause operating on a large part, if not the whole, of the earth's surface; while, as the supply basin is limited in valley glaciers, it would require a considerable rise or fall in the mean temperature materially to affect the volume of them, neither of which has been observed. Still, an increased or diminished precipitation of snow on the *névé* of the ice-stream would affect the latter, besides altering the surface ablation of the stream itself. But as the amount of precipitation increases in ascending a mountain range from the lowlands, and then diminishes, much may depend upon the position of the zone on which it is at a maximum. As that zone probably does not exceed, at any rate in the Alps, a thousand feet



FIG. 2.—The Rhone Glacier on August 30, 1912.

vertical, rather small variations in the mean temperature or snowfall of a region may produce somewhat marked effects. The last period of diminution, now more than half a century, seems to bear no relation to either the eleven-year sun-spot period or Brückner's thirty-five-year one, and thus suggests a complication of causes. Be that as it may, in this memoir on the Rhone Glacier the variations in its length, area, volume, and level, the snowfall and ablation, the movement of its several parts, and the relation between the velocity of the surface and the thickness of the ice, are all placed on record, so that students of glaciers owe a debt of gratitude to the authors of this volume and the Swiss Natural History Society.

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SOURCES OF NITROGEN COMPOUNDS IN THE UNITED STATES.¹

THE problem of how to turn the vast store of uncombined nitrogen which exists in the atmosphere into useful products may be said to have been only seriously attacked within the lifetime of the present generation. It had its origin in the growing demand for forms of combined nitrogen suitable for use in the arts, and more particularly in agriculture, the oldest of all the arts. But circumstances arising out of the present world-wide struggle, affecting in greater or less degree every nation, but more particularly those engaged in the war, have forced the problem into still greater prominence by demonstrating how intimately it is bound up with the question of national defence. Indeed, as regards the Central Powers, their very existence is dependent upon it, as they now painfully realise.

Accordingly nearly every highly developed nation is considering it, and its urgency is shown by the circumstance that its solution is no longer left wholly to individual effort or private enterprise. Even our own Government, hitherto not very prompt to initiate action in such matters, has been moved to recognise its national importance, and has got so far as to appoint at least two committees associated with public departments to consider and report upon it.

In this connection it is of interest to note how the question strikes American expert opinion. This is revealed in the publication before us by Dr. C. G. Gilbert, recently issued by the Smithsonian Institution.

As the author points out, in the extension of chemical needs, as in the development of cyaniding in industry, of refrigeration in the preservation of foodstuffs, and more especially in the increased use of fertilisers, nitrogen compounds are now necessary not only to the welfare, but to the very existence of a people living under modern conditions of economic development. Until within a few years past, the yields from India, from Continental sewage-farms, together with the natural supplies from South America, have met the demand for nitrates. Ammoniacal compounds have been produced in rapidly increasing quantities, as by-products, in the various methods of the destructive distillation of coal, peat, and oil-shale; in producer and blast-furnace gas; in bone carbonising, in sewage and garbage disposal, and in a variety of other methods; and the sulphate of ammonia thus obtained bids fair to overtake, if not largely to supplant, Chile saltpetre as a fertiliser. But even these combined sources are now proving inadequate to meet the world's demands, and the increasing necessity has stimulated efforts to effect the synthetic production of ammonia and nitric acid from atmospheric nitrogen.

Of the several methods of accomplishing this synthesis there are at present, so far as is known, only three which are commercially practicable,

¹ "Sources of Nitrogen Compounds in the United States." By Dr. C. G. Gilbert. (Smithsonian Institution, Washington, 1916.)