

Ice and the Formation of Alpine Scenery*

THREE dates stand out as landmarks when a special revival of interest in Alpine glaciology occurred: namely, 1840, when Jean Agassiz published his "Études sur les Glaciers"; 1862, when Ramsay read his paper on the glacial origin of lakes to the Geological Society and Tyndall published his paper in the *Philosophical Magazine*, in which he advocated a glacial origin for the Alpine valleys; and 1900, about which time Peach described the Alpine trough-valleys, and W. M. Davis emphasised the glacial overdeepening of the Ticino Valley, and when, a little later, Penck and Brueckner completed their monumental work on the ice age in the Alps.

It is not until the advent of the eighteenth century that we find any interest being taken in glaciers; then Scheuchzer, between 1706 and 1723, published various works on the natural history of Switzerland which contained some glacial observations, and in which he propounded the dilatation theory of glacier motion. He was followed by Gottlieb Gruner, who in 1760 published his "Eisgebirge", in which he describes the alternate advance and retreat of glaciers, illustrated by an account of the measurements of the Grindelwald Glacier between 1540 and 1750. De Saussure, between 1779 and 1796, published his famous "Voyages dans les Alpes", in which he defined the term 'glacier' and classified glaciers under three orders; in this work he also described *roches moutonnées*, which he attributed to water action, and he ascribed the transport of erratic blocks to a deluge or catastrophe. Though usually credited with the view that glaciers moved as solid bodies, his description of the Mount Dolent Glacier as moulding itself to the form of its valley shows that he recognised the plasticity of ice.

In the first half of the nineteenth century a new impetus was given to glacial studies by the observations of Schimper and Esmark and the writings of Venetz, Charpentier, and Agassiz, all of whom attributed the transport of the famous erratics now found on the Jura to the former greater extension of the present glaciers. This view had, however, been anticipated by Hutton.

* Substance of the presidential address by Prof. E. J. Garwood, F.R.S., before the annual general meeting of the Geological Society of London on Feb. 19.

The publication of Agassiz's "Études sur les Glaciers" did much to stimulate further observation on glacial phenomena during the next few years, but interest again waned after Agassiz's departure for America.

Ramsay's paper to the Geological Society in 1862 created renewed interest, fostered by Tyndall's views on the glacial erosion of Alpine valleys, and discussion was now directed to the work of ice as an erosive agent. Writers on this subject were divided into two camps. Whereas Wallace, Jukes, the brothers Geikie, Logan, Steenstrup, and Penck supported Ramsay, others, including Murchison, Lyell, the Duke of Argyll, Bonney, Rutimeyer, Heim, Credner, and Desor attributed but little erosive action to glaciers.

By the beginning of the present century most observers admitted some erosive action to ice, and more detailed observation focused attention on special features of Alpine scenery. Penck described the trough-shaped characters of Alpine valleys, and Prof. W. M. Davis attributed the hanging valleys and truncated spurs in the Val Ticino to the formation of the trough by glacial overdeepening. The origin of cirques was also discussed and was variously attributed to glacial erosion, water action, and frost action on the cirque wall. The work of Penck and Brueckner had established the occurrence of four glacial and three interglacial periods in the Alps, chiefly on the evidence of the deposits, and the benches which occur on the valley flanks confirm this conclusion. The truncation of the overlapping spurs which occur in the trough valleys shows, however, that the overdeepening must have been largely the result of river erosion during the last interglacial period, the valley having later been widened and modified by glacial action. Certain features, namely, the *arêtes*, cirque floors, the steep south side of the Alps, and in part the hanging valleys, appear to owe their special features to the relatively protective character of ice. The steps in the main and tributary valleys present special difficulties, and cannot be satisfactorily accounted for by simple glacial erosion. They appear to be due in some way to the alternation of glacial and interglacial periods, and may possibly also be due to protection by glaciers during interglacial periods.

Past and Present Whaling Records

IN the whaling ports which furnished the fleets of the nineteenth century lie many log-books containing records of long years of whale fishing. Charles H. Townsend has struck upon the happy idea of using the old records (in New Bedford Public Library alone there are hundreds of log-books) to obtain information regarding the great whaling grounds, the numbers of whales slain, the position and month of capture, and so on (*Bull. New York Zool. Soc.*, Nov.-Dec. 1931, p. 173).

There are several important collections of whale-ship logs at Nantucket, Salem, and other New England ports celebrated in the history of the whaling industry, but these first records are drawn only from the New Bedford logs and refer only to the sperm whale. Nevertheless, the number of sperm whales represented by the plottings upon the chart accompanying the paper is no less than 11,026. The 'whaling grounds', including twelve in the North Atlantic, were visited during fairly definite seasons, as the plottings which

record the position and month of each whale capture show.

In the North Atlantic the plotted areas above latitude 25° show the presence of whales, with few exceptions, during the April-September period, and in the Sargasso Sea the killings are almost wholly confined to the summer period of the northern hemisphere. Between lat. 25° N. and the equator, whales were taken chiefly during the October-March season, and along the coast of South America and towards the Cape of Good Hope the catches were largely made during the same season, or summer time in the southern hemisphere. Off Japan and along lat. 30° N. the period changes to the April-September season. In the Pacific and to some extent also in the Atlantic Ocean, catches for all months are recorded along the equatorial belts, and the cool Benguela and Humboldt Currents had the effect of creating all-the-year whale fisheries off the west coast of Africa and in the neighbourhood of the Galapagos Archipelago.