EARLY DISCOVERERS

XV

A FORGOTTEN PIONEER OF THE GLACIAL THEORY

JOHN PLAYFAIR (1748-1819)

By Louis Seylaz (Lausanne)

It is surprising that the first idea of a glacial epoch during which the Alpine glaciers spread over the centre of Europe was put forward by a man who had not been outside Great Britain and had never seen either the Alps or a glacier.

The son of a Scottish clergyman, John Playfair began his career by studying theology; but he later developed an overwhelming interest in science. In 1785 he became Professor of Mathematics in the University of Edinburgh, and in 1805 he gave up his chair of Mathematics for that of Natural Philosophy.

After the death of the celebrated geologist James Hutton, Playfair, who had been his pupil and later became his colleague at the University of Edinburgh, was given the task of making known Hutton's ideas, and this he did in *Illustrations of the Huttonian theory*, Edinburgh, 1802, a work which brought him great fame in the world of learned men and which is still considered to be the basis of modern geology. But while the exposition of Hutton's theories only takes up 140 pages of the book, Playfair devotes 388 pages of notes to the completion and the explanation of those theories.

In 1779 Volume 1 of *Voyages dans les Alpes*, by Horace-Bénedict de Saussure, had appeared at Neuchâtel. In it the author makes a study of the geological terrain around Geneva. After pointing out the fact that the whole country, not only the banks of the Lake of Geneva but also the slopes of the Salève and the sides of the Jura which face the Alps, are scattered with fragments of rocks, he states that

"the majority of these stones are of granite . . . that the ground on which they have been deposited is of an entirely different kind . . . and that one cannot help recognizing that these fragments are from a quite different formation torn away from the Alps by some powerful agent which has carried them down to their present position".

What is this agent? Discarding the theory put forward by J. A. de Luc of a volcanic explosion that would have thrown masses weighing several tons to distances of 20 to 30 km., de Saussure concludes

"that water is this agent there can be no doubt".

The second part of this same Volume 1 contains the "Journey round Mont Blanc". In this de Saussure describes the glaciers as

"these masses of ice which slide down the slope towards the valley below, full of pieces of the rocks found at the sides of the glaciers, pieces which form the moraines".

These boulders are dragged towards the bottoms of the valleys and arrive between mountains of a kind quite different from their own. He describes very clearly the stones of the moraine

"rounded and polished by friction, boulders housed on the glacier, which have retained their keen, sharp ridges".

One cannot help being surprised that de Saussure, after setting forth the facts of the

problem so clearly, did not draw the correct conclusion from his observations and take the logical step in the field of speculation which could have opened up to him the way of truth.

It was John Playfair who was to offer the only logical and irrefutable solution of the problem. From far-away Scotland, without ever having seen a glacier, purely by deduction and from the sole facts provided by the work of de Saussure, he wrote in the notes accompanying the *Illustrations of the Huttonian theory of the Earth*, Edinburgh, 1802:

"Saussure observed in another part of the Alps that where the Drance . . . joins the Rhone in the Vallais, the valley it runs in lies between mountains of primary schists, in which no granite appears, and yet that the bottom of this valley, toward its lower extremity, is for a considerable way covered with loose blocks of granite. His familiar acquaintance with all the rocks of those mountains led him immediately to suspect that these stones came from the granite chain of Mont Blanc which is westward of the Drance. . . . This conjecture was verified by the observations of one of his friends who found the stones in question to agree exactly with a rock at the point of Ornex [Orny], the nearest part of the granite chain . . . .

"For the moving of large masses of rock, the most powerful engines without doubt which nature employs are the glaciers, those lakes or rivers of ice which are formed in the highest valleys of the Alps. . . . These great masses are in perpetual motion, undermined by the influx of heat from the earth, and impelled down the declivities on which they rest by their own enormous weight, together with that of the innumerable fragments of rock with which they are loaded. These fragments they gradually transport to their utmost boundaries, where a formidable wall ascertains the magnitude, and attests the force, of the great engine by which it was erected. The immense quantity and size of the rocks thus transported have been remarked with astonishment by every observer. *Footnote:* The stones collected on the Glacier de Miage, when Saussure visited it, were in such quantity as to conceal the ice entirely, and explain sufficiently how fragments of rock may be put in motion even where there is but little declivity, and where the actual surface of the ground is considerably uneven. In this manner . . . huge fragments of rock may have been carried to a great distance . . . ."

In 1815-16, when peace had been restored to Europe, John Playfair made a long stay in Europe, in France, Switzerland and Italy. Guided by Ebel and following in de Saussure's footsteps, he travelled through most of the Alpine valleys. At Chamonix he had as a guide Jacques Balmat who shared his admiration for the great Swiss scientist.

On returning to Scotland Playfair was preparing a new edition of the *Illustrations* when death suddenly overtook him in July 1819. We are, however, informed of the results of his researches in the Alps and about the subject nearest to his heart, namely glacial phenomena, by the biographical account which his nephew put as a foreword to the *Collected works of the late Professor Playfair*, Edinburgh, 1822. What he saw in Switzerland and in the Alps fully confirmed the theory which he had put forward in 1802. The foreword states:

"On entering the Val Travers in Mont Jura he met with a phenomenon . . . which had often engaged his attention, namely the existence of loose blocks of granite . . . on the surface of a chain of mountains entirely calcareous. . . . The largest and most striking of these [he calculated to weigh] 2,520 tons. When we consider that the nearest point where the granite is to be found in its native place is at a distance of 70 miles [112 km.] it is clear that this block could not have 'performed such a journey over intervening hills and valleys. . . . A current of water would have deposited it in the first valley it came to . . .' a glacier etc."

As in 1802 so again in 1822, Playfair's revolutionary ideas passed unnoticed, ignored or completely despised. The famous geologists and physicists of the period, Darwin, von Humbolt, de Buch, Buckland, and Louis Agassiz himself before he found his road to Damascus, were determined and relentless enemies of the glacial theory. They held obstinately to de Saussure's explanation—huge floods of water rushing down from the tops of the Alps dragging blocks of stone weighing hundreds of tons—but being aware of the unsurmountable objections which observation, physical laws and simple common sense put against this theory, they were banging their heads against these puzzling boulders. De Charpentier was a doubter for a long time. In England, it was not until 1843 that the well-known glaciologist J. D. Forbes did justice to

Playfair in his book *Travels through the Alps of Savoy and other parts of the Pennine Chain*, Edinburgh, 1843, in which he quoted the work of 1822. By 1843, however, the theory of the extension of glaciers back to prehistoric times had been confirmed incontestably and accepted universally since 1841 by the publication of Agassiz's *Etudes sur les glaciers*, Neuchâtel, 1840, and de Charpentier's *Essai sur les glaciers*, Lausanne, 1841.

In Switzerland the first promoter of the idea was a simple peasant from the Val de Bagnes (Valais), Jean Perraudin. He had been struck by the presence of huge lumps of volcanic rock on the sides of the valley; he had also noticed the scars left by the glaciers on the surface of the rocks. Already in 1815 he had tried to interest de Charpentier in his ideas as to their origin but had only had a shrug of the shoulders in reply. It required all the insistence of the Swiss engineer Ignatius Venetz to convince him. He was forced to give in to the evidence of the facts and from then on he became the keenest supporter of the glacial theory. In his turn he converted Agassiz during the visit which he made to Bex in 1836.

Thus in Switzerland the combination of Perraudin-Venetz-de Charpentier-Agassiz is well established, but it is no less a fact that John Playfair was the first to give a valid explanation of the origin of the wandering boulders and of their transportation far from their original sites.

XVI

THE ORIGIN OF TABULAR ICEBERGS IN THE SOUTHERN OCEAN

In his review of ice observations made during Capt. James Cook's second voyage, 1772-75, Herdman (1959) has drawn attention to Cook's opinions about the origin of tabular icebergs, or "ice islands", as he called them. During the voyage, Cook modified his ideas on the subject, finally concluding that these ice formations must originate, not at sea, but along coasts. In his journal entry for 21 February 1775, he postulated the existence of what later came to be called ice shelves (not discovered until Ross described one 66 years later), from which he thought that these floating ice masses must periodically break away. Some further light on the development of this theory is now available. The publication of Cook's original journal of the voyage (Beaglehole, 1961) includes an Appendix containing extracts from the independent log kept by Charles Clerke (1743-79), second lieutenant on H.M.S. *Resolution*. This is in the Public Record Office (Adm. 55/103). Clerke's thoughts on "ice islands" in 1775 are reproduced on the opposite page, from Beaglehole's transcript (p. 766).

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