

any member of the party has prevented us from reaching our objectives" (p. 131), the question is suggested, whether had there been three climbers in the final attempts of 1924 and 1933 a higher point, perhaps even the summit, might not have been reached, and Mallory and Irvine might not have perished. The success of the Nanda Devi Expedition afforded a strong argument in favour of a small and more mobile organization; but it was reduced beyond expectations, because of the desertion of some of the porters, the lack of whom was severely felt by the climbers, while the supply of food appears to have been skimpy. And Nanda Devi is 3400 ft. lower than Everest.

"One of the most acute problems of expedition life," says Mr. Shipton, "is the difficulty of preserving harmony among the members of the party" (p. 207). Essential to such harmony is that each man should feel he has an important part to play, must be capable of deriving a deep satisfaction from some aspect of his environment, and that all should be in agreement with the general conduct and policy of the expedition. "In my opinion far too much emphasis has been laid on leadership in connection with mountaineering and exploratory expeditions, for this has led to an exaggerated notion of the importance of the leader and the difficulty of the task" (p. 210).

The modest format of the book is hardly in keeping with the importance of its contents, and although the author's powers of description are very considerable, yet his style is so restrained that readers, not versed in mountaineering topics, may hardly realize how great his achievements have been. Among the illustrations which are excellent, there stands out a superb view of the Makalu as a frontispiece, which the attractive wrapper shows the author looking out from a peak N.W. of Everest. Pictures of Shaksgam peaks are very striking. It is regrettable that there is no index.

J. W. A. H.

*Problems in the Geology of Mountains*, by Joel E. Fisher, 8vo., 80 pages, with 41 illustrations (mostly photographs pasted in the text). New York: published privately, 1944.

Many Alpinists perhaps do not realize that their wide and varied experience with snowfields and mountain glaciers places them in a particularly favorable position to contribute to glacial geology.

Many ideas and theories of glaciers have arisen from relatively limited observations by a few scientists of an earlier generation who did not have that wide acquaintance with snow and ice behavior under all sorts of conditions which is needed for a full understanding of the phenomena in the proper perspective. Much is therefore open to correction and much still remains to be added. Geologists have not followed up the early leads as they might have done in later years and thus real opportunities are left to the veteran mountaineer to bring his broader experience to bear on some of the weak points of glaciology.

Mr. Fisher, soundly trained in geology and related sciences at Yale, has evidently sensed this and very commendably, has utilized his advantages to improve our knowledge and explanations of glacial phenomena. His resulting book is an important and welcome contribution, modestly offered, yet presented with a confidence induced by his extensive observations and thoughtful study.

Five problems are treated in separate sections. In the first, the author has marshalled all the various characteristics of *nieves penitentes*, interpreted the testimony of each in turn, and then, on the principle of the master key, has found the general theory of origin which will fit them all. The observed facts, admirably handled, are made to tell their own tales and the combined consistent story has every presumption of being the true one. This section should be read carefully for its working methods as well as for its explanation of *nieves penitentes* and certain other features shaped by melting.

The beautifully regular Forbes dirt bands are the subject of the second section. A few years ago Bradford Washburn brought out the significant fact that, approaching an icefall, a glacier splits in a major crevasse extending almost completely across it. As the crevasse moves onward, new ones open in succession, breaking the glacier into long, parallel transverse blocks. It was his belief that the hard ice of these blocks melt less readily than the softer ice *débris* accumulating in the intervening crevasses; that, because of this and for other reasons, rock fragments and dirt become more concentrated in the partially filled crevasses than on the adjacent ice blocks; and that, upon reconsolidation below the icefall, the lines of the former crevasses become the darker dirt bands while the cleaner surfaces of the old ice blocks between them are the lighter bands.

Fisher, however reverses the sequence contending that the sites of the old crevasses become the light bands while the sites of the more resistant ice blocks become the dark bands. He says that "the unbroken surface of the glacier at the upper lip of the icefall, is definitely dirtier than any ice underneath its actual surface," and that "Ice débris falling into the glacier-wide crevasses characteristic of these icefalls, while carrying with it a portion of the dirty surfaces from the adjacent intervening blocks, will nevertheless greatly dilute that dirt with an overwhelming amount of clean sub-surface ice, so that the floor of the glacier-wide crevasses must be cleaner than the surface of intervening blocks." To show these relations he presents an abundance of photographs (although glaciers developing Forbes dirt bands are quite rare) and brings forth strong evidence in support of his thesis. But which of our two club members is right? Fisher suggests a way to find out by an experiment on the Géant icefall after the war.

The origin of glacial cirques is treated in section three. A cirque is here considered as "no more than the head of a 'U-shaped valley.'" While the reviewer would qualify this statement in certain respects, this approach is a very good one, for rapid erosion of the lower slopes—both of valley sides and cirque walls—is the crux of the problem. What causes this very effective erosion? It has long been recognized that the copious supply of rock débris (cutting tools) along the flanks of the glacier is an important factor in rounding the original V-shaped cross section of its valley to resemble the letter U. For the cirque, Fisher envisages the bergschrund as a passageway by which angular rock fragments from the cliffs above are fed to the bottom of the glacier, there to aid in that powerful erosion of the lower slopes and nearby portion of the amphitheater floor which all well-developed cirques clearly indicate has taken place. He properly (in the opinion of the reviewer) attaches much less importance to freezing of melt water in joint cracks near the bottom of the bergschrund.

As the glacier cuts deeper, steepening the headwall and lowering the floor, ice and snow accumulate here to greater thickness, increasing the weight of overburden and thereby augmenting the cutting power of this portion of the glacier. Erosion here actually increases the capacity to erode still more effectively, as Fisher shows conclusively, and the cirques form becomes more and more sharply sculptured.

The author might well have introduced also the giant steps seen in many strongly glaciated valleys where icefalls have come into being and locally over-steepened the valley bottom. Although in general these declivities are less striking than the cirque head-wall, the plunging ice in many cases has likewise scooped out a rock basin (now perhaps holding a lakelet) at the foot of the cascade where erosion was greatest. Attention should be called to the fact that the steep plunge of an icefall must change its direction nearly to horizontality at the foot of the fall and that the resisting flood which causes this deflection of the ice necessarily suffers excessive erosion at this place. No bergschrund is at the top of a downstream icefall, but the deep crevasses which form there may enable rock fragments from the surface to reach the glacier bottom, functioning there as an additional illustration of the operation which Fisher has clearly portrayed for the cirque.

The last two chapters, entitled "Shiftings of the Axis of Gyration of the Earth as an Originating Mountain-Making Force" and "Overturned Folds in Mountain Ranges and their Origin," tackle difficult problems in tectonic geology with which experts are struggling but without as yet developing more than partial solutions. The author is far less secure climbing these slopes than on snow and ice. Quantitative tests of the adequacy of possible shiftings of the axis of gyration to produce our major mountain ranges could probably be made fairly readily by a series of calculations based on reasonable assumptions of how much earth mass might be displaced by recognized geologic processes. Any real verdict must await quantitative appraisal.

R. T. C.

*War Below Zero; The Battle for Greenland*, by Bernt Balchen, Corey Ford and Oliver Lafarge, with a foreword by General H. H. Arnold, 8vo.; 127 pages, with 15 full pages of illustrations from photographs and an end-paper map. Boston: Houghton Mifflin Co., 1944. Price \$2.00.

Lying inappropriately named, across the top of the world, half within the Arctic Circle, Greenland offered splendid bases from which the Germans could refuel submarines to prey on North Atlantic shipping, launch planes within bombing distance of North Atlantic shores and gauge the future weather of Europe. For us