

which the study is begun." The chapters themselves, however, treat of the subjects with precision and sufficient detail for the production of definite notions on the points discussed.

The treatment of Historical Geology is on the lines of Dana's Manual, but without the details. This method in an exhaustive manual is valuable, but it may be doubted whether the use of so many scientific names of animals and plants as is necessary in such a treatment conveys any definite information to readers who are unfamiliar with zoology and botany; and even to zoologists, unless very well acquainted with the paleontological side of their science. The fact is that a really satisfactory mode of treatment of this fascinating subject of the biological problems of historical geology has not yet come to light.

The illustrations are, in the main, excellent and new and, as has been said, richly American. But some of them are so imperfectly reproduced from the original photographs as to lose much of their value.

The publishers' part of the work is well done, though the user of the book will often be caused to lament that it is found necessary to put so much weight into a book one is expected to hold in a single hand.

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The Glaciers of North America. By ISRAEL C. RUSSELL, Professor of Geology in the University of Michigan. Boston, Ginn & Co. Pp. x+210.

When the glaciers of Switzerland had been well explored those in this country were scarcely known, and now Professor Russell tells us that North America is the best region in the world for the study of glaciers; that all types occur here, of all sizes and in great variety; and he makes good his assertion by the descriptions of the glaciers of North America, so far as they are now known, which fill the greater part of the volume before us.

Professor Russell attacks his subject as a geographer; his aim is to report the present condition of knowledge concerning the glaciers of this country and to 'stimulate a thirst for

fresh explorations and renewed study along an almost untrodden path.'

To carry out this object the book must necessarily be largely a compilation, but the material for an important part is furnished by the original papers of the author himself. Of these we mention especially the account of the Mt. St. Elias region, which Professor Russell explored in the course of two remarkably plucky attempts to ascend Mt. St. Elias.

He opens with a chapter giving a clear account of the characteristics of glaciers and their work, in the course of which he is confronted with the question: 'What is a glacier?'

A concise definition of a class of natural objects is always difficult; and certainly none has yet been given which includes all the phenomena of glaciers. Mr. Russell recognizes this and gives provisionally the following definition: A glacier is an ice body originating from the condensation of snow in regions where secular accumulation exceeds melting and evaporation, *i. e.*, above the snow line, and flowing to regions where waste exceeds supply, *i. e.*, below the snow line.

The majority of geologists and physicists would accept this as fairly representing the essential characteristics of a glacier; but the small number who believe that the force urging a glacier down its bed is not due to gravity alone, but to a large extent to the increase of the volume of the ice on account of the growth of the ice grains, must utterly reject it; for, according to their hypothesis, the source of supply is not snow that falls in the *névé*-fields, but the water that freezes throughout the body of the glacier.

The glaciers of North America are confined to the Cordilleran mountain series and to the Greenland region. Professor Russell says that "the Cordilleran glaciers form an irregular curve, broadest and reaching the sea line in the Mt. St. Elias region, and narrowing and becoming more and more elevated at both its western and southern extremities," and then he successively describes in greater detail the glaciers of the Sierra Nevada; of the Cascade range, the higher peaks of which are volcanic cones and carry glaciers radiating from their summits; of Canada, and of Alaska. The

latter, of course, claim the greatest attention, on account of their number, size and variety. Here are the most accessible tide-water glaciers, and many tourists have already seen the birth of icebergs at the end of Muir glacier. Here also is the great Malaspina glacier, a mass of ice formed by the coalescence of the ends of many glaciers descending from the St. Elias Alps. It lies on a flat expanse between the mountains and the ocean and covers an area of some 1,500 square miles. Professor Russell has crossed this glacier along several lines and practically all we know of it is due to his explorations. It is the only Piedmont glacier that has been visited.

The absence of glaciers in the central and northern parts of Alaska is explained as due to insufficient precipitation; but in these regions we find the strange subsoil ice whose thickness has not been determined, but which in places certainly extends several hundred feet below the surface of the soil.

The glaciers in the northeastern part of the continent occur both in Grinnell Land and Greenland. Some of the former have been visited and described, but have not received much attention, whereas the latter have attracted quite a number of observers. The recent studies of Professor Chamberlin first made us familiar with certain remarkable characteristics of these glaciers which are not found in regions further south.

In the chapter on Climatic Changes, Professor Russell shows that the glaciers of North America, with a few exceptions, are growing smaller; and he mentions the efforts being made by the International Committee on Glaciers to collect information on the variations of glaciers everywhere.

In telling of 'How and Why Glaciers move,' the observations of Kock and Klocke are narrated. These observers thought they had detected certain irregularities in the motion of the Moteratsch glacier, parts of the ice moving at times up the valley. Professor Russell is cautious in accepting such an anomaly, and indeed the observers themselves have since recognized that these irregularities were within the limit of the errors of observation.

The hypotheses which have been advanced

to account for the apparent plastic flow of ice, notwithstanding its great brittleness, are well given and well criticised, especially from the point of view of the geographer; though James Thomson's theory is too shortly dismissed, and Croll's hypothesis receives more attention than it deserves, for it is radically wrong. The growth of the glacier grains, as a cause of motion, has been advanced from time to time, but has not been sustained; Forel developed this hypothesis into a theory, but found later that it was not supported by his observations.

Professor Russell believes that the motion of glaciers is due principally to the plastic flow of ice under its own weight, but that many other causes play a minor part; some of these a physicist would throw out entirely.

The book closes with a very interesting chapter on 'The Life History of a Glacier.' This is an extension of Professor Davis' topographical cycle to the history of a glacier, and is an entirely new addition to glacial literature.

A slip is made on page 181 in saying that the heat absorbed when ice melts equals the heat necessary to raise the water thus formed from its freezing to its boiling point, and §11, p. 187 is misleading; exception might also be taken to the statement (p. 192) that in a vertical section through the névé-fields the maximum flow [velocity] would probably be near the bottom.

This book may be heartily commended to the general reader, and will be of great help to the student of glaciers. It is illustrated by a number of well-selected pictures and maps, and important references are given in foot-notes.

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Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus, herausgegeben von PROF. DR. G. HELLMANN.

No. 7. *Esperienza dell'Argento Vivo*. EVANGELISTA TORRICELLI. *Istrumenti per conoscere l'Alterazioni dell'Aria*. ACCADEMIA DEL CIMENTO. 4to. Pp. 22, 16.

No. 8. *Meteorologische Karten*. E. HALLEY, A. VON HUMBOLDT, E. LOOMIS, U. J. LEVERRIER, E. RENOU. 1688, 1817, 1846, 1863, 1864. 4to. Pp. 13. Charts 6.