A FIRST BOOK IN GEOLOGY: DESIGNED FOR THE USE OF BEGINNERS

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DESIGNED FOR

THE USE OF BEGINNERS.

BY

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INTRODUCTION.

THIS First Book of Geology is intended to give the beginner in the study of that science some general ideas concerning the action of those forces that have shaped the earth. Only a very small part of the more important facts that constitute the store of the geologist is given within its pages. The effort of the writer has been to select from that ample store such topics as will give the student an idea of the world as a great workshop, where the geological forces are constantly working towards definite ends.

The greatest and most easily seen of these agents is water, therefore the book begins with a study of water in its most simple mode of action. Next, the action of heat, in its various ways of working, should command the student's attention. Finally, the animal and vegetable life of the earth, whose forces come mainly from the action of heat, receive some attention.

It will be well for the student to have a general idea of the solar system, for all this machinery of the earth's workshop depends in a large measure on the way in which

the sun acts on the earth. The sun is related to the earth as the boiler to the steam engine, and it is well to know something of its nature, and of the motions of the earth about it, before looking at its effects. Although this preliminary knowledge is desirable, it is not indispensable, for the text explains itself.

However carefully a text-book may be prepared, and however well it may be used, it cannot of itself alone give much insight into nature. This must come from the use of the student's eyes and mind. The most the student can expect from the book is an idea of what is to be seen in the outer world. He will not really know much of this world until he has learned to read the facts himself. The real use of the book to the beginner is to show those things that cannot be readily seen, and to set forth the nature of the forces that act in propelling the earth's machinery.

It will be noticed that some of the most important points in the mechanism of the earth are repeatedly referred to in successive chapters. This has been done with a view to fixing the memory of the most important truths by looking at them from many sides. Every one who has taught geology must have seen the importance of considering each important fact from many points of view.

In using this book, the student should, under each chap-

ter, seek to find if there are not some facts in his neighborhood that have a bearing on the matter given in the text. Some of the chapters give an account of matters which are found only in a few parts of the earth. Rarely will a student find himself in a position to see with his own eyes the structure or action of volcanoes, or the way in which caverns are formed, but there will always be some part of the book where he can help his understanding of the matter with his own eyes.

Let me also urge upon the students who use this little first book that they help themselves to a more pleasant relation with their world by making collections of minerals, fossils, plants, and other objects that will tell them something of nature. Not only is there to most young people a peculiar charm in owning a collection of this sort, but, if the owner will learn all he can about each object in his collection, he will soon come to have a valuable fund of precise and well-remembered information that will stay by him all his life; while the things that have had nothing but words to fix them on the memory will soon fade away.

But, above all, I beg each reader and student of this book to remember that this earth is full of lessons that can be read by every one who wishes to know them, — lessons that will widen the mind and make the soul more

fit for the duties and pleasures of life. The inattentive eye never gets this teaching; but, to those who learn to look rightly on this world, it gives without stint from its great store of truth.

The woodcuts in this book were drawn on wood by Mr. Charles E. Robinson. They are mostly original, but I am indebted to the works of Professor J. D. Dana, Joseph Leidy, and H. A. Nicholson, and to the *Seaside Studies in Natural History* of Mrs. E. C. Agassiz, and Alexander Agassiz, for certain figures.

N. S. SHALER.

CAMBRIDGE, MASS., Jan. 1, 1884.

QUESTIONS FOR THE USE OF STUDENTS.

It should be noticed that sometimes these questions are designed to direct the student to his personal experiences as well as to the statements of the book. A few questions are enclosed in brackets. These may be omitted, as they are a little outside of the text.

CHAPTER I.

Lesson I. Page 1.

1. What variety do we notice in river pebbles? 2. What is the history of these river pebbles? 3. In what way do they journey down stream? 4. Compare the making of boys' marbles with the making of pebbles. 5. How does frost help in the work? 6. How can this be shown by means of a bomb shell?

Lesson II. Page 5.

1. What is a beach? 2. How does the sea-beach wear its pebbles? 3. What is formed of the ground-up pebbles? 4. Is the same grinding up carried on in a river? 5. How do the two processes differ? 6. Whereabouts on the beach are the pebbles the largest? 7. How does the sea begin the process of pebble making?

Lesson III. Page 8.

1. What is a glacier? 2. How do its pebbles differ from those made in rivers and on beaches? 3. What are moraines? 4. How are glacial pebbles made? 5. Finding these pebbles where no glaciers now exist, what do they teach us? 6. Where are glacial pebbles found in North America? 7. If you live in the part of North Amer-