REVIEWS

The Structure of Geology: by DAVID B. KITTS. P. xix, 180. Dallas, 1977 (Southern Methodist Univ. Press, $8.95) paperback.—Few geologists receive formal education in the philosophical foundations of our science. Certainly we have all been exposed to terms such as laws, theories, postulates, and hypotheses. However, one could question whether or not geologists agree on the meaning of these terms and how they are incorporated into thought processes. It might even be said that geologists are a practical lot; they are content to make observations in nature without regard for philosophical matters. It is curious that few geologists have been concerned with this aspect of science.

Kitts addresses the question of the philosophical base of our science in *The Structure of Geology*. Kitts is well qualified to have undertaken this task, as he has been engaged in this sort of research for nearly two decades. This book is organized as follows; preface, introduction, eight main chapters, footnotes, and index. The eight chapters represent articles originally published in geological journals and, in one case, a book entitled *The Fabric of Geology* (Albritton, 1963). *The Structure of Geology* is nicely presented and moderately priced. Kitts' purpose for presenting a series of essays on this subject is that (p. 26): "It is my conviction that to make the inferential procedures of our discipline explicit in light of the clear recognition of its historical character may lead to increased consistency, economy, and completeness in the system of geology."

There are numerous important points discussed in this book of which only a few are highlighted here. Geology is a scientific endeavor, which in contrast to other disciplines such as theoretical physics or mathematics is essentially historical and descriptive in nature. This does not mean that geology is "less scientific" than physical sciences such as theoretical physics, but that it is based on a unique philosophical methodology. Some would claim that one of the values in science is its predictive efficacy. Kitts argues that geology, with the possible exception of, for example, recent trends in applied seismology, is not much concerned with predicting the future, in fact, because of the overwhelming historical component to our science, we are compelled to describe the past. This concern for reconstructing events in early history is termed retrodiction.

The terms observations, theories, hypotheses, and laws are everyday words in our profession. Students of geology are often taught, for example, about the "laws" of superposition and uniformitarianism. In fact, these fundamentals of our science are not laws because they are not strictly universal, that is, they are not true in all instances.

I was particularly interested in the discussion of plate tectonics, continental drift, and paradigms. The paradigm concept is one of the major features of Thomas Kuhn's (1970) monumental essay on the nature of scientific revolutions. Kitts states that (p. 115): "Kuhn rejected the view that science develops by the piecemeal addition of items to the stockpile of scientific knowledge. He suggested rather that periods of "normal science," which are characterized by theoretical stability, are

broken occasionally by episodes of rather sudden change ["paradigms"] in theoretical foundation." Kitts concludes that the revolution in the earth sciences has resulted from a type of paradigm. Later chapters include discussions of absolute geological time and paleontological problems such as the origin of higher categories and phylogeny reconstruction.

My basic reaction to this book is positive. However, I have several criticisms of a negative nature. One of the fundamentals of the scientific method is the use of hypotheses. At present there is no general agreement among scientists as to how hypotheses are constructed or tested. It would have been relevant for Kitts to include detailed discussions of such current controversies as induction versus deduction and verifiability versus falsifiability with regard to hypotheses. Kitts' (1977) article entitled "Karl Popper, verifiability, and systematic zoology" would have brought *The Structure of Geology* up to date. I would have liked to see this article included as the final chapter. Another less substantive comment is that the same geological examples, which illustrate philosophical problems, are used several times in different chapters, and this becomes repetitive to the reader. I look forward to a book by Kitts on this same subject with more continuity and less repetition than can be derived from a series of articles.

There have been too few attempts to explain the philosophical foundations of geology. Kitts has basically succeeded in presenting in an interesting fashion what some might consider to be an abstract and unpalatable subject. I recommend *The Structure of Geology* to those who would like to know more about how we do our science.

References

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