ings perfectly. The earth, Buckland argued, cools continually through time. Mammals replace reptiles when colder climates require constant body temperatures for optimal design. Others, like Agassiz, argued that progress must reflect an intrinsic and independent tendency for perfection; since progress records the operation of God's mind in time, it cannot merely reflect something so vulgar as a vector of environmental change. Thus, Lyell and Buckland lined up on the side of climatic determinism, though they differed on the question of progress. For Buckland, climate changed directionally with time, and life progressed to match it. For Lyell, climates remained in dynamic steady state, and the mean complexity of life stayed constant. Agassiz and Chambers, on the other hand, accepted intrinsic progress as a sign of God's plan. For Agassiz, God worked by successive extinctions and creations; for Chambers, he labored by transmutation. Pro- and anti-evolutionism was simply not the issue.

The book, needless to say, is not without its problems. I hate to sound like a carping esthete, but I do wish that the quality of bookmaking matched the quality of content. The pages are cut unevenly in both copies I have seen, and my Xerox machine would have done much better with the plates. Bowler's fine work deserves better. Pride in craft goeth before higher prices, but ten bucks isn't cheap enough to excuse such a shoddy job.

Of course, the content is not immaculate either. With its passive infinitives and numerous discussions of minor debates among scholars, the book reads like a doctoral dissertation (perhaps it is). More seriously, its lack of attention to German sources (except for a few translated into English and French) leads to some parochialism. For example, Bowler claims that the argument of intrinsic advance, introduced by Agassiz and Chambers in the 1840's, represented a "totally new form of progressionism." But the German *Naturphilosophen*, writing for the most part between 1790 and 1810, had founded a whole school of thought upon this premise. In fact, as Bowler mentions in passing, Agassiz had studied with its two leading lights, Oken and Schelling. Admittedly, the *Naturphilosophen* did not emphasize fossils, but neither did anyone else in the days before Smith and Cuvier recognized their stratigraphic importance.

It might have required another book, but I wish that Bowler had not dismissed in a paragraph (admittedly by acknowledging its importance) the social and political influences upon arguments for progress in the 19th century. The absence of this dimension gives his book a character too close to his subject. It almost seems to argue for inevitable progress in scientific views about progress: as more and more fossils are found, scientists approach the evolutionary model of a branching tree. I don't wish to place myself in the camp of extreme relativism. As a professional paleontologist, I will be astounded if branching trees do not embody an empirical truth. Still, I do not see how any account of progressionism can be fully satisfying without an explicit treatment of the political themes that were wedded to its assertion. If progress had not been extracted from biological evidence, an age of aggressive imperialism would surely have invented it. If stately gradualism had not been championed as the primary mode of geological change, then liberals facing a world in revolution would have found it somewhere else in nature. Progress was the hottest subject in Victorian England. Working men at the Hand and Banner public house argued about it in George Eliot's *Daniel Deronda*. Kipling asserted a right of dominion over "lesser breeds without the law." Spencer outsold Darwin by a long shot. This faith did not rest on the evidence of fossils.

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Petrology

The Evolution of the Crystalline Rocks. D. K. BAILEY and R. MACDONALD, Eds. Academic Press, New York, 1976. xii, 484 pp., illus. $35.

Although this book is composed of six chapters by six authors, it is too highly unified to be regarded as a collection of papers. The theme is the contribution of experimentally estimated phase equilibria to our understanding of nonsedimentary rocks. The editors' preface suggests that the book is intended as a sequel to N. L. Bowen's epochal and unsurpassed 1928 work, *The Evolution of the Igneous Rocks*. Except in spirit, it is clearly not that; half of it deals with metamorphic rocks, which Bowen did not cover, and many aspects of igneous petrology are not treated. The field has grown too large for adequately detailed treatment in a single volume. One of the most important variables represented in the book's numerous phase diagrams is pressure, which could not be adequately controlled at the same time as temperature until a decade after Bowen's book was published (all of his diagrams are limited to pressures of less than 80 atmospheres).

The book is, nevertheless, highly successful in its own right. Thanks to careful editing, the chapters are thoroughly integrated and cross-referenced, with little duplication of explanatory material. Increasingly sophisticated concepts are introduced throughout the book, so that the reader must study the chapters on metamorphic rock as well as those on igneous rock. In light of the increasing specialization among petrologists, this necessity is an exhilarating challenge that can only improve communication between specialists.

In the first part of the book, D. K. Bailey provides a 99-page summary of experimental techniques and strategy that is adequate for the nonpractitioner and a generally clear explanation of how to interpret phase diagrams. Bailey follows Bowen in avoiding thermodynamic vocabulary and equations, but he will surely offend most readers (from advanced undergraduates on) by claiming that "classical thermodynamic terms and concepts are not common currency among earth scientists." The omission of the definitions of fugacity and free energy and of discussions of entropy and volume changes during reactions would be far more serious if most potential readers were not already aware of them.

Fortunately, the authors of subsequent chapters do introduce thermodynamic arguments. R. C. Newton and W. S. Fyfe compare experimental phase relations with natural mineral assemblages in high-pressure metamorphism. H. J. Greenwood reviews metamorphic reactions at moderate temperatures and pressures, summarizing the roles of water and carbon dioxide. W. Schreyer provides an updated summary of mineral stabilities and metamorphic assemblages at high temperatures and low pressures. W. C. Luth presents previously unpublished results and informative new projections of familiar data concerning granitic rocks. Bailey summarizes our incomplete understanding of alkaline rocks. All of the authors point out the limitations of their data and caution against their misuse. Luth, in particular, emphasizes the astonishing lack of experimentation with granite systems at pressures between 500 bars and 1 atmosphere.

These are highly competent reviews of important topics, and most are current through 1974. The generation of magmas is not mentioned, and very little is said about how primitive magmas may evolve into felsic rocks. Bowen began with basaltic magma and derived other igneous rocks by crystal fractionation at progres-

sively lower temperatures. Bailey and Macdonald, in contrast, trace a sequence of metamorphism with ascending temperature that culminates in partial fusion, generating the felsic melts. This volume therefore avoids overlap with H. S. Yoder's 1976 book, *Generation of Basaltic Magma*, as well as with Bowen's classic.

Bowen himself provided the appropriate conclusion for this review; in the following quotation from his 1952 review of Turner and Verhoogen's textbook *Igneous and Metamorphic Petrology*, only the price is changed. "It is a good book. Every petrologist who can borrow $35 should have his copy."

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Marine Geoscience

The Geophysics of the Pacific Ocean Basin and Its Margin. A Volume in Honor of George P. Woollard. Papers from a symposium, Honolulu, Dec. 1974. GEORGE H. SUTTON, MURLI H. MANGHNANI, RALPH MOBERLY, and ETHEL U. MCAFEE, Eds. American Geophysical Union, Washington, D.C., 1976. xvi, 480 pp., illus. $15. Geophysical Monograph Series, 19.

This volume includes 32 papers, many of which have a more geological than geophysical flavor, presented at a symposium celebrating the 66th birthday of George P. Woollard. Contributions are grouped into sections headed Gravity and Geodesy (five papers), Seismology (seven), Magnetism (six), Marine Geology and Tectonics (three), Volcanology and Petrology (six), and Tectonophysics (five). Only the section on magnetism has an introduction that attempts to fit the papers into the framework of past and present research. Similar introductions to other sections would have increased the value of the book to the nonspecialist. In addition to the papers there are five abstracts published without papers, but most of them are so uninformative that their inclusion seems unwarranted.

The papers are of different types and cover a wide range of subjects. Some, especially those from Hawaiian authors, are original reports of specific experiments that could equally well have been published in specialized journals (for example, the reflection and refraction results from the Colombian and Peruvian margins reported by Meyer and others and by Hussong and others). Other original contributions interpret data from wide areas of the Pacific (for example, gravity and magnetics in the northwest Pacific, by Watts and others and by Hilde and others). However, there has been no attempt to achieve complete geographic coverage of the Pacific area, and several of the papers stray beyond the confines suggested by the title (for example, the documentation and discussion by Melson and others of the chemical diversity of volcanic glasses erupted worldwide at oceanic spreading centers). There are also papers that are mostly reviews of previously published results. Several of these are welcome syntheses of less accessible reports (for example, the summary by Wright and others of the U. S. Geological Survey studies of Kilauean lava lakes), some are useful introductions to subjects with large bibliographies (Jackson's paper on linear volcanic chains on the Pacific plate), and a few are merely condensations of longer papers or monographs (the analysis of the Cenozoic history of the central equatorial Pacific by van Andel and others). Macdonald has contributed a succinct and informative historical essay on the development of volcanology in the Pacific area.

This volume does not provide a coherent view of the present understanding of the Pacific ocean crust and its interactions with surrounding continents, but most specialists in geophysics, marine geology, or volcanology will find several papers that they will want to read and that will justify paying the remarkably low price for this handsomely produced volume.

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