enjoy prolonged use among a variety of biologists, will serve as a standard against which future books will be judged, and will be a tough act to follow.

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Strongly Nonequilibrium States

Thermodynamic Theory of Structure, Stability and Fluctuations. P. GLANSDORFF and I. PRIGOGINE. Wiley-Interscience, New York, 1971. xxvi, 305 pp., illus. $15.50.

Thermodynamics, as conventionally taught, is concerned with states of thermal equilibrium; or more occasionally, with states that are very near to equilibrium. Glansdorff and Prigogine have long been involved with the thermodynamics of states that are very far from equilibrium. Their views are summarized in this book.

Can one construct a thermodynamic theory for strongly nonequilibrium states? If the macroscopic state of the system can be described by the same variables as are used near equilibrium, for example if "local equilibrium" prevails, then the answer is yes. Further, many interesting nonequilibrium situations appear to obey this local equilibrium condition.

Why should one want to construct such a theory? Aside from academic curiosity, there are many practical reasons. The world is filled with nonlinear phenomena, for which conventional (that is, linear) nonequilibrium thermodynamics is not valid. Some examples are turbulent fluid flow, laser action, and oscillating biochemical reactions. And, in fact, there is an extensive and well-developed theory of many such nonlinear phenomena. The authors attempt a unification and generalization of this existing theory.

When a system is near equilibrium, it tends to relax toward the equilibrium state; and it is stable to small fluctuations. But when it is far from equilibrium, it may be unstable to small fluctuations, and may tend toward a nonequilibrium steady state that involves new structures not present at equilibrium. An example (not discussed in this book) is the development of self-oscillation of a laser. The authors present general criteria for stability to fluctuations in nonlinear thermodynamic and hydrodynamic systems, and they discuss some of the new structures that develop in systems maintained in nonequilibrium states. They present a variational method which often allows practical computations of these new structures, and they show how the variational method works for some hydrodynamic problems. Finally, they discuss coupled chemical reactions in open systems far from equilibrium.

Altogether, this book is not easy to read. It is quite mathematical, in parts highly formal, and written in a heavy style. One annoying feature is the quite unnecessary use of tensor notation; this saves space, but will be unfamiliar to many potential readers. The first half of the book is quite abstract. Only toward the end of the book are there any numerical treatments of practical problems, and those are drawn mainly from previous publications on hydrodynamic instabilities and chemical reactions.

At the end of the book the authors say, "Concluding rather optimistically, we feel that the unified description of the macro-world, developed in this monograph, may prove useful for future progress." They may be right, but I suspect that this will come about only after another book is written, explaining their ideas in simpler and more digestible form.

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Active Volcanism

Volcanoes. GORDON A. MACDONALD. Prentice-Hall, Englewood Cliffs, N.J., 1972. xiv, 510 pp., illus. $18.

Anyone interested in active volcanism will enjoy reading this book. The introductory chapter, which describes the two contrasting eruptions of Hibokhibok in the Philippines and Kilauea in Hawaii, and the chapter describing the classical types of volcanic eruptions are exceptionally well-drawn word pictures of these events. The geologist will find the material on conduits, pipes, plugs, and dikes to be an effective summary. The chapter on the relationship of volcanoes to man is interesting and informative.

The book is written so that it may be appreciated by those who have an elementary geologic knowledge, but elementary student and professional will both applaud the comprehensive collection of so much material descriptive of volcanoes and volcanic processes. Quantitative material is not overlooked.

The references (over 500 items) are well selected. Most of the important volcanological papers of recent years are cited. One wonders why the English edition of Rittman's standard book on volcanology was not included, although both German and French editions are referenced. I noticed no articles in the Russian language in the bibliography. Although many readers will have no command of this language, some material in Russian (not yet or perhaps never to be translated) should have been included if only to indicate the importance and extent of the Russian volcanological literature. Meniailov's 1955 monograph on the Shiveluch dome (*Trudy Laboratorii Vulkanologii*, No. 9) is an example of a study that would have been a welcome addition.

The many photographs which illustrate this volume are well chosen and credited. Unless one objects to Hawaii's having more than proportionate representation (this reviewer does not), almost all the selections will appear to be appropriate. They are informative, supplement the text, and are good photographs as well. The Hawaiian photos are particularly good; the background of the author might suggest that they would be.

The geologist may regret the omission of data of chemical petrology related to magmas and their origin, but the author tells us in his preface that he will not consider this material, so we are forewarned. There are a few errors of scientific or geographical fact, such as the statement that Hatherton and Dickerson relate Na_2O/K_2O, rather than K_2O as the graph on the adjacent page shows, to depth to the Benioff zone, or the listing of Mexican volcanoes under the heading Central America. But these minor faults do not invalidate the characterization of the book as well printed, well organized, well written, and up to date. It will be a very welcome addition to the libraries of geologists and other scientists interested in volcanoes.

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