

weather and climate. The intricacies of the circulation are well described, as is the newly gained knowledge on cloud physics and dynamics, severe storms, and hurricanes. The characteristics of weather and climate in various parts of the globe are lucidly discussed. On page after page the facts are discussed by someone with direct experience with the phenomena. There is not the usually thin filtrate from the work of others that often makes elementary books such unpalatable fare. There is, however, no neglect or lack of credit given to the many who have contributed to the advancement of meteorology in the past decades; the author has interwoven their work skillfully with his own. Only a few minor slips were noted.

Considerable emphasis is placed on the practical applications of meteorology, from the intelligent use of the daily forecasts and warnings to the long-range implication of climatic statistics for water supplies and flood damage prevention. The realities and prospects of weather and climate control are also presented in proper perspective.

In all it is an enjoyable book to read. It should be profitable to those who want a nonmathematical but nonetheless technical review of modern meteorology. Students in related fields, such as hydrology, agronomy, forestry, and resource conservation, will find it very useful. The many well-drawn illustrations help the reader to visualize the complex happenings in the turbulent shell that surrounds the globe. The book is certainly an introduction that will lead to more than just casual acquaintance.

H. E. Landsberg

ROLL, H. U., *Physics of the Marine Atmosphere*, vol. 7 of the International Geophysics Series, Academic Press, New York and London, 426 pp., 1965, \$15.00.

This book is a monumental effort that should be in the hands of every student of meteorology, oceanography, or any activity related to marine science. An undergraduate training in physical science is required to make full use of the material, but a biologist or even an interested layman could find much useful and comprehensible information. The bibliography and documentation of recent research are excellent and very nearly complete.

The book treats the physics of the marine atmosphere primarily from the viewpoint of sea-air interaction and the ocean's role in the structure and motions of the air; it is not, however, a treatise on sea-air interaction since the ocean side of the boundary is considered only as it affects the air and very little as the ocean is affected by the atmosphere in turn.

The book begins with a section on meteorological observations at sea. Although excellent in content, the order of presentation is unfortunate since it tends to overemphasize tools too early in the game rather than treating the more inspiring area of problems. This minor deficiency and a few others are more than compensated for by the

major sections on atmospheric chemistry, boundary flow, and thermodynamics of the boundary regions. A comprehensive treatment of airborne nuclei has long been needed and is found here. The temptation to overemphasize boundary hydrodynamics from the engineering or theoretical standpoint is avoided by a beautiful section on thermodynamics and convective processes.

The book's faults are few and largely necessitated by the complexity and vast unknown areas of the subject. The author walks skillfully the tight rope between despair at this situation on the one hand and dogmatic presentation of inadequate or oversimplified fragments of research on the other. Frequently, however, some sections read like abstracts rather than a text—an attempt to be comprehensive and yet not too lengthy. The individual chapters have an organizing framework, particularly where they include areas of the author's own fine research. An over-all unifying framework is, however, not quite apparent, possibly, this reviewer believes, because of underemphasis on large-scale circulations. These circulations patently regulate, indirectly or directly, all the processes that the writer describes. This is in line with a criticism of the final chapter—a statement by the author that the primary need in this science is more data. The reviewer agrees that more data are a basic and urgent need, but surely data are of little use to advance knowledge or prediction without a physical or theoretical framework to organize and guide them.

In conclusion the author is to be congratulated on a fine and valuable contribution and on his excellent use of the English language, particularly since English is not his native tongue.

Joanne Malkus Simpson

SHUMSKII, P. A., *Principles of Structural Glaciology* (Translated from the Russian by David Kraus), Dover Publications, New York, 497 pp., 1964, \$3.00.

The title of this volume, although appropriate, is not really indicative of its content. It becomes more than a book on structural glaciology through its detailed treatment of many facets of glaciology, which the author defines as the science of natural ice in all its aspects. People interested in ground ice, sea ice, lake ice, glaciers, and snow, among other topics, will find much of value in this book. Shumskii professes to have a primary interest in the petrology of ice rocks and the laws of their formation, but he carefully develops a foundation of basic information before treating the specific topics of structural glaciology.

The original manuscript was finished in 1951, with additions made in early 1952. Thus, the material is 14 years old, and the intervening years have seen rapid progress in glaciology. Nonetheless, the volume is surprisingly useful, partly because it gives an insight into Russian glaciological work but especially because it provides a more comprehensive digest and summary of glaciological

material than is now available in any single English source.

Russian territory embraces a lot of ice, and through the years Russian scientists have developed a high level of competence in glaciology. This is well demonstrated by Shumskii's book itself and by the many citations to the Russian literature. It is apparent that to some degree the thoughts of Russian and Western glaciologists have evolved along parallel paths.

The organizational focus on structural and petrological aspects of ice as a major theme can mask the additional wealth of useful information available in the book. For instance, 'The dynamic metamorphism of ice' (Chapter 14) is introduced by an excellent 28-page review of thoughts, theories, and concepts pertinent to problems of glacial flow. One might not expect to find such material in this book and probably not under the heading noted above. Chapter 3 on the basic physical properties of ordinary ice is a better compendium of basic information than most of us who are interested in the subject have been able to glean from a decade of searching through dispersed sources in the literature. Much of this information is as sound and useful today as it was in 1952.

Coverage of European literature outside of Russia is good, but the Western literature receives much less attention. However, Shumskii does better by Western ideas than most of us would have done for Russian concepts if we had prepared a similar treatise. Commendably, the author does not hesitate to introduce material based on his own work where proper and pertinent.

There seems to be scant reason for trying to point out weaknesses in this work. This reviewer likes this book. It is not a must for all workers in glaciology, but those newly entering the field can save much time by selected readings therein. Well-informed readers will also discover some new ideas and some new approaches to old problems. Almost anyone interested in ice will find this a useful reference.

David Kraus has done a most careful, devoted job of translation. He has gone to much pain to use easily comprehensible yet scientifically sound terms. The best tribute that can be paid Kraus is to say that one does not feel as though he were reading a translation as he peruses Shumskii's book.

Robert P. Sharp

WALT, MARTIN, (ED.), *Auroral Phenomena*, First Lockheed Research Symposium on Space Science, Stanford University Press, Stanford, Calif., and Oxford University Press, London, 170 pp., 1965, \$6.50.

This collection of papers, presented in somewhat

different form at a symposium sponsored by Lockheed Missiles and Space Company, is an authoritative summary of current experimental work on the polar aurora.

It is the clearest account available on the state of research in this subject.

Chapter 1, 'Morphology of Auroral Displays,' by C. T. Elvey, is interesting because of Elvey's attempt to classify all auroras into five classes. His groups are polar-glow aurora, polar-cap (discrete), high red arcs (Störmer type 3 homogeneous arcs), medium-high gray arcs, and conventional auroral zone aurora. These groups are based on geometry, height, and spectral characteristics. This chapter also contains a short account of Davis's work with the low-light-level television that enables cinematography of changing aurora.

The chapter 'Optical Measurements of Auroras,' by A. Vallance Jones, is a thorough review of the spectroscopy of the aurora. This should be a first reference for students of this subject.

The chapter 'Interaction of Energetic Charged Particles with the Atmosphere,' by A. Dalgarno, is a relatively brief summary.

The long chapter 'Balloon Measurements of X Rays in the Auroral Zone,' by Kinsey A. Anderson, is a very fine account.

Chapter 5, 'Precipitation of Energetic Particles into the Atmosphere,' by B. J. O'Brien, is excellent. Especially valuable are the data on the relation of trapped particles to the usual auroral zone.

'Electromagnetic Measurements of Auroras,' by R. L. Leadbrand of Stanford Research Institute, brings together all aspects of the subject. It also points out the difficulties of reconciling the various observations and theories and indicates the direction that further research might well take.

Chapter 7, 'Coordinated Measurements on Auroras,' by J. E. Evans, gives first results on coordinated experiments involving satellites, airplanes, and ground observers. This enormously difficult and frustrating type of experiment should be tried more frequently. The chapter by Elvey makes it clear that one successful attempt is not enough because of the various types of aurora.

Joseph W. Chamberlain's chapter, 'The Present Status of Auroral Theory,' shows the unsatisfactory state of all present theories and pleads for more quantitative work.

The Summary, by Anders Omholt, is an attempt to refocus attention on some particular problems and points of view. Perhaps this chapter should be read first.

This small volume is a refreshing summary of the research in this field. It also shows the importance of the field—importance that was not anticipated by scientists 25 years ago.

Carl W. Gartlein