clusion. Besides its 14 papers the book contains a list of those who attended the symposium; an account of a modeling problem sprung on the participants for discussion without their having prior knowledge of its nature; four assessments of the proceedings by as many judges; and satisfyingly complete author and subject indexes.

E. C. PIELOU

*Department of Biology, Dalhousie University, Halifax, Nova Scotia*

## Air and Sea

**Atmosphere-Ocean Interaction.** E. B. KRAUS. Oxford University Press, New York, 1972. viii, 276 pp., illus. $18.75. Oxford Monographs on Meteorology.

The sea surface is a restless creature. It both responds to the atmosphere and modifies its condition. Exchanges of matter, momentum, and energy are basic to the global climate balances at one end of the scale and to the physical and chemical environment enjoyed by phytoplankton at the other. A tantalizing variety of physical processes are involved, and their interplay continues to challenge both oceanographers and meteorologists. For example, as Kraus points out, the chemical composition of droplets in spindrift, swept from the crest of a wave in a high wind, is variable and different from the bulk composition of seawater because of the existence of a surface film of largely biological origin. The evaporation of these droplets provides salt nuclei for subsequent precipitation in moderate and low latitudes.

This book is concerned with the physics of the processes involved in the interactions between the ocean and the atmosphere. Its scope is a good deal wider than Kitaigorodsky's "Physics of Air-Sea Interaction" (at present available only in Russian), which concentrates on the local exchange processes for momentum, heat, and matter. There is rather less emphasis here on the overall parametrization needed by numerical atmospheric modelers, perhaps for good reason—where the physics is lacking, attempts at parametrization are likely to be misleading. The states of matter near the interface, ranging from mushy ice to bubbles and spray, illustrate the complexities involved. Surface waves, turbulent transfers near the interface, both above and below, the structure of the planetary boundary layer and large-scale, low-frequency planetary waves all receive some attention. More detailed accounts of each of these are available elsewhere but not placed so firmly in this context.

Not always easy to read, the book suffers at times from an unevenness in level. On the one hand, ideas about surface tension are described in detail, even though these should be common knowledge to juniors in a good physics course. On the other hand, the mathematical approaches given for the specification of atmospheric and oceanic turbulence are likely to be tough going for all but well-trained physical oceanographers and meteorologists. The latter problem is, I suppose, intrinsic to the subject matter, but the professional or the advanced graduate student, to whom the book is addressed, may find some parts of it either prolix or, when results are given without the supporting arguments, frustratingly brief. Nevertheless, it complements well the existing books on this subject and with its breadth of coverage and fine bibliography will surely find its place on the bookshelves of both meteorologists and physical oceanographers.

O. M. PHILLIPS

*Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland*

## Climate and Human History

**Times of Feast, Times of Famine.** A History of Climate since the Year 1000. EMMANUEL LE ROY LADURIE. Translated from the French by Barbara Bray. Doubleday, Garden City, N.Y., 1971. xxiv, 426 pp. + plates. $10.

Ladurie has given us a wealth of carefully considered data on the geologically recent history of climate in *Times of Feast, Times of Famine*. This synthesis is derived from a mass of contemporary documentary evidence of crop yields, dates of grape harvests, and reports on wine quality and on advances of glaciers, mostly from the long series of records from France and the Alpine region.

As a student of past climate as deduced from palynology I find it exciting but almost daunting to encounter the precision with which the professional economic historian can pinpoint the years of abnormal climate, when the radiocarbon-dated pollen diagrams cannot yet indicate which decades were affected by climatic alterations. Ladurie has proceeded cautiously in evaluating the phenological data, avoiding the trap of trying to derive paleoclimatic inferences from historical events which were not direct climatic indices; he set himself the task of compiling data to which he could apply "a qualitative method comparable in rigor if not in accuracy and variety to the methods of modern meteorology." A potential pitfall is the change in areas of crop growth due to economic and cultivation changes; for example, the northward movement of olive growing from 1550 to 1600 occurred not because of climatic warming but because the growers were trying to exploit an expanding market, actually at a time of colder climate. Ladurie also maintains that late medieval reductions in French grape cultivation resulted not from climatic change but from high labor costs due to the plague and disruptions of war. He is opposed to the climatic-determinist approach to history, exemplified by Huntington, and criticizes C. E. P. Brooks, for using circular reasoning in his studies of paleoclimate, for using secondary rather than available primary sources, and for introducing a fictional glacial retreat in the middle of the "Little Ice Age." Historians draw criticism for lack of interest in climatic history, and Ladurie castigates those students of climate he calls "cycle mad."

The long series of French and German wine harvest dates and quality reports have been examined for their phenological interest: early harvests resulted from warm springs and summers characterized by anticyclonic conditions, and late ones from cool springs and summers with cool and cloudy cyclonic conditions. The correspondence of German records with those from France is reassuring, and indicates regional climatic control. Reliable German records assembled by K. Müller cover the years 1453 to 1950, with some data back to A.D. 1000. The French data (many of them gathered by Angot) are ample back to the 17th century, with fewer series covering the 16th century, and with some data back to the 14th century. The validity of the phenological data is confirmed by comparisons of vintage dates and wine quality reports with meteorological records in the last two centuries. Germany experienced generally warm summers from 1453 to 1552, but from then until about 1600 the summers were over-