Climatic Evolution

World Climate from 8000 to 0 B.C. Proceedings of an international symposium, London, April 1966. J. S. SAWYER, Ed. Royal Meteorological Society, London, 1967. iv + 229 pp., illus. Paper, $8.80.

Because "meteorologists are just about within sight of achieving a quantitative theory of the general circulation of the atmosphere," P. A. Sheppard writes in the preface to these conference papers, and their models of the earth-atmosphere system will soon be "sufficiently realistic to be compared with observation where it exists," the need may be foreseen for "[integrated, quantitative] data on the actual climates of the past and on their evolution against which to test the predictions of theory." The purpose of the conference was to explore the possibilities of such integration of data for one fairly well-documented period of substantial change, resembling the present in landform. The period chosen was 8000 to 0 B.C. The program was planned "with the aim of achieving, as far as possible, a world picture for the period, a quantitative assessment of the data (in time and meteorological quantity), and a treatment involving all the major disciplines contributing to the subject."

The eight disciplines or fields of study selected for treatment are represented in the published proceedings as follows: landforms—L. Starkel (19 pp.); glaciology—G. Manley, R. P. Goldthwait (20 pp.); sea level changes—S. Jelgersma (18 pp.); desert evolution—K. W. Butzer (12 pp.); ocean sediments—J. D. H. Wiseman (15 pp.); pollen and other botanical evidence—B. Frenzel, C. J. Heusser, M. E. S. Morrison, D. Walker (with D. M. Churchill and N. T. Moar) (56 pp.); paleolimnology—H. E. Wright, Jr. (17 pp.); meteorological appreciation—H. H. Lamb (with R. P. W. Lewis and A. Woodroffe), J. S. Sawyer (55 pp.).

We may ask to what extent each of these disciplines succeeds in contributing in broad terms to a distinct, mutually consistent picture of climatic sequence and change, and the degree to which the integrated picture thus achieved advances our previous understanding of climate during the Holocene period, essentially the stated objective of the program.

This is, as Sheppard acknowledges, an ambitious aim the full realization of which is not realistically possible. The climatic picture continues to be clearest in the geographical area of the British Isles and northern Europe, where the most investigation has been carried out, and decreasingly clear in the geographically more remote regions roughly in proportion to the amount of pertinent investigation completed. This in turn is a function in part of the type and accessibility of local evidence. The London conference contributes most to the outline of the climatic picture in some of the regions where it previously was less well established. In those limited areas or respects in which conflicting evidence emerges it is not sufficiently reliably established or confirmed to be accepted as finally changing the previously established picture.

Of the eight fields of study represented, two—landforms and botanical evidence—contribute practically the complete picture of Holocene climate in Europe presented in the table here shown, together with the suggestion of shorter climatic oscillations that are not sufficiently reliably fixed or correlated to be specified in the table. The same two disciplines contribute the evidence indicating that at least in North and South America the climatic sequence seems to have paralleled closely that indicated for Europe.

Techniques for the analysis of the evidence from sea-level changes, desert evolution, ocean sediments, and lake sediments (paleolimnology) have not been applied or perfected to the point where these disciplines can contribute reliably to the picture of Holocene climate, although all four disciplines give promise of significant potential contribution. Glaciology can contribute important information, but it is difficult to interpret because individual glaciers are so variously affected by local topography that only statistical evidence from a group of glaciers can be accepted at face value.

In the field of meteorological appreciation, Lamb, on the basis of all available past and present climatic information, synthesizes probable mean wind charts for critical epochs of the Holocene period. These reconstructed circulation patterns probably are quite realistic, and lend themselves to further clarification of the contemporary climatic conditions, notably with respect to the probable distribution of precipitation.

By way of conclusion, it must be said that the results of the conference as set forth in this volume do not radically change or extend our picture of Holocene climate. On the other hand, the volume certainly does to a significant degree confirm and fill in many details. Its greatest value is that it compiles in one authentic and readily available source most of what is known from all fields of study concerning climatic change during the Holocene period, including an evaluation of the present and potential contributions of each field to this knowledge, and a rather complete referencing by field of the hundreds of publications and journal articles which constitute the widely scattered source material.

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Outline, by periods, of the Holocene climate in Europe.

8300–6200 B.C., pre-Boreal, Boreal
Increasing warmth and dryness from preceding cold, wet glacial period. Then, as now, climate of eastern Europe more continental than that of western Europe.

6200–3000 B.C., Atlantic
Climatic optimum, warm and humid, with rain all year round and prolonged periods of heavy rain. Annual mean temperature 2°C higher than today.

3000–500 B.C., sub-Boreal
Periodically warm with cooler intervals, averaging less warm than the climatic optimum. Rather dry but with considerable variation of humidity.

500 B.C.–A.D. 200, Early sub-Atlantic
Marked climatic cooling to pre-Boreal conditions, cooler than today. Snowy, frosty winters and cool, wet summers. Increasing glaciation.

A.D. 200–1000, Late sub-Atlantic
Climate becoming warmer and drier. Glaciation in retreat. Conditions by late period in northern Europe temporarily more favorable to human activities than today.

The Fortunes of the ARS

The Agricultural Research Service. ERNEST G. MOORE. Praeger, New York, 1967. xii + 244 pp., illus. $5.95. Praeger Library of U.S. Government Departments and Agencies.

The Department of Agriculture has engaged in basic research since its inception. In 1953, as part of a general reorganization, the Agricultural Research Service was formed to centralize the administration of the department's research program. Ernest G. Moore's book tells how the research of Department of Agriculture scientists resulted in improved plants and animals, ad-

vanced farming methods, and new products ranging from drip-dry cotton shirts to frozen orange juice and shaving cream. Regulatory divisions within ARS conduct programs in animal and plant inspection and quarantine, animal and plant disease and pest eradication, and pesticide control.

For most of its history, Department of Agriculture research remained virtually unknown to the nonfarming public. The publication of Rachel Carson's *Silent Spring*, however, brought ARS into the full light of public comment and criticism. After considerable public and congressional debate, ARS had not only improved its public image but had also received additional research funds it had previously sought unsuccessfully.

Shifting political patterns have had their effect on ARS. Although agricultural research long ago lost its farm orientation, only recently has ARS recognized that its "clients" are predominantly city-dwellers. While basic research activities remain the same, ARS now directs its public information efforts more toward a consumer audience than toward farmers.

Moore has written a light, easily read summary of the administration and work of the Agricultural Research Service. Moore's background as ARS's information director and his attempt to write for a wide audience probably account for his conversational style. Unfortunately, faulty organization mars the book. The reader is frequently referred to future chapters, which often contain little more than second mention of previously encountered subjects. A chronological organization of the material would probably have overcome most of the difficulties. The specialist might wish that the author had furnished less summary and more information.

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An Aspect of Sexual Behavior

Courtship. An Ethological Study. MARGARET BASTOCK. Aldine, Chicago, 1967. viii + 220 pp., illus. $6.

According to what is written on the dust cover of the British edition, this little book is intended for nonspecialists in animal behavior: sixth formers, university students, "specialists in other fields." It will serve this audience well. Neither the descriptions of facts nor the presentations of ideas are beyond the comprehension of the intelligent general reader, yet the book gives a scholarly treatment of its subject. But the book should also appeal to scientists whose business is the study of animal behavior. They may not find much factual information that is news to them; nor will they find revolutionary new ideas. They will find a concise, selective review that is representative of how European ethology has matured in Britain. They will also find clear thinking clearly expressed on topics about which there has been much muddled thinking and muddled writing. In this book the concept of genetic inheritance is used only as a genetic concept, not, in addition, as a concept standing in for knowledge about the ontogeny of behavior. Protean terms like "instinct" and "drive" either are avoided (neither of these is included in the index) or are introduced with such care that their issue-clouding propensities are given little scope.

The plan of the book is simple. A brief introduction outlines the nature of courtship behavior and the problems it poses. These themes are developed in the three parts which constitute the rest of the book. The first part presents a selection of descriptions of courtship behavior, drawn from fish, birds, and arthropods, which serves to illustrate ways in which patterns of courtship in different kinds of animals resemble and differ from one another. The second part is about evolutionary aspects of courtship: survival value, evolutionary antecedents, genetics. The third part is about the more immediate causal control of courtship: temporal and sequential patterns in courtship and what they imply or suggest, hormonal mechanisms, neural mechanisms.

Of the three parts, the one about evolutionary aspects is the longest and perhaps the most authoritative. On some of the topics dealt with here Bastock writes with the insight and firsthand knowledge of one who has contributed to their elucidation through her own research. But it might be said that, with its roots in what can be referred to as classical zoology, the ethological tradition in which Bastock stands has always had a bias in favor of evolutionary approaches to behavior, even though this bias has often gone unrecognized. For example, the facts on the basis of which Lorenz and Tinbergen built their theories of instinctive control systems tended to be facts about the adaptive significance or functional patterning of behavior, rather than facts about how sensory, neural, and hormonal systems work. The confusion latent in this sort of argument has been a weakness in much ethological theory. Fortunately there is little trace of it in Bastock's book. For the most part she has kept questions about adaptive significance and questions about proximate causation clearly apart; and for her discussion of causal mechanisms she manifestly has done her homework. (Incidentally, there is one little point here on which her homework let her down. On page 175 she cites a study on *Streptopelia roseogrisia* as the basis for a suggestion about the subject of another study, the "related species" *Streptopelia risoria.* In fact both of these studies were on the same species: the domestic ring dove, which is usually referred to as *risoria* and which is believed to be descended from the wild rosy-gray dove, *roseogrisia*, of North Africa.)

In her preface, Bastock points out that a short book cannot be comprehensive. Perhaps so. But one is surprised at some of the omissions here. For example, there is no mention of "redirection," a concept of considerable pertinence to the topics of conflict behavior and the evolutionary sources of displays, and one which Bastock herself helped to introduce into ethology. Even more to be wondered at is the complete absence of any discussion about ontogenetic aspects of courtship behavior. Admittedly, there is less that can definitely be said on this subject than on those the book does deal with; it has been the least well served by ethologists in general. But a book which purports to be a review of the subject of courtship—a discussion of "its importance in the study of animal behavior as a whole"—should surely at least explain why it makes no attempt to deal with one of the subject's major aspects. Moreover, it is perhaps on this aspect more than any other that we are in need of the kind of clear thinking that Bastock brings to her writing. Numerous other topics have been excluded, some, no doubt, too esoteric and technical for a book of this sort.