Ecological Physiology

Avian Energetics. Papers from a symposium, Provincetown, Mass., Oct. 1973. RAYMOND A. PAYNTER, JR., Ed. Nuttall Ornithological Club (c/o Museum of Comparative Zoology, Harvard University), Cambridge, Mass., 1974. viii, 334 pp., illus. $17. Publications of the Nuttall Ornithological Club, No. 15.

This is a collection of four superb treatises by James R. King, William A. Calder, III, Robert E. Ricklefs, and Vance A. Tucker which were presented in abstracted form at a symposium held in observance of the Nuttall Ornithological Club's centennial. Each exposition is followed by prepared comments by four distinguished avian energeticists: George A. Bartholomew, William R. Dawson, S. Charles Kendeigh, and Eugene P. Odum.

In the chapter "Seasonal allocation of time and energy resources in birds" King delineates the diversity of annual cycles of migration, molt, reproduction, mating systems, and social organization. He reviews physical and biological factors that affect avian energy budgets and surveys the methods for estimating energy consumption in free-living birds. King provides a comprehensive synthesis of the available data on daily energy expenditure in free-living birds and mammals and describes the need for future research in six areas. He concludes by forecasting that through the joint efforts of physiologists, ecologists, and population biologists will come data for models "that will give us better insights into the temporal and social organization of bird species and communities reflecting evolutionary compromises in the allocation of time and energy."

The chapter by Calder is in two parts: (i) the importance of body size in avian energetics and (ii) body size and hummingbird energetics. Calder describes in an unusually lucid manner the allometric relationships between body size and components of energetics: metabolism (for example basal, existence, summit, and flight), physiological determinants of oxygen supply (for example cardiac output, breathing frequency, and tidal volume), and factors controlling fuel supply (for example territory size and gut mass). In the second part he examines the time and energy budgets of hummingbirds and their methods of conserving energy by hypothermic torpor and by selecting microhabitats that moderate heat loss to the environment. Much of his work illustrates a strong integration of field and laboratory measurements, an emerging focus in ecological physiology.

Ricklefs's chapter on "Energetics of reproduction in birds" is a monumental synthesis (122 pages, 312 references). He begins with a brief review of the energy equivalents of foods, respiratory gas exchange, and avian biomass and of different measures of adult energy metabolism. This prepares the reader for a robust review and synthesis (including both published and unpublished data) of the energetics of egg formation, incubation, and growth. This extensive analysis demonstrates Ricklefs's superior ability to understand and explain the dimensions of a problem. He concludes with a treatment of the influence of environmental factors on energy expenditure by adults and clutch size, modes of development, and rate of growth. This discourse focuses clearly on the potential value of energetics in understanding the evolution of avian reproductive strategies.

In the final chapter, entitled "Energetics of natural avian flight," Tucker examines the potential differences in the power required for flight in a wind tunnel and under natural conditions. He presents an elegant model which describes the effect of altitude, air temperature, and vertical and horizontal air movements on flight velocity and power requirements. This model is used to examine the complexities of flight range, and Tucker concludes that the longest nonstop flights of birds are physiologically possible only if the birds are aided, or at least not hindered, by the wind. Tucker's paper blends the aerodynamic and physiological approaches to flight energetics into a coherent and very useful body of information.

This book is indispensable for avian physiologists and ecologists. I agree with G. A. Bartholomew that "these treatises will represent the base line from which all subsequent studies involving the energetics of birds must start."

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Membranes

Perspectives in Membrane Biology. Proceedings of a symposium, Oaxaca, Mexico, Jan. 1974. SERGIO ESTRADA-O. and CARLOS GITLER, Eds. Academic Press, New York, 1974. xvi, 660 pp., illus. $24.50.

The symposium of which this book is an outgrowth was organized to expose (young) Mexican scientists to some of the perspectives of membrane biology. The main function of the meeting was therefore to be pedagogical, to present ideas and not to present "recent data." Consequently, one approaches this book with rather high expectations, which are largely fulfilled.

The emphasis of the book is on the chemistry and biochemistry of cell and organelle membranes. The two main ideas are, predictably, the plasticity of membranes and the coupling between metabolism and ion transport.

The first and largest section is concerned with membrane structure. The articles are well chosen and very readable. They range from x-ray analysis of lipid-water mixtures (Luzzati), to nuclear magnetic resonance studies of lipid bilayers (Pethica and Tiddy), to disassembly and reassembly of the Semliki forest virus (Simons *et al.*). The last article, by Gitler and Klip, is a stimulating counterpoint to techniques and ideas presented in other articles (Bretscher, Singer). The major topics are the use of chemical labels (and the dangers involved in interpreting the results), the use of encounter fluorescence quenching, and lipid-protein interactions.

The second section deals with active ion transport (Kaback, Skou) and the relationship between metabolism and ion transport across cell membranes (Peña).

The next two sections cover energy transduction in mitochondrial and photosynthetic membranes. The emphasis in the first two articles is on the role of cations and cation translocation in oxidative metabolism. The next three articles deal with the measurement of localized or delocalized electrical fields by the use of optical methods and extrinsic (Chance *et al.*) or intrinsic (Crofts, Witt) probes. Cone gives a very lucid review of visual excitation and especially of membrane fluidity as seen in the frog rod disk-membranes when rhodopsin is used as a probe.

The next topic is the role of cell membranes as information transducers in hormone action, cell recognition, and immunological responses. Articles by Cuatrecasas and Bennett and by Marinetti *et al.* give extensive reviews of hormone binding to plasma membranes and the information transduction events occurring in the membrane. Melchers discusses the regulation of immunoglobin M synthesis and the question of membrane-bound antibodies. Nathenson and Raff *et al.* review the complementary topic of membrane-bound antigens, as well as ligand-induced redistribution of membrane macromolecules.

The final section is devoted to the reconstitution of specific membrane functions and includes articles by Montal on reconstitution in planar decane-free artificial lipid bilayers, by Racker on the reconstitution of active ion transport in lipid vesicles, and by Läuger *et al.* on the systematic and stepwise incorporation of

complex functions into Mueller-Rudin lipid bilayers.

It is inevitable that one gets a feeling of *déjà vu* when reading a book such as this, but the order of presentation and the choice of topics are excellent. A few obvious omissions are noted, for example ion transport and ion selectivity in artificial lipid bilayers. Two major objections can be raised. First, the book contains no index. Second, the typography (single-spaced typescript) has not been selected for readability, and it is disturbing not to have the figures adjacent to the text. But all in all, the editors have collected a good and reasonably up-to-date account of membrane biology.

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Economic Prehistory

Palaeoeconomy. Being the Second Volume of Papers in Economic Prehistory by Members and Associates of the British Academy Major Research Project in the Early History of Agriculture. E. S. HIGGS, Ed. Cambridge University Press, New York, 1975. x, 244 pp., illus. $25.

The jacket blurb of this second volume by the Cambridge research team headed by Eric Higgs reflects the *chutzpah* of the first volume: "Discarding previous theories and models [these workers] have been able to demonstrate very convincingly that the development of agriculture was a much more gradual and wide-spread phenomenon than had previously been imagined."

The first volume, also edited by Higgs and published in 1972, drew considerable attention for its new ideas, including the rejection of much work by zoologists and others concerned with the beginnings of farming. It argued for discarding the domestic-wild dichotomy and attempted to demonstrate an early herding of gazelle and red deer—hypotheses that have met considerable skepticism. On the other hand, it did open new ways of thinking and described important new techniques such as the froth-flotation machine, which greatly improves recovery of carbonized plant remains from archeological deposits.

The present volume, about the same size as the first but costing 40 percent more, commences with a theoretical paper by Higgs and Jarman intended as an apologia for what the Cambridge group (following their founder J. G. D. Clark) call the "economic approach" to prehistory. The paper fails to advance archeological theory, pays only lip service to much recent thinking in archeology, and contains a number of truly surprising statements. Thus we learn that "the concern of ethnography is the characterization of the races of man" (p. 3), and the authors think it necessary to admonish archeologists not to include supernatural causation as an explanation for prehistoric events (p. 1). Those are anthropological concerns of a century ago, and they do not increase the reader's confidence that the authors' underlying assumptions are congruent with current thinking in anthropological archeology. It is perhaps because they hold such notions that Higgs and Jarman can reject "palaeoethnography" (which they do not define) as an aid in the analysis of cultural process. They likewise reject the use of general systems theory and "human palaeoecology," the latter defined narrowly in terms of the ecosystem model. Not surprisingly, they opt for "palaeoeconomy" as the most fruitful approach. It is not clear why the rejected conceptual frameworks should be incompatible with paleoeconomy.

Five valuable empirical studies, unified only in having a general emphasis on relationships between human groups and their environments, make up the bulk of the volume. Wilkinson and Sturdy apply studies of animal behavior to the explication of human activities in the late Pleistocene. Wilkinson concludes that musk oxen in Eurasia and North America, in both modern and prehistoric times, were hunted as a "critical resource," meaning "one which is not exploited intensively, but without which survival in certain areas or periods is difficult or impossible." He finds nothing to suggest that musk oxen were herded in prehistory.

Sturdy's European Magdalenian hunters of the late Pleistocene concentrated on the exploitation of a single ungulate species, generally reindeer or horse. He analyzes seasonality among the reindeer hunters—the antlers, grown by both sexes and shed annually, lend themselves admirably to a study of the seasons at which the sites at which they are found were occupied—and concludes that seasonal migration patterns of the herds consisted of wintering in the North European plain and summering in highland regions as far south as the Swiss Jura. Of the possible exploitative strategies employed by the Magdalenian hunters who preyed upon them, he regards herd-following as the most probable. The question why some sites have high percentages of deer bones and antlers, while other sites have high percentages of horse remains, is not broached.

Both papers are important contributions. Each has the methodological weakness, however, that many of their conclusions, although they appear plausible, remain unverified. The reasoning often consists of a string of untested propositions, such as the following: "The steepness of the Altmühl valley . . . was probably accentuated by gelifraction and the sparse vegetation in the Late Glacial. This area was probably summer grazing for reindeer, its archaeological sites probably occupied by human groups practising some form of herd following" (p. 80). One's confidence is raised neither by the fact that the sites cover a considerable time span nor by the fact that the area under consideration encloses parts of southern Scandinavia, Hungary, Switzerland, and France. Thus while the studies are innovative and stimulating, they leave the reader not fully convinced.

Barker studies the relationship between "site catchments" and their related "economies" in central Italy through time, from about 75,000 years ago up to—in some cases—the Romans! An enormous amount of carefully digested material is presented, but the reader must work hard to keep in mind the structure and purpose of the paper, particularly in the absence of even the simplest descriptive statistics.

Jarman and Webley discuss settlement and land use in another area of Italy. The strictures just mentioned apply to this paper as well. One wishes the authors of the two papers had pooled their data and approaches; as it stands, the reports are difficult to compare.

A guide to site catchment analysis is appended. This seems a useful empirical field technique in the study of site location in a region, and one would like to see it used and evaluated in other well-studied areas, for example the American Southwest. The appendix on site catchment analysis is followed by a consideration by Vita-Finzi of how "related territories"—ones beyond the area of site catchment—can help in interpreting alluvial sequences.

In sum, the book is basically a collection of unrelated, high-quality papers, many of general interest. None involves the excavation of sites. None is a truly multidisciplinary effort. Despite lip service to "the computer" on p. 1, there is an almost complete absence of quantification. (Sturdy's paper does contain scattergrams.) While the level of measurement error and the lack of mathematically based sampling procedures in data gathering preclude the use of many statistical procedures, there are some that are appropriate and would have strengthened the arguments. The project's habit of steering clear of problems of quantification may prove a major obstacle to its further research developments.

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