

THE FIRE IS IN THE FAT

Mammalian Thermogenesis. L. Girardier and M. J. Stock, eds. Chapman & Hall, New York, 1983. 359 pp., illus. \$80.00 (cloth).

This book is not for the general reader. The rapid advance of research on cellular and biochemical processes of nonshivering thermogenesis (NST) requires a review directed toward advanced students and researchers. Particular chapters, however, may interest a wider spectrum of physiologists as well as students interested in mammalian function. The book will also be useful to teachers of comparative animal or mammalian physiology for updating lectures on various aspects of heat production.

COMPILED INVERTEBRATES

Culture of Marine Invertebrates: Selected Readings. C. J. Berg, Jr. Hutchinson Ross, Stroudsburg, PA, 1983. 400 pp. \$45.00 (cloth).

I once tried teaching a graduate invertebrate aquaculture course using approximately 100 selected articles that we discussed during class. The task of selecting good culture papers with some general significance is not easy. I tried to do in a class what Carl Berg has attempted in this book, and I think I know, in part, what he must have gone through when compiling *Culture of Marine Invertebrates*.

Berg has selected 29 manuscripts that have recently appeared in journals or books; 4 others were written specifically for this volume. Many of the contributing authors are major figures in aquaculture, and some of the papers will no doubt be familiar to those in the field of invertebrate culture. Invertebrate culture has two major goals, Berg points out, one scientific, the other commercial, and unfortunately, the two almost never seem to marry. Berg has clearly opted to stress the scientific side; the book contains precious few topics relating to commercial invertebrate culture, such as economics or management.

The first 25 articles fall under the heading, "Basic Techniques." These have, in turn, been divided into subgroups, the first dealing with design; how a system is physically put together so that it works well. Two of the best efforts in this volume are found here: a review of chemostats by M. R. Droop, which includes how and why they work, and a

Sixteen contributors from four countries give this volume a decidedly international flavor. This wide selection of authors brings together researchers concerned with cold-induced thermogenesis and brown fat and those interested in diet-induced thermogenesis and obesity. Thus, the book includes chapters on the energetics of maintenance and growth, hypermetabolism in trauma, fever, and the pharmacological manipulation of thermogenesis. Most of the 11 chapters conclude with a brief summary and complete references. The publisher should be congratulated for including so many references because they alone make this volume invaluable for anyone beginning a research career in thermogenesis. Although older papers are cited, a surpris-

ing number of the references date from 1977 through 1982.

well-written article by R. T. Hanlon and R. F. Hixon on rearing and maintaining cephalopods.

The next group of papers addresses water quality. Three deal with subjects familiar to most researchers: UV sterilization, pH, and ammonia. The fourth, by F. W. Wheaton and his colleagues, on foam fractionation is interesting but a little off the beaten path.

The book's largest section deals with nutrition, including algal culture; the nutritional value of common feed organisms like *Artemia*, *Daphnia*, and *Branichionus* and how to rear them; and the use of prepared feed. The book ends with a section on diseases and eight final papers called "Topical Studies," which are, in several cases, only casually interesting to those of us wanting to learn about invertebrate culture. They deal more with the applications of laboratory-grown invertebrates than with the growing itself.

Some of the best writing in the book is by Berg himself, who introduces the sections, explains why the topic was included, and reviews some of the important literature not included in his book. No one will ever agree entirely with any editor about the selections for a book like this. Berg's are generally high quality, but they do reflect his particular bias: one-third of the papers in this volume deal with molluscs.

If you don't already have many of the individual papers in your files, you might consider buying this book.

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In the introductory chapter, the editors attempt to sort out some of the terminological tangle resulting from two different approaches: that of the whole-animal nutritionist concerned with energy budgets and of the cellular bioenergeticist focusing on heat production. A useful figure compares use of metabolizable energy in terms of energy balance and thermal balance. This comparison provides a necessary foundation for reading the remaining chapters, as the editors have not imposed uniform terminology on all the contributors. In fact, I needed to refer frequently to the first chapter to keep the concepts of energy balance and associated terminology clear throughout the rest of the book. One hopes that, when this topic is next reviewed, researchers will have agreed on terminology so that the reader will be spared learning four or five terms for the same phenomenon.

The introductory chapter is followed by four chapters focusing on BAT (brown adipose tissue). Nicholls and Locke conclude that the mechanisms of heat dissipation in BAT resemble the fatty acid uncoupling hypothesis except that this older hypothesis is translated into chemiosmotic terms. In the third chapter, Girardier asks why there should be an energy dissipating tissue at all. The answer seems to lie in the value of producing heat to maintain homeothermy. Thus, BAT function has been most extensively studied in hibernators and as an adaptation to cold stress. Of course, the answer ultimately depends on "Why be a homeotherm?" (Heinrich's article in *American Naturalist*, 1977, should be read in this connection.) Most of the chapter focuses on the function of BAT as a system integrating biochemical, behavioral, and physiological information. Landsberg and Young link the two major adaptive modes of thermogenesis—cold-induced and diet-induced—suggesting that the sympathoadrenal system may well be involved in alterations of thermogenesis associated with fever, hibernation, shock, and malignant hyperthermia, among others. Himms-Hagen discusses the role of the thyroid gland in obligatory thermogenesis (e.g., endothermy); the thyroid sets obligate heat production at a level balancing heat loss and establishing the background for facultative thermogenesis. How the thyroid primes BAT to respond to catecholamines remains unexplained.

Webster's discussion of the energetics

of maintenance and growth focuses on "why animals differ in their heat production in a way that is unrelated to size" (p. 204). The author maintains that differences in heat production can typically be attributed to normal metabolism, such as protein synthesis. Regulatory diet-induced thermogenesis, which seems to stimulate BAT to burn off excess energy intake, occurs only in exceptional circumstances. By contrast, Rothwell and Stock emphasize diet-induced thermogenesis (DIT) as a mechanism for regulating energy balance. They also provide a useful table demonstrating similarities in the cellular mechanisms of DIT and NST. Trayhurn and James link obesity to thermogenesis and BAT. The link is weak, and intriguing problems remain: For example, why do animals becoming obese not reduce food intake? Why does hyperphagia accompany a low level of energy expenditure in so many obese animals? These questions and others, such as the role of regulatory DIT, make it clear to the reader that much remains to be learned about both the mechanisms and adaptability of thermogenesis.

Some authors point out that thermogenesis also may be part of a mammal's defense system. Aulick and Wilmore describe the coordinated metabolic, circulatory, and thermoregulatory responses to injury that apparently mobilize resources for wound healing. The rise in body temperature after injury seems similar to the fever induced by pathogens. Fever is considered adaptive; Eiger and Kluger thus distinguish between fever, which is a regulated body temperature, and malignant hyperthermia, which is unregulated. Stribling points out that much remains to be learned about drugs' effects on thermogenesis. Researchers hope to eventually develop drug treatment for obesity but the interrelationships of metabolism and nerve and cardiac function may complicate this task.

Several of the book's chapters raise questions interesting to the ecologist. Because so much research on BAT and thermogenesis has focused on the laboratory rat, extrapolating the results to mammalian species in nature is risky. For example, do animals really "overeat" and then dissipate the excess ener-

gy? If so, what does that mean for concepts of optimal foraging and energy maximization? Is the heat from DIT useful in maintaining body temperature under cold stress? Does DIT provide a mechanism whereby animals may lose weight to reduce body size and total energy demands to prepare for seasonal food shortages? And what about the other major group of homeotherms, the birds? They have thermogenic capabilities but no BAT. In what ways are cellular and organismal mechanisms similar, and how do they differ?

Not all of these questions can be answered by a book concerned with mammalian thermogenesis. Perhaps the next review volume on thermogenesis, however, should also include chapters on ecological relationships and evolutionary patterns—in effect, some treatment of ultimate factors to complement the elucidation of proximal mechanisms.

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MORE DNA

Molecular Biology: A Comprehensive Introduction to Prokaryotes and Eukaryotes. D. Freifelder. James Publishing Co., New York, 1983. 990 pp., illus. \$34.95 (cloth).

Until about ten years ago, the study of bacteria and their viruses dominated molecular biology. Then came recombinant DNA technology. Based largely on prokaryotic tools, often supplemented with tools from chemistry and immunology, this technology has been used to analyze in breathtaking detail the complex genomes of eukaryotes. Brick walls that many molecular biologists had been banging their heads against for years have come tumbling down, and entirely new fields are emerging—not least in the applied areas of medicine, veterinary science, and agriculture.

How should teachers in general and textbook writers in particular respond to these developments? In this new book, David Freifelder offers an interesting answer. Freifelder has written a multipurpose college textbook (with a separate problem book) intended primarily for undergraduate courses emphasizing macromolecular synthesis and genetic phenomena or for introductory courses

on structural biology, cell chemistry, and molecular genetics. The first six chapters introduce the methods of molecular biology, basic cellular and metabolic biochemistry, and macromolecular structure. Chapters 7–10 deal with the genetic material, its replication, repair, and mutagenesis. Chapters 11–14 describe the machinery of transcription and translation and the regulation of gene expression in prokaryotes. Chapters 15–19 present detailed descriptions of bacteriophages, plasmids, homologous recombination, and transposable elements, and Chapter 20 concisely reviews the basics of recombinant DNA technology, with a few examples of its application. Eukaryotic viruses are the subject of Chapter 21, and Chapter 22 briefly and selectively surveys regulation in eukaryotes, including transcriptional and post-transcriptional regulation. Overall, I think both teachers and students would find this an interesting and useful book for an introductory course and for review.

One weakness is the book's superficiality in the introductory chapters and the treatment of eukaryotes. This is sometimes compensated for in later chapters by in-depth treatments of specific topics, but this book would have to be used in conjunction with a biochemistry text

having a strong basis in physical and organic chemistry and with texts on microbial physiology and eukaryotic biology, so the student can see molecular biology in context. For example, an essential feature of eukaryotes is their possession of extranuclear genetic systems in the mitochondrion and the chloroplast. Enormous studies have been made over the last 15 years in understanding the structure and function of these organellar genomes and their relationship with nuclear DNA, and yet Freifelder says very little about them. Another important feature of multicellular eukaryotes is cellular differentiation. Although the author mentions in some detail several excellent examples of cellular differentiation at the molecular level, the fascinating biological problems associated with cellular differentiation are poorly presented. He describes the hemoglobin gene family in some detail but misses the opportunity to discuss the different functions of myoglobin and fetal and adult hemoglobins. Shouldn't students be encouraged to be biologists first and molecular biologists second?

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