moderate amounts of solid-state reheating and recrystallization, but others remained cool and preserved intact the details of nebular processes.

Differentiated meteorites formed by melting. Some are samples of crusts and mantles of asteroid-sized bodies and provide key test materials for scaling igneous models to planets varying widely in such properties as size and pressure. Most iron meteorites formed in cores; they are the only core samples we shall ever be able to subject to laboratory study. The fractionation of some of these cores was more efficient than that found in the most differentiated terrestrial layered intrusions.

During the past two decades the rate of meteorite research has greatly increased, and it is more difficult each year to review the entire field. Thus it is pleasant to discover that Dodd's long-awaited monograph is an exceedingly valuable compendium on the formation and evolution of meteorites. Dodd's approach is petrologic, but he includes relevant data (especially on composition) from all disciplines.

The book opens with a 12-page introduction that includes definitions and fall statistics. It closes with a 12-page discussion of parent bodies and their formation and storage locations. The intervening pages are devoted to discussions of the individual groups of meteorites.

Chondrites are the most primitive meteorites and the most common among observed falls, and it is not surprising that about half of the book is devoted to them. Dodd has devoted his career to chondrites, and this is reflected in the detailed understanding evident in this portion of the book. There is some overlap among the chapters on the differentiated meteorites because of the inferred relationships among the groups. Roughly 30 pages are devoted to the iron meteorites, and 87 pages to the achondrites and stony-irons.

Over the years Dodd has published numerous hypotheses that are by no means universally accepted (in this field, there are often as many models as there are researchers). On the whole his discussion of them here is quite satisfactory. Although Dodd places more emphasis on certain ideas (for example, his sampling model bearing on the formation of porphyritic chondrules) than most others would have, he presents the full spectrum of viewpoints and is laudably cautious about the firmness with which conclusions can be reached.

The strongest part of the book is the extensive discussion of chondrite petrology. The least strong is the discussion of isotopic data; the coverage of age data and isotopic anomalies includes most of the material relevant to chondrite formation but (perhaps wisely) few of the speculations regarding the formation of anomalies in stellar and interstellar settings. In constructing models Dodd is not skeptical enough regarding the use of mineral or track data to infer model-dependent monotonic cooling rates. There are great difficulties in reconciling the inferred low values with old formation ages and coexisting unequilibrated minerals.

The book is copiously referenced, with key references at the end of each chapter and a comprehensive list at the end of the book. The references seem reasonably complete through 1979. It is useful to compare Dodd's book to books by Mason and Wasson published in 1962 and 1974 respectively. Dodd's petrologic approach is similar to that in Mason's book, which is now badly out of date, and complimentary to the more chemical and physical approach found in my book.

The book is remarkably free of typographical errors or printing problems. All meteorite researchers and earth science libraries should have it.

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Neurobiology

Neuropharmacology of Insects. Papers from a symposium, London, June 1981. Pitman, London, 1982 (U.S. distributor, CIBA Pharmaceutical Company, Summit, N.J.). x, 330 pp., illus. $35.

Professor Underwood introduces this volume by asking why insect neuropharmacology is often neglected by workers in other fields. The answer may lie in how well insect neuropharmacologists succeed in using insect preparations to address basic biological questions not amenable to attack in other preparations. Though there can be no doubt that this volume will be of use and interest to researchers who care about insects, it may be fair to ask what basic new concepts or information it offers to those who are not insect physiologists.

Papers by Cull-Candy and Gration describing characteristics of glutamate and gamma-aminobutyric acid (GABA) channels on insect muscle fibers are of significance to all of neuropharmacology. The octopamine modulatory system in insects, clearly described in a paper by Evans, has been influential in the development of the distinction between classical neurotransmitters and neuromodulators.

Much progress in neurobiology has come from the use of venoms and toxins isolated from various plants and animals. A paper by Piek describing recent work on wasp venoms and toxins is of wide interest because some of these substances may prove useful as probes for some excitatory glutamate receptor-channel complexes. Papers by House and Ginsborg, Mordue, and Berridge and Heslop on aminergic and peptidergic systems should also be valuable to vertebrate and invertebrate investigators alike.

In other cases the investigators working with insect preparations are at best trying to attain the level of information already available with other preparations. Notable in this regard are papers concerning the purification and isolation of the putative acetylcholine receptors from insects. Ironically, in spite of the undisputed importance of cholinergic mechanisms in insects, the physiological, biochemical, and pharmacological characterization of acetylcholine receptors in insects has seriously lagged behind work in many other systems. Also lagging behind work with vertebrates are studies of synaptosomal preparations and attempts to characterize glutamate and GABA receptors biochemically. Therefore, although papers in the book on these subjects result from years of careful work, they are likely to be of real value only to insect neuropharmacologists and will be of limited interest to a general audience.

Perhaps the most novel contributions to molecular neuropharmacology made with insect preparations in the past few years have come from the use of genetics in *Drosophila*. One would have welcomed more than the three papers on the subject in the volume (though the three do provide a beginning for the interested reader). Other fields in which invaluable contributions are being made by the use of insect preparations are perhaps also underrepresented.

One of the most enjoyable features of the volume is the extended discussion section that follows each paper. The discussions contain frank and frequently amusing interchanges among the participants (one of the highlights is Eldefrawi's account of fattening a cockroach by injecting it with 10 mouse-lethal doses of α-bungarotoxin), which in many cases are more illuminating than the papers themselves. The presence of J. S. Kelly at the meeting enlivened it, although the volume does not contain a paper by him. His outspoken challenge of the ease with which invertebrate neuropharmacology can be extrapolated to vertebrate neuropharmacology is a useful reminder to invertebrate neuropharmacologists that they still bear the burden (fairly or not) of having to justify the relevance of what they do. A careful reading of the discussions makes it clear that in the early stages of research it can be a nontrivial endeavor to distinguish general principles from species specific information.

The volume belongs in all university and research libraries and in the personal libraries of all insect neurophysiologists. Whether it will convince many vertebrate neuropharmacologists of the necessity of paying significantly more attention to insect neuropharmacology remains to be seen.

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Biological Rhythmicity

The Clocks That Time Us. Physiology of the Circadian Timing System. MARTIN C. MOORE-EDE, FRANK M. SULZMAN, and CHARLES A. FULLER. Harvard University Press, Cambridge, Mass., 1982. xvi, 448 pp., illus. $25. A Commonwealth Fund Book.

The "clocks" that are the focus of this book are those endogenous oscillators that are responsible for the generation of circadian (that is, about 24-hour) rhythms in humans and other mammals. It has only been in the last 25 to 30 years that more than just a handful of scientists have begun to seriously study circadian rhythms in plants and animals. The pioneering efforts of Jürgen Aschoff, Erwin Bünning, Colin Pittendrigh, and Curt Richter opened up a new scientific discipline that today enlists the efforts of hundreds of life scientists. Despite the rapid growth of this new area of biology, many life scientists are unaware of even the most fundamental properties of biological rhythms. As the authors point out, circadian oscillations in biological variables have simply represented the "noise" in baseline data for many investigators. Yet it is now apparent that just about every physiological variable shows some circadian fluctuation in humans as well as in other animals. *The Clocks That Time Us* is aimed at biologists and clinicians who are not directly concerned with biological rhythms but for whom a basic understanding of the circadian organization is critical for the design of experiments as well as the interpretation of data.

The book begins by outlining the history of interest in biological rhythms. Also in the opening chapter is a general introduction on the nature of endogenous circadian rhythms and how data on rhythmicity are collected and interpreted. The second chapter discusses the general features of circadian systems. During most of the modern era of the study of biological rhythms, the circadian system has been treated as a black box, studied by following the movement of the hands of the clock (that is, by monitoring some measurable circadian rhythm such as feeding, sleep, body temperature, or locomotor activity) under a variety of external environmental conditions. Any attempt to explain the physiological basis of circadian oscillations, whether at a systems, cellular, or molecular level, must take into consideration the fundamental properties of free-running or entrained circadian rhythms as discovered by such research, and Moore-Ede *et al.* lucidly explain many of these properties.

In chapters 3 through 5 the authors detail what is known about the endogenous nature of the clock system that regulates a multitude of circadian rhythms. It is now recognized that multicellular organisms utilize a number of circadian oscillators. A major concern of research today is the hierarchical nature and the interaction of these various oscillators and how they remain synchronized with one another as well as with the external environment. In mammals, and possibly other vertebrates, one "pacemaker" that drives many circadian rhythms appears to reside within the suprachiasmatic nuclei of the anterior hypothalamus. Moore-Ede *et al.* do an excellent job of reviewing the anatomy and function of these structures as related to the circadian organization.

The longest and most original chapter in this book (chapter 5) discusses how central circadian pacemakers time many bodily functions, including sleep, feeding, drinking, thermoregulation, excretion, reproduction, and endocrine activity. Though many circadian biologists are interested either in the location and structure of central circadian pacemakers or in the time course of various rhythmic variables, few attempts have been made to provide a complete picture of the physiological events that must accompany the transfer of information from a central circadian oscillator in the brain to an end organ or tissue. Moore-Ede *et al.* clearly outline how the circadian organization influences a variety of different physiological systems.

In the sixth chapter the authors present a mathematical model of human circadian rhythms that was recently developed by them and Kronauer. Whether or not this model will provide any new insight into the physiology of human circadian systems will depend on future studies. Its inclusion seems inappropriate in a general overview of the field.

The final chapter of the book is devoted to the medical implications of circadian rhythmicity. Although the data on humans are still fragmentary, it now appears that the most effective diagnosis and treatment of many illnesses depend on a working knowledge of the circadian organization of the patient. In addition, the etiology of many physical and mental disorders may involve disruption of normal circadian rhythmicity. Nevertheless, few attempts have been made to use the recently gained knowledge of biological rhythms for the benefit of human health. One objective of this book is to motivate physicians at least to begin to consider circadian rhythmicity in their practices. In an attempt to catch the ear of the medical community, the authors are at times guilty of sensationalism, an all too common practice of scientists who are trying to make their ideas known to a broader constituency. For example, when discussing the fact that the men who operate nuclear submarines in the U.S. Navy are on an abnormal 18-hour day-night cycle, Moore-Ede *et al.* write, "There should be some global concern about the health and performance of these men, since they are the ones with their fingers directly on the nuclear button!" (p. 337). Critical readers of this book do not need these histrionics to convince them of the importance of a normally functioning circadian system for human health. The authors have already laid a scholarly foundation for the medical implications of circadian rhythmicity.

In the preface of their book the authors raise the question "How could research on the clocks that time our sleep and wakefulness, our metabolic, endocrine, and neural functions be so easily ignored?" At least part of the answer lies in the fact that an easily readable book on biological rhythms in mammals and their implications for human health has not been available. Moore-Ede, Sulzman, and Fuller have provided such a book.

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