the color changes of some animals in his book *History of Animals*. The present book goes far beyond a mere discussion of integumentary zoochromes. It deals with all the colored molecules that occur in animals, including the carotenoids, fuscins, quinones, bilins, porphyrins, melanins, ommochromes, purines, pterins, isoalloxazines, and hemocyanins.

After a brief introductory chapter, there is a detailed chapter explaining the physical basis of color in molecules. The subsequent chapters concern themselves mainly with the functions of the many zoochromes in such processes as photoreception, camouflage, protection against radiation, oxidation and reduction, oxygen transport, and reproduction and development. In addition, there are interesting chapters on such topics as the genetic basis of chromogenesis, pathological states involving zoochromes, and zoochromes and evolution.

In the introductory chapter, Needham comments that because of the multiplicity of functions that biochromes serve many biologists are as yet disinclined to recognize what he refers to as "a discrete science of biochromatology." This book presents a strong case for such recognition.

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Thermal Biology

Temperature and Life. H. PRECHT, J. CHRISTOPHERSEN, H. HENSEL, and W. LARCHER, Eds. Springer-Verlag, New York, 1973. xx, 780 pp., illus. $54.70. Second edition of *Temperatur und Leben* (1955).

This is the long-awaited second edition of the authoritative book *Temperatur und Leben*. The second edition is in English and the translation is excellent throughout. Because the first edition was a bible for workers entering the field of thermal biology, this edition demands close attention.

The new book unfortunately is merely a compilation of relevant literature on microorganisms (two contributors), plants (seven contributors), poikilothermic animals (four contributors), and homoiothermic animals (three contributors). The bulk of the book suffers from a lack of either a synthetic or an analytical approach to the literature. In places it is reduced to a catalog, which makes it pedestrian reading. In most chapters coverage of the literature is complete up to 1972, and in one case work published in 1973 is included in footnotes.

The chapters, and in some cases sections of the same chapter, are largely independent of each other, and little or no attempt is made to integrate material on similar subjects in different sections. It is irritating to find such topics as frost resistance and cold injury in plants dealt with at a variety of levels by several different contributors. The chapters on plants, with the exception of the one by Gates, are the weakest. This may in part reflect current knowledge about the temperature relations of plants, which seems to be still at a very descriptive level. In my view that part of the book would have been improved by a more rigorous editorial policy.

I regret that more space could not be found for the excellent work on cryobiology, which surely deserves more than half a page. This is a field in which many exciting advances have been made, particularly in studies of the mode of action of cryoprotectants and on freezing injury, work that demands to be included. Furthermore, I cannot believe that nothing of significance has been published in this field since 1960, the most recent reference quoted. A similar criticism can be leveled at the section on the effect of temperature on spermatogenesis, where much of the significant literature since 1950 has been ignored. At least the publications from the laboratories of Lacy, Steinberger, and Clegg should have been included. It is also disappointing that the interesting observation by Edwards that maternal hyperthermia produces developmental abnormalities in the fetus is left out of the section on temperature and development.

Students will find the chapter by Gates most useful, and Precht's cautions regarding experimental procedure in thermal physiology are most instructive, though they would have been more pungent had they been illustrated by examples. At a time when more and more workers are studying the effect of temperature on enzyme kinetics, the contribution by Havsteen is most welcome. Surely, though, this was the place to discuss the significant contributions by Hochachka and his colleagues to our understanding of the mechanisms involved in capacity acclimation in terms of thermal modulation of enzyme activity. In fact, one of the most disappointing aspects of the book is that the opportunity to seek explanations for the observed effects of temperature on living organisms at a fundamental level is not taken. Accounts of effects of temperature on cells, cell organelles, and enzymes are scattered throughout the book. It seems a great pity that the proposed chapter by Lumper on physical and chemical aspects (to be published separately) was not included instead of the repetitive material in existing chapters. In my view the greatest omission is the recent spate of research on the effect of temperature on membranes, particularly on membrane fluidity and phospholipid model membranes. A chapter that included, for example, the elegant studies of Bangham, Chapman, and van Deenen on model membranes, together with the work of Fox, Overath, and McElhaney on bacteria, of Kemp, Hazel, and Raison on mitochondria and chloroplasts, of Charnock, Grisham, Papahadjopoulous, and Hokin on the Na^+–K^+ adenosine triphosphatase, of Eletr, Inesi, and Sreter on sarcoplasmic reticulum, and of Wunderlich on *Tetrahymena*, could have integrated these related studies and made the workers in these various fields less isolated from each other. The type of work done by Willis on tissues from hibernators might also have been included.

I found the index deficient. The publishers should consider presenting a supplementary index with the Lumper contribution, as well as an author and a species index. These addenda would make this a valuable reference text, particularly for new workers in the field.

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Theory of Statistical Mechanics

Nonequilibrium Statistical Thermodynamics. D. N. ZUBAREV. Translated from the Russian edition (Moscow, 1971) by P. J. Shepherd. P. Gray and P. J. Shepherd, Transl. Eds. Consultants Bureau (Plenum), New York, 1974, xx, 490 pp. $25. Studies in Soviet Science.

This text deals with the formal theory of equilibrium and nonequilibrium statistical mechanics. The treatment is at a level appropriate for a second-year graduate course. Zubarev's discussion is uniformly clear, and his development of the material is interspersed with a number of particularly illuminating remarks. The approach is formal in the sense that no attempt is made to supplement the discussion with either illustrative examples based on soluble models or a comparison of theory and experiment. These omissions tend to give the book a somewhat dry quality. In addition, we note that, although the date of the original Russian edition is given as 1971, most of the material in the text was already classical a decade earlier. Thus, some of the most important recent developments in statistical physics (for example, long time tails in transport phenomena and the theory of mode-mode coupling near critical

points) are entirely omitted. Nevertheless, the author's presentation of the basic material is lucid and professional and his book is a valuable addition to a field in which the number of treatises is surprisingly small.

The first two chapters of this text are devoted to equilibrium statistical mechanics of classical and quantum systems, respectively. The microcanonical, canonical, and grand canonical ensembles are introduced, their interrelationship is discussed, and their bearing on thermodynamic properties is established. We found the author's summary of the information theory approach to entropy and his discussion of the classical limit of quantum statistics to be especially illuminating. It should be mentioned that these two chapters are particularly concise, so that the student without a firm background in statistical physics will almost certainly require supplementary material. For example, the author does not discuss the ideal gas system, and the Boltzmann, Fermi, and Bose single-particle distribution functions do not appear explicitly in the text.

In chapter 3, Zubarev turns to an exposition of linear response theory. This is a subject that has been extensively developed in the past 25 years. It deals with disturbances in a system near absolute equilibrium. The magnitude of the disturbance is assumed to be negligibly small, but one is able to treat arbitrary wavelengths and frequencies. In particular, experiments on light and inelastic neutron scattering from fluids in the past decade have provided rich opportunities for the application of this theory. The formalism of the theory is very general, with results such as the Green-Kubo relations for susceptibilities, fluctuation-dissipation theorems, spectral representations, and frequency sum rules. The subject is put on a unified basis by use of the language of double time Green's functions. While Zubarev's exposition is clear and concise, the student would be well advised to read this chapter concurrently with other, more detailed expositions. Especially useful are P. Martin's *Measurements and Correlation Functions* (Gordon and Breach, 1970) and the lengthy review "Time dependent properties of condensed materials" by B. Berne in *Physical Chemistry*, volume 8, part b (H. Eyring, D. Henderson, and W. Jost, Eds., Academic Press, 1971).

Chapter 4 deals with irreversible processes in systems near local equilibrium. Here the magnitude of a disturbance can be large, but the theory has implicit limitations on how rapidly processes can vary in space and time. The classical prototype is the set of nonlinear Navier-Stokes equations of fluids. Zubarev's exposition is based on his own original investigations and on work by MacLennan. The theory leans heavily on the consequences of the microscopic conservation laws in conditioning the form of the self-contained macroscopic equations that are the object of the theory.

Chapter 4 also contains a number of shorter sections. There is a section on relaxation processes that deals with systems near equilibrium in a different sense. An example of such a system is a weakly ionized plasma, where a weak electric field produces a situation in which electrons and ions may be approximately considered as weakly coupled subsystems in separate equilibria at different temperatures. There are also special sections dealing with relativistic systems and with variational aspects of nonequilibrium statistical operators.

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