so with this text. Granted that *The Principal Diseases of Lower Vertebrates* attempts to be encyclopedic, ranging from immobilization and euthanasia through anatomy, etiology, descriptive pathology, and toxicology to surgical and medical therapy, healing processes, teratology and zoonoses of fishes, amphibians, and reptiles, and succumbs to the temptation to tabulate the signs of disease a little too provincially, it is an authoritative text nonetheless.

Parasitologists may wince somewhat at the paucity of morphological measurements that differentiate, perhaps, but the more demanding scholars will find these details by utilizing the excellent bibliographies that follow each chapter as well as clear line drawings that illustrate the main anatomical features.

Pathologists will be impressed by the photographic efforts put forth to depict gross lesions, although some illustrations suffer from whole-beast pictures when localized renditions would have been more illuminating, and what appear to be older close-up photographs suffer from depth-of-field limitations. The photomicrographs are very good.

Veterinarians will find the volume indispensable as clinical reference material, and epidemiologists will consider it a handy, if brief, reference manual, especially for fish zoonoses. Hobbyists will discover that it is easy to read and has two useful glossaries that convert taxonomic inscrutability into understandable and readable prose. But we won't eat fish for some time.

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Anatid Displays

Handbook of Waterfowl Behavior. Paul A. Johnsgard. Cornell University Press, Ithaca, N.Y., 1965. xvi + 378 pp. Illus. $10.

The rationale for this book proceeds from the premise that behavioral characters can be a reliable guide for taxonomy. This view is not new—for example, Heinroth (1911), Petrunkevitch (1926), and Lorenz (1941). An explicit restatement of the methods of behavioral systematics has recently been provided by Tinbergen (1962), who states that, "These arguments [that is, the justification for the criteria by which relationships and origins are established] are all full of pitfalls . . . [but] when the various criteria are applied together and all point in the same direction, they carry conviction" (in *Evolutionary Aspects of Animal Communications*, p. 3). This conclusion is certainly open to debate. The nonoperational nature of many of the taxonomists' concepts (for example, "primitive" or "specialized" characters), the lack of demonstrated independence between biochemical, embryological, or anatomical characters, and the difficulty of measuring the susceptibility of some characters to environmental agents have not been sufficiently recognized by taxonomists. The use of behavioral characters does not avoid these pitfalls, nor does it cause the sum of a string of "uncertainties" to lead to "conviction." One merit of Johnsgard's book is that it does acknowledge (in the introduction) certain of these difficulties. Johnsgard then, regretably, ignores his own caveats, as evidenced by his facile pronouncements about which of two species is more closely related to a third, or which display is more "generalized." However, pointless as his phylogenetic conclusions may be, they do not detract from what is essentially a series of competent descriptions of anatid *displays*. (Note, however, that his title refers to *behavior*, of which displays are but one feature: there is scarcely any material on duck behavior in its more general sense.)

The index, always of particular importance in a descriptive study, allows one to find either references to a particular species or a particular display. The value of the index would be enhanced if the latter entries directly indicated to which species they apply. Even a table from which one could read, for example, the names of all species that engage in "head-pumping" would be useful. The illustrations, principally pen-and-ink drawings, are adequate; the few photographs are generally poor, both in composition and technical quality.

This volume will probably appeal only to the more fanatic devotees of waterfowl, or possibly to teachers of ethology who require examples of displays. (Since both conditions apply to me, I am pleased to have a copy.)

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Physics

Some Aspects of Non-Equilibrium Thermodynamics in the Presence of a Radiation Field. Based on a set of lectures given at the University of Paris, February and March 1961. Richard N. Thomas. University of Colorado Press, Boulder, 1965. xiv + 210 pp. Illus. $5.

This book is based on lectures given by the author at the University of Paris in February and March 1961. The lectures, in turn, were based largely on work by the author and his collaborators. There are also some bibliographical comments and an annotated bibliography which contain references to sources as late as 1965; thus, we may assume that the material in the book represents the author's current thinking on the subject of the spectroscopic analysis of hot gaseous ensembles—stellar or laboratory, with primary emphasis on the stellar part.

The nexus of the author's thesis is that stellar atmospheres *cannot* generally be described by assuming that the gas in each region in the atmosphere is approximately in local thermodynamic equilibrium (LTE) at some temperature $T(z)$. Here z is a coordinate perpendicular to the surface of the system. (Curvature effects and time dependent problems are not considered here.)

If the assumption of LTE were valid, then knowledge of the temperature and chemical composition at a given position in the system would be sufficient to determine, via the usual theory of equilibrium statistical mechanics, the complete local state of the gas. The complete description of the state of the gas consists of specifying the occupation numbers n_k, of the various energy levels of the atoms and ions as well as the velocity distribution of the particles in the various energy states. The electrons and atoms in the ground state are assumed to have a Maxwellian distribution of velocities with local temperatures $T_e(z)$ which coincides with $T(z)$ for LTE.

The inadequacy of the LTE model is due to the low concentration of particles in stellar atmospheres so that collisional processes do not dominate the transition rates. Also, the other simplifying assumption that the local state of the gas is completely determined by the radiation incident on the system from the outside is not valid

when the optical thickness of the system is not small in some frequencies. Hence, in general, the determination of the local state of the gas at some point z requires knowledge of $I_\nu(z, \theta)$, the intensity of radiation with frequency ν making an angle θ with the z-axis, which in turn depends on the state of the gas in a large region surrounding the point z. The author calls this situation "nonlocally controlled." Determination of the state of the system now requires self consistent global solutions of the microscopic kinetic equations for the interconnected state of the gas and the radiation field. How to attempt to do this using the experimental information obtained from observing I_ν at the surface of the atmosphere is the main content of the book.

The book consists of seven lectures: "Aim and structure of spectroscopic diagnostics"; "Empirical methodology for specifying the observational state"; "Theoretical approach to the intermediate parameters"; "The small-perturbation vs. the general rate-process approach to the non-LTE configuration for a diffuse radiating gas"; "The radiative transfer problem for atmospheric self-emission"; "Relation of the local energy content of the gas to its spectroscopic state"; and "The new spectroscopy."

I found the book very instructive and, on this score, would recommend it highly to physicists interested in doing research in this field. (Warning: as a physicist working in nonequilibrium statistical mechanics, I found the constant use of the word "nonlocal" somewhat confusing. After all, even in LTE the temperature is nonlocally controlled.) I heartily wish I could say that I found the book easy or pleasant reading. Unfortunately, I did not. The style, which might have been clear in oral presentation, is generally very complex, so complex in fact that I frequently found it impossible to decide just what the author had in mind. Fortunately, there are exceptions to this rule. The bibliographical notes give a concise historical review, with acid comments, of the development of the subject. There is no general index.

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Chemistry of Natural Products Series

The Chemistry of the Vitamins. S. F. Dyke. Interscience (Wiley), New York, 1965. x + 363 pp. Illus. $10.

This book covers in a relatively comprehensive and satisfactory manner what its title indicates. Included are the borderline substances, lipoic acid, the essential fatty acids, and myoinositol as well as eight individual vitamins and five vitamin groups (vitamins B_6, vitamins A, vitamins D, vitamins E, and vitamins K). A short introductory chapter is concerned mostly with nomenclature. A total of about 950 references are cited at the ends of the individual chapters.

Unfortunately, from my viewpoint, real advances in the area of vitamins will not depend on more and more refined knowledge of their chemistry. Rather we need to know much more about their biological functioning and their interrelationships and to have quantitative information about vitamin requirements. The author has unavoidably introduced some of this biochemical material, and unfortunately, it is not of the highest order. He says, for example, "It is unlikely that all the vitamins have been discovered and much effort is being devoted to nutritional research at the present time." Although a categorical denial would not be justified, the statement suggests a misconception about the present status of the situation. He also states that "The normal adult requires about 3250 units per day of Vitamin A." The presentation of this figure does not take into account the fact that, for 13 years, Mead, Johnson, and Company offered a $15,000 prize to anyone who would determine the Vitamin A need of humans; there were no takers. Mead, Johnson would have been satisfied with a value expressed with *one* significant figure. In a number of places the author speaks of the production of vitamins by intestinal bacteria, but he does not mention this in connection with the requirements of humans for vitamins K. (Healthy adult mammals are generally considered to have all their vitamin K needs supplied by this means.)

These matters lie outside the subject of this book—that is, the *chemistry* of the vitamins. On the strictly chemical phases, I have no sound basis for challenging the author's competence. I did not attempt to detect typographical errors, but they appear to be few.

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Atomic Physics

The Theory of Electron-Atom Collisions. G. F. Drukarev. Translated from the Russian edition (1962) by S. Chomet. J. B. Hasted, Translation Ed. Academic Press, New York, 1965. xii + 161 pp. Illus. $6.50.

In recent years there has been an almost explosive development in the experimental and theoretical study of atomic collision phenomena at relatively low energies of impact. This has arisen partly because of the requirements for knowledge of the rates of a wide variety of collision processes in high temperature plasma physics, atmospheric physics and astrophysics, direct conversion of heat to electricity, and the study of lasers. Among the various phenomena are many that are concerned with the collisions of electrons with atoms, a subject which is still attractive in that it offers greater scope for detailed theoretical analysis than most others.

The appearance in a good translation, of a book such as that written by Drukarev, devoted to describing the present state of this analysis, is therefore very welcome. The author is at pains to apologize for not presenting a fully comprehensive account and for the fact that by the time the book has appeared it is already a little out of date. Neither apology is necessary. It remains important to present interim surveys even of rapidly expanding fields—there is always a strong tendency for those involved to miss seeing their own work in a larger context. Equally well, the book gains by not attempting to be too comprehensive. On the other hand it contains a great deal of general collision theory and a large part of the major theoretical applications to electron impact with atoms.

The first two chapters give rather concentrated but still thorough accounts of scattering theory, including variational methods and dispersion relations among other topics normally dealt with. Although these chapters are not easy