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.

JOHN MCCOY
Bureau of Biological Research, Rutgers University, New Brunswick, New Jersey

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.)

PETER H. KLOPFER
Zoology Department, Duke University, Durham, North Carolina

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