Arctic Life of Birds and Mammals including Man

By Laurence Irving. Volume 2, Zoophysiology and Ecology. Springer-Verlag, New York, Heidelberg, Berlin. 1972. xi + 192 pp. $14.00 (U.S.), cloth.

Laurence Irving is well known to physiologists for many years of work on low-temperature physiology of birds and mammals. He is perhaps best known to ornithologists for his studies on the birds of Anaktuvuk Pass in the Brooks Range. In this book he tries to synthesize these and related topics for a diverse readership. The early chapters deal with arctic climate and associated phenomena, habitats, Pleistocene glaciations, and origins, fluctuations and extinctions of the arctic fauna; then general accounts of arctic mammals, of arctic birds, and the maintenance of bird and mammal populations. The first five chapters, drawing largely on the work of others, sometimes lack coherence. In contrast, I found chapters 6 to 12, covering fields in which Irving has been most deeply involved, to present a clear and fascinating story.

The discussion of climate is adequate from the macroclimate viewpoint, but biologists are most concerned with climate on a smaller scale even than the meteorologist's microclimate — what we might call the nanoclimate, comprising the lowest meter, or often only 10 cm, of air. Fortunately, such a treatment is now available by P. S. Corbet (Acta Arctica 18, Munksgaard, København, 1972).

I noticed several innocuous typographic errors, but there are some more troublesome slips. In tables 3.2 and 3.3 we see reference to "several species" of *Canis lupus* and *Mustela rixosa*. On pp. 47 and 61 Theed Pearse appears as "Theed (P.)." The Urner and Storer paper cited on p. 63 is not in the references. *Calidris minutilla* and *C. pusillus (p. 64)* are in *Erolia* and *Ereunetes* on p. 65. (Fortunately the A.O.U. has now submerged these genera in *Calidris,* in line with European usage.) On p. 70 a table compiled from Savile and Oliver's account of Hazen Camp birds and mammals omits *Lagopus mutus* and *Sterna paradisaea* from nesting species; this paper (Canadian Field-Naturalist 78: 1–7. 1964) is not in the references. Isachsen (p. 72) is at 78°47′ N rather than 73°. On p. 116 the symbol for *Acanthis flammea* is RP in the figure but CR in the table. When an author writes, rewrites, and repeatedly rearranges familiar items, it is increasingly hard for him to read every word in the final version as the mind leaps ahead. This series of volumes is stated to have a managing editor, four editors, and 12 co-editors. Surely this galaxy of talent might have caught such slips and also helped to unify some of the early chapters and smooth out a few awkward sentences.

Now let me make some constructive comments on this valuable summary of a fascinating and timely theme, to aid readers unfamiliar with arctic biology. The most useful definition of the terrestrial arctic (p. 8) is simply the land beyond the last trees; this is less naïve than it may seem, for the trees control the microclimate as much as the climate controls the tree-line. Snow-cover (p. 14) is also critical because, without a certain depth, lemmings do not achieve breeding condition; hence, I suspect, their irregular fluctuations in arid high-arctic valleys. In connection with the postglacial immigration of birds and mammals (pp. 35, 53), we must realize that melting a continental ice-sheet, with a high albedo, takes much greater heat than is needed merely to keep land ice-free. Thus hypsithermal conditions *produced* the ice retreat rather than simply followed it; and growing conditions were generally good on all ground almost as soon as it was ice-free. We often underestimate plant migration rates, but we know that many species were fully 200 miles beyond today's limits far back in the Hypsithermal Interval; and early spread of animals was thus expedited. One function of the male Rock Ptarmigan's prolonged white plumage (p. 70) seems to be the "altruistic" one of distracting predators from the cryptic, close-sitting hen. The cock molts with a rush at about the end of incubation. Under insulation of birds (p. 106) more emphasis might be placed on the evident fact (not experimentally determinable because plumage of a detached skin cannot be "fluffed") that the insulation value of a chickadee's erected coat (perhaps 10 mm) is as high as that of the 50-mm pelage of an arctic fox. Thus small birds can survive in weather so cold that small mammals, unable to manage a long coat, must stay in shelter. The superb insulation provided by the interlocking feather elements gives clothing designers no cause for complacency. On p. 164 Irving echoes other zoologists' doubts about Bergmann's rule (that the largest races should occupy the coldest regions), pointing to the small size of the high-arctic Peary Caribou. Simple arithmetic assures us that the smaller of two similar bodies has the higher ratio of surface-to-volume and thus the greater heat loss; but other factors may be more critical than modest extra heat loss. Reduction of adult body size with limited food supply has been documented for some deer and is a probable cause of the small size of some island populations. Food supply is extremely short on many high-arctic islands, probably making small size strongly adaptive. The high-arctic *Gavia stellata* is also much smaller than the more southerly loons, *G. adamsii* and *G. immer,* for which

there are certainly two good reasons: it is critically important that the young can fly before the nest pond freezes, and presumably the small species fledges fastest; perhaps more importantly, only quite small ponds, from which a large loon could not take off, routinely become ice-free in the high arctic.

Irving rightly concludes that there are no major specifically arctic adaptations. The arctic fauna, like the arctic flora, is young and attenuate, made up from various alpine and temperate sources. There are no fully arctic genera, a few arctic species, and many arctic subspecies. The adaptations are mostly refinements of ones seen outside the arctic. The most conspicuous genetic adaptations are these: first, superb insulation; and second, heat-economy devices, notably highly developed counter-current heat exchangers in limbs and tails, whereby the outgoing arterial blood gives up most of its heat to the returning venous blood. Additionally, there is ample evidence for important degrees of acclimatization (non-genetic conditioning) of birds and mammals, such as is now known to occur in plants. We all experience cold-conditioning to some extent. How sharply we feel those first cool days in November (complaining of the damp, however dry the air), yet by January we cheerfully withstand much severer cold with no heavier clothing.

D. B. O. SAVILE

Biosystematics Research Institute
Central Experimental Farm
Ottawa, Canada K1A 0C6

Cadmium in the Environment — A toxicological and epidemiological appraisal

By Lars Friberg, Magnus Piscator, and Gunnar Nordberg. Karolinska Institute, Stockholm, Sweden. CRC Press, Cleveland, Ohio, 1971. 166 pp., 37 tables, 50 figures, and 4 plates. $25.00. Also available from the National Technical Information Service, U.S. Department of Commerce, PB-199 795.

This book was the first comprehensive work on the role that inorganic cadmium plays in the environment. It was most welcomed by physiologists, biochemists, ecologists and physicians, as well as engineers involved with environmental problems. This book focuses on the toxic action of cadmium and its effects on man and animals. The world had its mercury panic a few years ago and now the focus is on cadmium. This publication helps to put the effects of cadmium into proper perspective. It is known that cadmium is one of several factors in Itai-itai disease and has potential long-term effects on kidney function, while the research regarding possible relationship to hypertension has led to contradictory conclusions. This book and subsequent publications indicated below do an excellent job of summarizing the work to date and indicating the amount of research still required on this topic.

I must say, before going further in the review, that since this book appeared two other important publications on the same subject have been published. The first is *Cadmium in the Environment,* II, February 1973, 147 pp. by the same three authors plus T. Kjellstrom also from The Karolinska Institute, Department of Environmental Hygiene, Stockholm, Sweden. This book is also distributed by the NTIS, U.S. Dept. of Commerce, PB-221 198. The second "bible" on the subject is entitled *Cadmium the Dissipated Element,* January 1973, by W. Fulkerson and H. E. Goeller of the Oak Ridge National Laboratory, Oak Ridge, Tennessee. This bound edition of 473 pages is coded ORNL NSF-EP-21. The Karolinska Institute teams also contributed to this very exhaustive and valuable document.

It is the opinion of some analytical chemists that the Friberg 1971 edition, Chapter 2, dealing with problems of analysis, is relatively poor. No mention of technique as the anodic stripping voltametry is discussed. The other conventional methods are covered in only 3.5 pages. Based on the fact that all the rest of the book is based on levels of cadmium in air, soil, water, food stuff, human and animal tissue, etc., more thought should be given to the most reliable analytical techniques.

The Table of Contents indicates the wrong page numbers for all chapters. Because of the high price of the book such mistakes should be avoided.

The biomedical orientation of the book is well shown by the main chapters' titles: metabolism, respiratory effects and dose-response relationships, systemic effects and dose-response relationships, carcinogenic and genetic effects, the itai-itai disease. The value of the book is without any doubt enormous but the biologist certainly needs more information on the bioaccumulation of cadmium in the lower vertebrates and invertebrates. This is my major criticism. The effects of this metal in the lower animals and plants which are closer than man to the basis of the food chain are still unknown. This is partly why there are no standards as yet with respect to the cadmium content of food in the United States and Canada. It is well emphasized in the Friberg *et al.* book that severe gaps exist in the understanding of cadmium intoxication and on the turnover of cadmium in the biosphere. Accumulation via air and water in food chains should become a priority