plumaged and bizarrely behaving birds known, study of which can be expected to advance significantly our understanding of the relationships between ecological factors, behavior, and social organization. For each species our knowledge ranges only from moderate to meager, but it is enough to tease and tantalize, and one can easily envision enthusiastic readers of the book hastily departing for the field in search of data. Because of the wealth of exciting research topics suggested by the organisms it describes, this volume is one of the most stimulating books to appear in a long time for avian ecologists, sociobiologists, behaviorists, and systematists. Every species of cotingid is illustrated, and for most dimorphic species both the male and the female are figured. The color plates by Woodcock are excellent and should greatly facilitate identification of specimens in hand, but the size of the book, 9 by 11 inches, makes it unwieldy for field use.

The book begins with three chapters that briefly review the classification, evolution, behavior, and major morphological features of the family. These are followed by treatments of each genus, with species considered separately where information is available. Topics covered include distribution, ecology, behavior, annual cycles, plumages and molts, and physical characters. The literature coverage is excellent, though the author has not cited every publication mentioning the natural history of cotingids, and the accounts are good representations of what is known of each species. In addition, Snow has supplemented his sections with accounts by individuals especially knowledgeable about particular species.

The excellent distribution maps give individual localities instead of the vague shading usually provided in books of this type. This allows the reader to assess more easily areas of actual or potential sympatry or parapatry among species and to identify potentially suitable field sites. Unfortunately, the author did not provide an appendix listing the localities and citing the sources of information about them (museum specimens, literature references, and so forth). This would have been of value to scientists and birders alike. For the average reader, a map indicating the 10 to 15 topographic features repeatedly used in the distribution sections of the species accounts also would have been helpful. These omissions reflect the somewhat hybrid nature of the volume, which seems to have been designed to appeal to both the amateur and the scientist, preference being given to the former.

Two criticisms of the book seem justified. First, the author repeatedly refers to the scarcity of available information about the family but nevertheless bases generalized and unqualified statements on the insufficient evidence. This is particularly true with regard to food habits and molt cycles. For most species, data on these subjects are extremely limited or were collected during very narrow calendar periods and do not take seasonal variation into account. One suspects that many of Snow's statements are correct, but at present they remain unsubstantiated.

Second, the book was not rigorously edited. Typographical errors are few, but misplaced modifiers abound. Labels for the white-tailed and white-winged cotingas in plate 11 are reversed. The distribution maps are often far larger than necessary, and many pages are less than half or a quarter full; the resulting wasted space surely contributed to the expense of this volume.

On balance, these criticisms are minor. The book will be a valuable addition to the libraries of graduate students and senior investigators alike as a reference work on the Cotingidae, as a source of research ideas, and for the selection of species for investigation.

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Stellar Evolution

Binary and Multiple Stars as Tracers of Stellar Evolution. Proceedings of a colloquium, Bamberg, Germany, Aug. 1981. ZDENĚK KOPAL and JÜRGEN RAHE, Eds. Reidel, Boston, 1982 (distributor, Kluwer Boston, Hingham, Mass.). xxx, 504 pp., illus. $67.50. Astrophysics and Space Science Library, vol. 98.

Using binaries to trace the course of normal stellar evolution is not quite the same thing as studying the evolution of binary systems themselves; and the majority of the 62 papers in this volume (including most of the more interesting ones) in fact focus on some aspect of the latter topic.

The book (and, perhaps, the conference of which it is the proceedings) could profitably have had a larger complement of broad-based reviews. There are only three: R. Kippenhahn on post–main-sequence evolution of single stars of less than 10 $M_\odot$, M. J. Plavec on evolution of close binary systems, and P. van de Kamp on wide binaries. The second of these is probably of the widest general interest, bringing the reader up to date on a variety of classical problem systems, like ϵ Aurigae (whose massive disk component may well have a black hole at the center, though this doesn't really help much in understanding the system), the symbiotic stars (some of which may be experiencing rapid mass transfer onto a hydrogen-burning hot star rather than a white dwarf), and the barium stars (which are apparently all binaries, but again this doesn't help much in understanding them). There is also a new class of objects, the W Serpentis stars, which may be transitional between the symbiotics and the classical Algol binaries, in which mass transfer onto a main sequence star occurs quite slowly.

The contributed papers contain a feast of tidbits for the connoisseur of binaries. Different ones will be new to different readers, but I learned, for instance, that among nearby stars most of the binaries have similarly oriented orbital planes (J. Dommanget) and that stars like the sun (F6 through G5) have a lower incidence of binary companions than other spectral types (T. J. Herczeg).

Several authors toss out intriguing theoretical suggestions that should prove handy targets for future attacks. For instance, the brightest stellar objects seen in external galaxies, the Hubble-Sandage variables, may really be wide binaries with an unstable accretion disk around the main sequence component (F. Meyer and E. Meyer-Hofmeister); very-low-mass binaries might account for an appreciable fraction of the mass in extended galactic halos (H. Zinnecker); and the δ Scuti stars (a puzzling class of A-type main sequence variable stars) may be explicable by tidal interactions in close binaries (E. Antonello). One of the observations presented is at least as puzzling but much harder to attack—helium-rich single white dwarfs systematically have much lower masses (0.3 to 0.45 $M_\odot$) than those in wide binary systems (0.65 to 0.82 $M_\odot$) according to I. Bues. Standard evolutionary considerations would predict quite the opposite.

The largest group of theoretical papers addresses the origin, structure, and evolutionary status of low-mass contact binaries, the W Ursae Majoris stars, which are exceedingly common (nearly 0.1 percent of all stars; E. Budding). None of the proposed models is entirely satisfactory. A preponderance of the papers

favor extensive angular momentum loss by stars, still on the main sequence, that formed at initial separations of at least ten times their sizes (T. Rahunen and O. Vilhu, E. I. Popova *et al.*, L. Milano *et al.*, F. van't Veer), but this may be largely a function of who happened to attend the conference. The most unusual suggestion is undoubtedly that of Z. Kopal, who proposes that the W Ursae stars are really single stars, temporarily simulating binaries!

Most of these points and others addressed in the volume are unlikely to change much our basic understanding of stellar evolution or binary systems. Thus this book is not really a "must buy" for general science libraries, though many of them seem to have standing orders for the series to which it belongs.

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The Buildup of CO_2

Carbon Dioxide Review 1982. WILLIAM C. CLARK, Ed. Clarendon (Oxford University Press), New York, 1982. xx, 470 pp., illus., + loose map. $35.

This massive and expensively produced volume, printed on high-quality paper no more than 60 percent covered by text, is a multiauthor review of the carbon dioxide buildup in the atmosphere, as things seem in 1982. For the readers of *Science* no more useful account is available. Specialists will have seen much of the material before, though some of it is being published for the first time. All the writers write with the special enthusiasm that for a few years attaches to each new controversy. The list of writers includes Roger Revelle, who with his colleagues at La Jolla was the instigator 25 years ago of the present surge of interest. Today, if we can trust this volume, the buildup of CO_2 is unmistakably real, and the problem is attracting more interest than ever, from the media as well as from the scientific community.

Papers by Robert E. Dickinson and Charles F. Baes, on modeling the climatic response to the buildup and on the role of ocean chemistry, are excellent summaries of present knowledge. Dickinson reduces what is usually seen as a complex problem in three-dimensional modeling to a series of well-thought-out statements of simple physical process. Any scientist could follow him, and I for one am grateful for his account. Baes discusses a medium where large-scale modeling is difficult and where a qualitative grasp of the essential chemistry is a prerequisite to progress. He deals at length with the role of plankton in holding total carbon in surface waters well below the levels that a lifeless and well-mixed ocean would display. If this biotic sink did not exist atmospheric CO_2 pressures would rise strongly, perhaps to three times present levels. Climatologists are used to thinking of the ocean as a sink for CO_2; about half the CO_2 added to the atmosphere disappears, presumably into the ocean. If Baes's analysis is correct, there would be a strong reverse flow if anything happened to reduce the productivity of the plankton. This is a feedback that few climatologists are much aware of.

What emerges from the book in spite of these pellucid essays is a mass of uncertainty. The buildup of CO_2 is a reality, monitored with increasing precision since 1957 and inferred for much earlier dates. A statistical section gives the monitored values to 1980, as well as a review of a long series of measurements made at Mauna Loa by the pioneers of such monitoring, Charles D. Keeling, Robert B. Bacastow, and Timothy P. Whorf. There the confidence ends. The volume is a long litany of uncertainties—of the internal transport processes in the ocean, of ocean-atmosphere interaction, of the magnitude of forest and soil carbon wastage, of the future course of fossil-fuel consumption. Yet something else emerges, too: *if* (the most frequent word in the book) the CO_2 buildup continues, *if* the big general circulation models are right about its impact on climate, and *if* we have not miscalculated the potential role of the oceans, then we face a climatic change in the next century and a half like nothing the post-glacial world, and hence civilized humanity, has seen.

Late in the volume Charles F. Cooper tries to assess what such a change might mean for society. With the commentators on his paper (Sylvan H. Wittwer, Norman J. Rosenberg, and Peter A. Oram) he appears to think that CO_2 buildup implies large economic, social, and political impacts but not necessarily disaster. In fact the direct impact on crops and forest growth may be positive, allowing for technological adaptation. The common prejudgment that all environmental change is bad is absent. No firm conclusion is reached, however; and on present evidence none is possible. Three world agencies—the World Meteorological Organization, the United Nations Environment Programme, and the International Council of Scientific Unions—have the issue of CO_2 buildup on their agendas, because many individuals and even nations see it as a threat to their security. A consensus on possible world action is to be attempted in 1985. Those involved will have to take this volume very much into account.

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Books Received

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Advances in Organometallic Chemistry. Vol. 20. F. G. A. Stone and Robert West, Eds. Academic Press, New York, 1982. x, 370 pp., illus. $56.

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Animal Models of Inherited Metabolic Diseases. Proceedings of a symposium, Bethesda, Md., Oct. 1981. Robert J. Desnick, Donald F. Patterson, and Dante G. Scarpelli, Eds. Liss, New York, 1982. xx, 522 pp., illus. $54. Progress in Clinical and Biological Research, vol. 94.

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Biochemical Applications of Raman and Resonance Raman Spectroscopes. P. R. Carey. Academic Press, New York, 1982. xii, 264 pp., illus. $34. Molecular Biology.

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Dichotomies of the Mind. A Systems Science Model of the Mind and Personality. Walter Lowen with

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