continue to swirl) around certain topics. For example, the nature of DP 2 fluctuations is still a matter of some controversy, centering around whether the causative current system is merely a variant of one of the previously known current systems (for example, DS) or is something unique and different. A second example concerns substorms, which Nishida discusses in the framework of the neutral line hypothesis. There is, in fact, a strong school of opinion that contends that substorms do not involve the formation of near-earth neutral points in the region of the neutral sheet. In both of these cases, Nishida neglects to mention the opposite points of view, leaving the impression that there is no disagreement about the points of view expressed in the book. Despite this, I feel that the book is one of the most comprehensive, up-to-date works dealing with magnetospheric physics that is available.

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Binary Systems

Double Stars. WULFF D. HEINTZ. Reidel, Boston, 1978. x, 176 pp., illus. Cloth, $29; paper, $14. Geophysics and Astrophysics Monographs, vol. 15.

Dynamics of Close Binary Systems. ZDENĚK KOPAL. Reidel, Boston, 1978. xiv, 514 pp., illus. $65. Astrophysics and Space Science Library, vol. 68.

Wulff Heintz begins the preface to his book, "Double and multiple stars are the rule in the stellar population, and single stars the minority, as the abundance of binary systems in the space surrounding the sun shows beyond doubt." This fact, slow in dawning on the astronomical community, is still not widely appreciated—its implications for nucleosynthesis, galactic evolution, and population synthesis remain largely unexplored. And yet the opening of new regions of the electromagnetic spectrum to astronomical inquiry and investigations of peculiar stars have inundated us with exotic objects of known or suspected duplicity in such a profusion of guises as to confuse newcomer and authority alike. The pace of exploration has so outstripped the assimilation of its results that any discussion that purports to bring order to the subject deserves attention.

Zdeněk Kopal, author of numerous astronomical texts, is a veteran of nearly half a century's labor on problems connected in one way or another with the interaction of two stars in a binary system. As early as 1934, when it was decidedly unfashionable to do so, he ventured a discussion of the evolution of binaries. Our understanding of these objects has undergone several metamorphoses since then, and to Kopal goes credit for a number of important contributions to the subject, most notably the popularization of the Roche potential in describing the geometry of binary systems. His book *Close Binary Systems* (Chapman and Hall, 1959), now out of print, was a landmark in the development of the subject and remains widely cited.

Kopal's avowed purpose in writing this new monograph is "to provide a comprehensive account of our present knowledge of the theory of dynamical phenomena exhibited by close binary systems; and on the basis of such phenomena as have been attested by available observations to outline probable evolutionary trends of such systems in the course of time." The sense attached here to the word "dynamical" is purely a mechanical one: figures of equilibrium, dynamical tides, generalized rotation, orbital dynamics, the Roche model, and the secular and dynamical stability of self-gravitating configurations of arbitrary structure, in the order of their appearance (chapters 2 through 7). The treatment does not extend to hydrodynamical or magnetohydrodynamical phenomena, such as the physics of mass loss or mass accretion.

The greater part of this book thus deals with subjects that have been the focus of much of Kopal's own research, and of that of his students at the University of Manchester, in the two decades since the publication of *Close Binary Systems*. Much of the presentation parallels that of the earlier volume (and of Kopal's *Figures of Equilibrium of Celestial Bodies*, University of Wisconsin Press, 1960), as developed and elaborated by Kopal and co-workers in a long series of articles in the journal *Astrophysics and Space Science*, which Kopal edits. Indeed, portions of the text are repeated practically verbatim from these sources, but they are welded together in nearly seamless fashion. Omitted from the present volume, but promised in a future work, are the observational aspects of the subject—light and radial velocity variations—that were dealt with in *Close Binary Systems*.

Dynamics of Close Binary Systems is unmistakably out of the same mold as Kopal's earlier works and shares their strengths and weaknesses. The presentation is extremely formal but eminently readable. The mathematical development of each subject is given fully. If so expansive a treatment occasionally borders on tediousness, it is nevertheless an enormous help to the novice in coming to grips with a mathematically complex subject. The author rarely ventures far beyond his own published studies of dynamical processes, but he continues the laudable practice of *Close Binary Systems* in providing extensive bibliographical notes at the end of each chapter.

Ultimately, however, the severely classical approach Kopal adopts is likely to prove more satisfying to the mathematician than to the astrophysicist. The attempt to divorce mechanical aspects of a problem from their underlying physical processes and astrophysical context frequently leaves a wide gulf between the mathematical framework developed and its application. (A notable exception is the discussion of apsidal motion.) Thus, for example, convection scarcely rears its ugly head during the discussion of dynamical tides (it never has been amenable to rigorous treatment), although where it occurs it utterly dominates all other sources of dissipation. The reader is likely to find the classic series of papers on this subject by J.-P. Zahn of far greater utility in astrophysical applications, though Zahn's work receives only the scantiest of recognition here. It is the stress on what are mathematically well-defined problems that flavors the six central chapters of Kopal's book.

The final chapter deserves special comment. Addressing the broad question of the origin and evolution of close binary systems, it promises fulfillment of the second half of the author's stated goal. In fact, it is as much a personal statement of philosophy as an overview of the subject. The author aims many barbs at the way in which one or another problem has been handled theoretically (see, for example, the amazing broadside leveled at studies of eruptive binaries on p. 472). These criticisms are well taken, and we should applaud the author all the more for them did he not himself indulge in the ad hoc concoction of "scenarios" he so vehemently condemns. Thus we encounter speculations concerning chemically homogeneous evolution among progenitors of Algol-type binaries or the birth of cataclysmic binaries in the fission of the rapidly rotating cores of red giants that are easily excluded on observational grounds. The chapter is extremely uneven: it contains a well-argued account of the classification of binary systems by degree of detachment, for instance, but also a disturbing number of factual misrepresentations (for ex-

ample, on p. 471 it is stated that in the U Geminorum-type stars it is the primary, red, component whose spasmodic eruptions give rise to variability, even though Smak's classic 1971 analysis of U Gem itself proved that the secondary, blue, component was the seat of its outbursts). Ultimately, it is the superficial treatment given to the physics of stellar structure and evolution, mass loss, and mass accretion—issues central to the evolutionary problem—that most seriously hampers the discussion. Mechanical considerations alone impose only very broad constraints.

Notwithstanding these misgivings about the final chapter, the worth of Kopal's book lies in its account of the dynamical problems. The very severity of its classical approach to them will insure that it occupies an important place in the literature for years to come. There is a liberal sprinkling of typographical errors throughout the book, and it does perpetuate the so-called Roche coordinate system, which does not exist for the general Roche problem according to Papaloizou and Pringle. But the treatment of dynamics is basically sound, and it is useful to have Kopal's broad contributions to the subject assembled in a coherent account.

Heintz's *Double Stars* is billed as a revised translation of its earlier German edition, *Doppelsterne* (Goldmann, Munich, 1971), incorporating literature up to late 1976. However, large portions of the text have been not only rewritten but rethought.

This slender, unpretentious volume fills a crying need for a contemporary account of the binary star phenomenon. The only comparable account of the subject is the very valuable one by Batten, *Binary and Multiple Systems of Stars* (Pergamon, 1973), now somewhat outdated as a result of the enormous progress that has been made both theoretically and observationally since its publication, and particularly the growth of interest in late stages of binary evolution. Given the delays inherent in any book's finding its way into print, Heintz has done a superlative job of reflecting the state of the art, ranging far more broadly than any of his predecessors and conveying both a sense of the important problems yet unsolved and the flavor of current research.

Double Stars is roughly evenly divided between discussion of visual binaries and of close (spectroscopic and eclipsing) binaries. Broadly speaking, the author's outlook is an observational one, which is to say that theoretical conjectures are fitted to an observational context, rather than vice versa. The progression throughout the book is generally toward more and more exotic phenomena, the treatment culminating in a thumbnail sketch of our knowledge of x-ray binaries (such as it was two years ago). The size of the book does not permit any subject to be discussed in much depth, so individuals may quibble whether one or another subject should have received more attention. But the virtue of the book is that the discussion is balanced in depth and quality, an impressive achievement considering the enormous variety of subjects covered, from historical observations of visual binaries and the determination of their orbits to mass transfer, novas, and x-ray binaries. Heintz shows a sure sense of what contributions have been pivotal and presents an enormous amount of information in a very accessible, concise form.

Double Stars is a very welcome addition to the literature of the subject and an outstanding vehicle for introducing it to advanced undergraduates or graduate students. It deserves a place on the shelf of every serious student of binary systems.

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Books Received

Advances in Food Research. Vol. 23. C. O. Chichester, E. M. Mrak, and G. F. Stewart, Eds. Academic Press, New York, 1977. viii, 436 pp., illus. $29.

Advances in Lipid Research. Vol. 15. Rudolfo Paoletti and David Kritchevsky, Eds. Academic Press, New York, 1977. x, 360 pp., illus. $31.

Advances in Magnetic Resonance. Vol. 9. John S. Waugh, Ed. Academic Press, New York, 1977. xii, 428 pp., illus. $44.

Advances in Protein Chemistry. C. B. Anfinsen, John T. Edsall, and Frederic M. Richards, Eds. Academic Press, New York, 1977. viii, 450 pp., illus. $31.

The Animal Remains from Four Sites in the Kermanshah Valley, Iran: Asiab, Sarab, Dehsavar and Siahbid. The Faunal Evolution, Environmental Changes and Development of Animal Husbandry, VIII-III Millennia B.C. S. Bökönyi. British Archaeological Reports, Oxford, England, 1977. iv, 136 pp., illus. Paper, £2.60. B.A.R. Supplementary Series 34.

Annual Review of Biophysics and Bioengineering. Vol. 7. L. J. Mullins, William A. Hagins, Carol Newton, and Gregorio Weber, Eds. Annual Reviews, Palo Alto, Calif., 1978. x, 602 pp., illus. $17.

Applied Acoustics. G. Porges. Halsted (Wiley), New York, 1978. x, 180 pp., illus. $16.95.

Applied General Systems Research. Recent Developments and Trends. Proceedings of a conference, Binghamton, N.Y., Aug. 1977. George J. Klir, Ed. Plenum, New York, 1978. xviii, 1002 pp., illus. $65. NATO Conference Series II, vol. 5.

Biotechnological Applications of Proteins and Enzymes. Papers from a conference, Kiryat Anavim, Israel, May 1976. Zvi Bohak and Nathan Sharon, Eds. Academic Press, New York, 1977. xlviii, 368 pp., illus. $29.

Cattle, Priests, and Progress in Medicine. Calvin W. Schwabe. University of Minnesota Press, Minneapolis, 1978. xiv, 278 pp., illus. $19.75. The Wesley W. Spink Lectures on Comparative Medicine, vol. 4.

Chemical Principles for Life. Lois W. Forney. Prentice-Hall, Englewood Cliffs, N.J., 1978. xvi, 574 pp., illus. Paper, $12.95.

Chemistry. Concepts and Calculations. Arnold B. Loebel. Canfield Press (Harper and Row), San Francisco, 1978. xvi, 560 pp., illus. $13.95.

Cognitive Theory. Vol. 3. Papers from a conference, Bloomington, Ind., Apr. 1976. N. John Castellan, Jr., and Frank Restle, Eds. Erlbaum, Hillsdale, N.J., 1978 (distributor, Halsted [Wiley], New York. xii, 320 pp., illus. $19.95.

Color. From Rainbows to Lasers. Franklyn M. Branley. Illustrated by Henry Roth. Crowell, New York, 1978. viii, 90 pp. $8.95.

Concepts in Cell Biology. William K. Stephenson. Wiley, New York, 1978. xii, 222 pp., illus. Paper, $7.95.

Contemporary Issues in Bioethics. Tom L. Beauchamp and LeRoy Walters, Eds. Dickenson, Encino, Calif., 1978. xii, 612 pp. Cloth.

Contemporary Optics. A. K. Ghatak and K. Thyagarajan. Plenum, New York, 1978. x, 370 pp., illus. $32.50. Optical Physics and Engineering.

Contemporary Research in Behavioral Pharmacology. D. E. Blackman and D. J. Sanger, Eds. Plenum, New York, 1978, xiv, 506 pp., illus. $39.50.

Continuing Medical Education. Perspectives, Problems, Prognosis. Robert K. Richards. Yale University Press, New Haven, Conn., 1978. viii, 214 pp. $15.

Cosmetic Science. Vol. 1. M. M. Breuer, Ed. Academic Press, New York, 1978. xiv, 356 pp., illus. $35.25.

The Cycle of Violence. Assertive, Aggressive, and Abusive Family Interaction. Suzanne K. Steinmetz. Praeger, New York, 1977. xviii, 196 pp. $16.95. Praeger Special Studies in U.S. Economic, Social, and Political Issues.

Development of Survey Methods to Assess Survey Practices. A Report of the American Statistical Association Pilot Project on the Assessment of Survey Practices and Data Quality in Surveys of Human Populations. Barbara A. Bailar and C. Michael Lanphier. American Statistical Association, Washington, D.C., 1978. x, 118 pp. Paper.

Developmental Biology. Embryos, Plants, and Regeneration. John W. Brookbank. Harper and Row, New York, 1978. xii, 450 pp., illus. $17.95.

The Diabetic Pancreas. Bruno W. Volk and Klaus F. Wellmann, Eds. Plenum, New York, 1977. xviii, 600 pp., illus. $45.

La Dialéctica Clases-Elites en México. Jorge Alonso. Centro de Investigaciones Superiores, Tlalpan, 1976. 256 pp. Paper. Ediciones de la Casa Chata, 3.

Dictionary of Science and Technology. English-German. A. F. Dorian, Ed. Elsevier, New York, ed. 2, 1978. xii, 1402 pp. $86.95.

Digital Circuits. A Preparation for Micro-