the simple physical theory of meteors. It is followed by a chapter on initial heating phenomena and the details of the progressive interaction between air molecules and the meteoroid as the momentum and energy exchange varies from a free molecular (Newtonian) to a near-continuum type of flow. A chapter on ablation processes considers both experimental results and theoretical modeling assuming near-equilibrium flows. It also contains good discussions of meteoroid energetics and of the morphology of meteoritic ablation processes. A chapter on the luminosity and spectra of meteoroids discusses experimental results concerning differential luminous efficiency and compares the chemical abundances of meteorites and those deduced for meteoroids from spectral analysis. A chapter on ionization discusses the formation and development of the head echo and wake ionization and their relation to meteor radar systems and the subsequent decay processes. There is a chapter on the determination of the dynamic and photometric meteoroid masses and the deduction of bulk density from these and related quantities. This chapter analyzes fireball observations, including the recovered and photographed Pribram, Lost City, and Innisfree meteorites, and draws conclusions regarding the types of meteoroids entering the atmosphere.

There are four appendixes in the English edition. Two consider recent detailed models of the fireball-atmosphere interaction which corroborate the heat transfer coefficients deduced by observation, experiment, and theory earlier in the book, one covers "electrophonic" ("or ethaerial") sounds, and one summarizes recent work on analytical modeling of the onset of fragmentation due to uniaxial compressive failure of the meteoroid.

The choice of subject matter and depth of treatment are moderately subjective. There is no discussion of rates of meteoroid influx, cratering processes, the propagation and decay of shock and sound waves, or comparable effects in other planetary atmospheres. There is almost no mention of the techniques of instrumental or data analysis by means of which many of the theoretical conclusions can be inferred from the observations. It is somewhat surprising that "electrophonic" sound, which has not yet been observed instrumentally, is treated whereas "ordinary" nonlinear, weakly nonlinear, and linearized acoustic-gravity waves from fireballs are not discussed. It is also surprising that Bronshten has not attempted to define his realm of interest more precisely for extremely large masses, $\gtrsim 10^{17}$ grams.

An introduction, however rudimentary, to radiation gas dynamics and its methods as they apply to meteoric phenomena would have been useful to the reader in assessing the limitations of the simple ablation theory in continuum flow even in the absence of gross fragmentation. I cannot generally agree with Bronshten's conclusions concerning the bulk densities of meteoroids. As has been shown by Ceplecha and McCrosky and later by Wetherill and ReVelle, a substantial fraction (up to a third) of the observed fireballs have bulk densities comparable to those of ordinary chondrites. Clearly more work needs to be done on this subject, especially for friable meteoroids.

These differences aside, Bronshten has assembled, synthesized, and critically commented upon an enormous amount of literature, much of it written by Soviet and Eastern Bloc scientists during the period from about 1960 to 1980 (though comparatively little Western literature more recent than 1977 is included). Renewed interest in permanent earth-orbiting vehicles such as the NASA Space Station project requires that scientists and engineers from many disciplines gain modern perspective on the meteoroid population and its interaction with the earth's atmosphere. *Physics of Meteoric Phenomena* will provide an impetus for discoveries in this field.

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## Origins of Modern Astronomy

**The History of Astronomy from Herschel to Hertzsprung**. DIETER B. HERRMANN. Cambridge University Press, New York, 1984. x, 220 pp., illus. $24.95. Translated from the German edition (1973) and revised by Kevin Krisciunas.

This broad-brush review of the origins of modern astronomy presents the contributions of 19th- and early 20th-century German astronomers from a point of view intimately associated with Eastern Bloc political philosophy. Herrmann treats all aspects of modern astronomy, as practiced both in Europe and America, from this point of view, but provides more than sufficient objective historical narrative to make the book of great value, if read with perspective.

Herrmann, director of the Archenhold Observatory in Berlin-Treptow, is well known to historians of astronomy as a prolific researcher and interpreter of the development of modern astronomy and astrophysics, as well as of the history of German astronomy. He has collected here much of his own research on the founders of German astrophysics, patterns of growth of astrophysical enterprises (observatories, journals, and data), and comparative studies of national styles in astrophysical research in the late 19th century. Krisciunas, an astronomer with an avid interest in history, has provided a straightforward translation that preserves the general flavor of Herrmann's style, as well as his sometimes obtrusive Marxist rhetoric.

The book covers a wide range of topics, including the modern transition from a static to a dynamic and evolutionary cosmology; the growth of astrophysical observing techniques as related to problems in photometry, photography, and spectroscopy; the subsequent increase of astrophysical data, who generated them and why; and the application of modern physics to the study of stellar systems, stellar structure, and stellar evolution. Any of these topics would be difficult to squeeze into 200 pages of text. Herrmann has in general done a good job of distilling the story even further, but as a result of the compression the information content, historical depth, and treatment of complex issues are not completely satisfying. The role of solar studies as a driver of stellar astrophysics is not emphasized; for example, the treatment of the importance of Saha's ionization theory to modern studies of stellar atmospheres and interiors is brief and superficial. We learn only that the theory is important, not why, or how it was derived. In the discussion of the origins of the Hertzsprung-Russell diagram, the critical influence of Antonia Maury's complex spectral classification system upon Hertzsprung is not identified. The application of modern physics to astronomy is not analyzed to the point where one might understand how and why it took place, what the problems were (there were many), and how they were overcome. Although Eddington's use of radiative equilibrium to study stellar interiors is discussed, the fact that it was a significant departure from earlier theories that used only convective transport is not made clear.

In sum, a work on this scale should have been a primary introduction to the history of modern astronomy, but this one presupposes too much. Still, for those with some knowledge of the subject, it will provide useful factual back-

ground material on German contributions to the development of modern astrophysics, and for that alone it is well worth having.

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## The Cell Division Cycle

**Cell Cycle Clocks.** LELAND N. EDMUNDS, JR., Ed. Dekker, New York, 1984. xiv, 616 pp., illus. $99.75.

This volume draws together a wide variety of data and models that pertain to the possible relation between intrinsic biochemical or circadian oscillators and the timing of events in the prokaryotic and eukaryotic cell division cycle.

The 27 chapters in the volume are divided into six sections, each prefaced by a short, useful introduction by the editor. Part 1 deals with general features of the origin and breakdown of temporal organization in cells in four chapters by Gilbert, Lloyd and Edwards, Klevecz, and Winfree. Part 2 considers models of the cell division cycle and its variability, with two especially interesting chapters on circadian variation by Thorud *et al.* and Keiding *et al.* and a most useful compendium of the variation in the phases of the cell cycle by Guiguet *et al.*

Part 3 deals with regulatory aspects of the cell division cycle and introduces the "events, sequences, pathways, and timers" that are central to much of the rest of the work presented. The initial chapter by Mitchison treats the interaction of the DNA division cycle and the growth cycle (updating the material first presented in his 1971 book). Painter and Tyson examine the possible role of periodic enzyme synthesis in the control of the cell cycle, and Poole reexamines the hypothesis that energy metabolism may serve as the timer for division (this hypothesis is also considered in the chapter by Lloyd and Edwards). In the next two chapters Cooper and Mendelson each examine the continuum and helix clock models of the cell cycle (the helix clock model proposes that spatial order may be utilized to provide temporal order for the cell division cycle). Analyses by Fantes and by Tyson and Sachsenmaier give strong support to the hypothesis that division is regulated by a cell "sizer" and thus offer a good springboard for Part 4, which examines the possible role of autonomous intrinsic oscillators with circadian or near-circadian periods in the control of the cell division cycle. Shymko *et al.* and Petrovic *et al.* examine the possible role of a quantized oscillator with added noise in the cell division cycle. Edmunds and Laval-Martin summarize data from a variety of cell types that support the argument that there is a circadian-type oscillator involved in the timing of the cell division cycle. The final three chapters emphasize the interaction of environmental cues with the cell division cycle.

Part 5, which deals with the relation between the cell division cycle and cancer, opens with an interesting speculation by Willie and Scott about the way in which alteration of an underlying oscillator controlling the cell division cycle might lead to neoplastic transformation. Scheving and Moller each emphasize the importance to therapeutic interventions of circadian variation in the cell division cycle. Part 6 deals with the cell division cycle in development and aging. A paper by Belisle *et al.* is particularly interesting in its treatment of the relation between the cell division cycle and development in the sea urchin. The final chapter, by Zorn and Smith, presents new data on aging in cultured cells, which again indicate that aging is associated with a lengthening $G_2$ phase of the cell division cycle.

The book is noteworthy for the number of new data presented and the number of new and imaginative proposals made concerning the regulation of the cell cycle. The editor is to be congratulated for his selections and for the production of a finished product in which the chapters exhibit a high degree of conformity.

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## Books Received

**Annual Review of Energy**. Vol. 9. Jack M. Hollander and Harvey Brooks, Eds. Annual Reviews, Palo Alto, Calif., 1984. xii, 577 pp., illus. $56.

**Annual Review of Physical Chemistry**. Vol. 35. B. Seymour Rabinovitch, J. Michael Schurr, and Herbert L. Strauss, Eds. Annual Reviews, Palo Alto, Calif., 1984. xiv, 733 pp., illus. $28.

**Antarctic Earth Science**. R. L. Oliver, P. R. James, and J. B. Jago, Eds. Cambridge University Press, New York, 1984. xxii, 697 pp., illus. $79.50. From a symposium, Adelaide, Australia, Aug. 1982.

**Blowout Prevention**. Theory and Applications. Peter G. Mills. International Human Resources Development Corporation, Boston, 1984. xvi, 193 pp., illus. $46.

**Boundary Areas in Social and Developmental Psychology**. John C. Masters and Kerry Yarkin-Levin, Eds. Academic Press, Orlando, Fla., 1984. xvi, 319 pp. $39.

**Carcinogenesis and Mutagenesis Testing**. J. F. Douglas, Ed. Humana, Clifton, N.J., 1984. xx, 335 pp., illus. $49.50. Contemporary Biomedicine.

**Carcinoma of the Esophagus and Gastric Cardia**. Guo Jun Huang and Wu Ying K'ai, Eds. Springer-Verlag, New York, 1984. x, 395 pp., illus. $109.

**Eucalypts for Wood Production**. W. E. Hillis and A. G. Brown, Eds. Commonwealth Scientific and Industrial Research Organization, East Melbourne, Australia, and Academic Press, Orlando, Fla., 1984. xii, 434 pp., illus. $55.50.

**European Urbanization 1500–1800**. Jan de Vries. Harvard University Press, Cambridge, Mass., 1984. xviii, 398 pp., illus. $28.50. Harvard Studies in Urban History.

**Everybody's Guide to Homeopathic Medicines**. Stephen Cummings and Dana Ullman. Tarcher, Los Angeles, 1984 (distributor, Houghton Mifflin, Boston). xii, 312 pp. $14.95; paper, $8.95.

**Fishery Management**. J. L. McHugh, Springer-Verlag, New York, 1984. viii, 207 pp., illus. Paper, $15. Lecture Notes on Coastal and Estuarine Studies, vol. 10.

**Flying Free**. Dan True. Dodd, Mead, New York, 1984. vi, 163 pp., illus. $13.95.

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**Isotopes and Radiation in Agricultural Sciences**. M. F. L'Annunziata and J. O. Legg, Eds. Academic Press, Orlando, Fla., 1984. Two volumes. Vol. 1, Soil-Plant-Water Relationships. xxii, 292 pp., illus. $60. Vol. 2, Animals, Plants, Food and the Environment. xxii, 356 pp., illus. $75.

**Issues and Reviews in Teratology**. Vol. 2. Harold Kalter, Ed. Plenum, New York, 1984. xvi, 516 pp., illus. $69.50.

**The Jívaro**. People of the Sacred Waterfalls. Michael J. Harner. University of California Press, Berkeley, 1984. xx, 234 pp. + plates. $24.95; paper, $7.95. Reprint with new preface, 1972 edition.

**A Killing Rain**. The Global Threat of Acid Precipitation. Thomas Pawlick. Sierra Club Books, San Francisco, 1984 (trade distributor, Random, New York). x, 206 pp. $14.95.

**Land Reform in Mexico: 1910–1980**. Susan R. Walsh Sanderson. Academic Press, Orlando, Fla. 1984. xx, 188 pp., illus. $35. Studies in Social Discontinuity.

**Large Hadron Collider in the LEP Tunnel**. Vol. 1. CERN, Geneva, 1984. x, 361 pp., illus. Paper. CERN 84-10. From a workshop, Lausanne and Geneva, March 1984.

**Monopole '83**. James L. Stone, Ed. Plenum, New York, 1984. xiv, 699 pp., illus. $105. NATO ASI Series B, vol. 111. From a workshop, Ann Arbor, Mich, Oct. 1983.

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**Nonlinear Electrodynamics in Biological Systems**. W. Ross Adey and Albert F. Lawrence, Eds. Plenum, New York, 1984. xii, 603 pp., illus. $89.50. From a conference, Loma Linda, Calif., June 1983.

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**Ocean Uses and Their Regulation**. Luc Cuyvers. Wiley-Interscience, New York, 1984. xii, 179 pp., illus. $29.95.

**On Food and Cooking**. The Science and Lore of the Kitchen. Harold McGee. Scribner, New York, 1984. xviii, 684 pp., illus. $29.95.

**Psychophysiological Perspectives**. Festschrift for Beatrice and John Lacey. Michael G. H. Coles, J. Richard Jennings, and John A. Stern, Eds. Van Nostrand Reinhold, New York, 1984. xviii, 317 pp., illus. $29.50. From a symposium, Minneapolis, Oct. 1982.

**Pulsed Light Sources**. I. S. Marshak. Consultants Bureau (Plenum), New York, 1984. xii, 461 pp., illus. $75. Translated from the second Russian edition.

**QSAR in Environmental Toxicology**. Klaus L. E. Kaiser, Ed. Reidel, Boston, 1984 (distributor, Kluwer Boston, Hingham, Mass.). xiv, 406 pp., illus. $54.50. From a workshop, Hamilton, Ontario, Canada, Aug. 1983.

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**Renal Effects of Petroleum Hydrocarbons**. Myron A. Mehlman *et al.*, Eds. Princeton Scientific Publishers, Princeton, N.J., 1984. xvi, 306 pp., illus. $60. Advances in Modern Environmental Toxicology, vol. 7. From a workshop.

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**System Sciences and Modelling**. A. Ruberti, Ed. Reidel, Boston, and Unesco, Paris, 1984 (distributor, Kluwer Boston, Hingham, Mass.). xiv, 159 pp. $24.50. Trends in Scientific Research 1.