makes it very difficult to implement a coherent reform.

The U.S.S.R. is undoubtedly going through an intense acute phase of this long-standing debate again today, but without all the arguments out in the open. In interpreting what clues we do get, I find the kind of retrospective Parrott has provided is extremely helpful.

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Differences of Scale

Powers of Ten. A Book about the Relative Size of Things in the Universe and the Effect of Adding Another Zero. PHILIP AND PHYLIS MORRISON and the OFFICE OF CHARLES AND RAY EAMES. Scientific American Library (Freeman), New York, 1983. xii, 150 pp., illus., + index. $29.95.

This book is a celebration of the creative friendship of two couples, Charles and Ray Eames and Philip and Phylis Morrison. It is also a memorial to the one member of this extraordinary quartet who is no longer among us, the architect Charles Eames. It is written in a tone of reverence—for Eames, for his vision, and above all for the sense of wonder that drives us to transcend the limits imposed by our senses.

It is a rendering in book form of a ten-minute film produced in 1977 by the Eames team with Philip Morrison providing the narration. The film presented 42 still photographs descending in scale by a factor of 10 at each step from the cosmic range of 10^{25} meters to a subnuclear 10^{-16}. At the center of each image, the next image in the sequence was highlighted by a thin border and defined in slightly greater detail, inviting the eye to make the next leap.

In order to take full advantage of the superior resolution of high-quality color printing, the images have been rephotographed from their original sources. On the page facing each are smaller illustrations and text, offering far more information than could be conveyed in the ten seconds alloted to each order of magnitude in the original sound track. A film designed to whet the appetite has become a book to satisfy it. The reader's attention is drawn to details that might otherwise be overlooked, and to ideas and facts that illuminate what is seen.

For the benefit of those not yet satiated, 50 additional pages of text explain the technologies behind the images, the history of the discoveries and inventions that made them possible, and the scientific and aesthetic visions that governed this enterprise. Devotees of Philip Morrison's book reviews in *Scientific American* will recognize his lucid and lyrical style in these passages.

For the insatiably curious the text is extensively referenced, and there is a bibliography. The book is also provided with a fairly comprehensive index. A short section introduces the uninitiated to the wonders of exponential notation.

The authors are careful to remind the reader that only 15 of the 42 images, those spanning the range from 10^{8} meters to 10^{-6}, are based on anything that can be rightfully called a photograph. Images of larger orders of magnitude depict the cosmos from vantage points that cameras have never reached. Those of smaller ones depict a world in which the very notion of vision, on which so much of our consciousness is based, breaks down. Any rendering of a DNA molecule, of the electron "cloud" in an atom, or of the dance of quarks and gluons at the final step is necessarily symbolic. Passive observation of objects that are unaffected by our presence, and that change slowly enough for the eye to follow, has no place in the study of the microworld.

Where true images are possible, however, they have been selected with great care. The splendid blue-and-white orb of our planet as seen from the moon grows closer until we view North America centered on the Chicago lakefront. There we spy on a couple sunning themselves on a blanket. We enter the surface of the skin, meeting a leukocyte and finally its nucleus as seen in a scanning electron micrograph. Then follows the symbolic plunge through molecules to the heart of a nucleon. The photographs have been enhanced to improve contrast and definition without making them seem artificial.

This book may be read for pleasure and profit by anyone from a teenager to a working research scientist. The former will gain a sense of the vast scope of present-day science and of some questions it can answer and others that remain tantalizingly unanswered. The latter may find a vivid depiction of how his or her work fits into this grander vista. The book is sufficiently handsome to serve as the kind of coffee-table ornament that seems to be required to keep the book business alive in an age of more clamorous visual media.

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Cosmology

Astrophysical Cosmology. Proceedings of a study week, The Vatican, Sept. 1981. H. A. BRÜCK, G. V. COYNE, and M. S. LONGAIR, Eds. Pontifical Academy of Sciences, Vatican City, 1982 (distributor, Specola Vaticana, Vatican City). xxxviii, 600 pp., illus. Paper. $43; to libraries and institutions, $58. Pontificiae Academiae Scientiarvm Scripta Varia, 48.

During the past few years there has been an enormous growth in the interaction between cosmology and fundamental physics, and elementary particle physics is now addressing such important cosmological issues as nucleosynthesis, the origin of galaxies, the excess of particles over antiparticles in the universe, the extreme isotropy of the universe, and the closeness of the universe to being gravitationally bound. Conversely, new theories of particle physics are being constrained by astrophysical and cosmological considerations.

This proceedings volume consists of papers on the large-scale structure of the universe, the origin and evolution of galaxies and active galactic nuclei, primordial nucleosynthesis, and particle physics in the very early universe. Roughly half the papers are reviews. The remainder present the results of original research, usually with broad introductory surveys of the field. A useful transcript of the questions and answers following each paper is also included.

An introductory paper by Rees and a summary paper by Longair are helpful in putting the other papers into a unifying context. In all, there is remarkable agreement among the authors about a variety of issues. A paper by Oort on the large-scale structure of the universe demonstrates the clumpiness of the universe, with filamentary superclusters of galaxies separated by large voids. Additional evidence concerning the large-scale structure and its dynamical implications is presented in a paper by Davis. Besides discussing the evolution of galaxies, papers by Faber and by Gunn discuss the evidence that only 10 percent of the mass in galaxies and clusters of galaxies is visible and that the ratio of visible to total mass may be constant on galactic scales and larger. Papers by Silk and by Peebles discuss constraints on models of galaxy formation and the possibility that the dark matter that dominates the mass of galaxies may consist of neutrinos having nonzero mass. The contribution of active galaxies to the x-ray background and the evidence that quasars were either formed or first began

emitting radiation at a redshift of around 4 are discussed in several papers. Weinberg provides an excellent review of the possible role of particle physics in the early universe, including baryosynthesis, the inflationary universe, and possible elementary particle candidates for the dark (invisible) matter that may dominate the universe. There is a good review of the observations of Hubble's constant, the deceleration parameter, and the local velocity field by Sandage and Tammann, although an advocate of the use of the Fisher-Tully relation might challenge their conclusion that the value of Hubble's constant is 50 kilometers per second per megaparsec.

On the whole, the volume provides a useful discussion of the current issues in astrophysical cosmology and of the relation of cosmology to particle physics. The book does not include several recent developments such as N-body simulations of the large-scale structure of the universe, the implications of candidate particles other than massive neutrinos for the dark matter, and evidence that dwarf spheroidal galaxies may contain large amounts of dark matter. Nevertheless, it should be most useful both to astrophysicists and to physicists who want to acquaint themselves with the cosmological issues that can be addressed by high-energy physics.

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Fossil Mammals

Mammalian Paleofaunas of the World. DONALD E. SAVAGE and DONALD E. RUSSELL. Addison-Wesley Advanced Book Program, Reading, Mass., 1983. xx, 432 pp., illus. $79.95.

Fossil mammals have played an increasingly important role in biostratigraphy for more than a century. The distribution of some mammalian taxa is very wide, often intercontinental, and the temporal range of mammalian genera and species is generally quite restricted. Thus mammalian paleontology can provide significant information about the sequence and timing of geological events in widely separated areas of the globe. Radioisotopic dating and paleomagnetic stratigraphy combine with mammalian and other kinds of biostratigraphy to provide ever more useful and accurate knowledge about global correlation of the local events and processes of earth history.

Donald E. Savage and Donald E. Russell have set out to fill a major gap in the literature of biostratigraphy and chronostratigraphy by compiling what is known of temporal and spatial distribution of mammalian paleofaunas. Their effort is generally successful, although specialists will carp about details. The last such major compilation was made by E. Thenius in 1959, following a long gap after H. F. Osborn's pioneering efforts at the turn of the century. Meanwhile, the literature of mammalian paleontology has participated in the universal information explosion of recent years. The present compilation of the biostratigraphic and chronostratigraphic aspects of the subject took its roots in R. A. Stirton's attempts to keep track of it all, using as a vehicle the class lecture notes for mammalian paleontology courses at the Berkeley campus of the University of California. Various stages of the book have had wide circulation for years. The published 1983 version will serve as a nonevolving text for some years to come, but its main use to students and professionals alike will be as a guide to the literature; people who read dictionaries for fun (I am one) will find the long lists of names of localities and fossils useful, but others will simply choke on the vast amount of raw information presented, such as the 26 pages devoted to Miocene localities and lithostratigraphic units.

The book does not break major new conceptual ground. For instance, it is untouched by any current ferment in cladistics or vicariance biogeography and does not go into sufficient detail regarding the effects of plate tectonics on past geography. Rather, the book may be the last of its kind. Future such compilations might be better and more frugally distributed in the form of computer tape or disks, so that users could call up what information they need.

Although I find the book generally useful, even indispensable for the specialist and the generalist alike, I hope that future versions, whether printed or electronic, will make up for certain shortcomings. Students of Mesozoic faunas will learn little from Savage and Russell's book other than that they should read another one mentioned. Readers will also find that the treatment of South American faunas leaves much to be desired and that it goes little beyond Simpson's admirable but dated summaries. Russian paleontological literature seems strangely slighted. Instead, the concentration is focused on North America and Europe, which the authors know best, as well as Africa, Australia, and Asia. A heroic attempt is made to summarize the now voluminous literature on Chinese fossil mammals and stratigraphy. One looks in vain, however, for a discussion of the nature and origin of the Antillean mammalian faunas.

The illustrations in the book range in quality from excellent to excruciatingly awful. Hasty compilations of line and stippled drawings of fossil mammals, mostly taken from publications of the authors' own institutions, are coupled with location maps that combine errors of design, sins both of commission and of omission, and poor editing and proofreading. Annoyingly, in many cases distributions are shown on continents with present-day outlines. About half of the maps lack at least some of the numbers that identify localities, suggesting that overlays were lost or damaged at the press. However, other numbers are sometimes missing from the figure legends. One overlay (figure 6–25) was printed upside down. Only the correlation charts show care in preparation.

Although I salute Savage and Russell for their Herculean effort, I wish that they had taken a bit longer to prepare it and that the editors had done a more critical job of getting it into published form.

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Books Received

Aerosols in the Mining and Industrial Work Environments. Papers from a symposium, Minneapolis, Nov. 1981. Virgil A. Marple and Benjamin Y. H. Liu, Eds. Ann Arbor Science (Butterworths), Woburn, Mass., 1983. Three volumes. Vol. 1, Fundamentals and Status. xii pp. + pp. 1–360, illus., + index. $34.50. Vol. 2, Characterization. xii pp. + pp. 361–644, illus., + index. $18.75. Vol. 3, Instrumentation. xii pp. + pp. 645–1222, illus., + index. $37.50.

Against the Night, the Stars. The Science Fiction of Arthur C. Clarke. John Hollow. Harcourt Brace Jovanovich, San Diego, 1983. x, 198 pp. $14.95.

Alcohol Abuse. Geographical Perspectives. Christopher J. Smith and Robert Q. Hanham. Association of American Geographers, Washington, D.C., 1982. viii, 84 pp., illus. Paper, $5. Resource Publications in Geography.

Algeny. Jeremy Rifkin in collaboration with Nicanor Perlas. Viking, New York, 1983. xii, 300 pp. $14.75.

All About Sex Therapy. Peter R. Kilmann and Katherine H. Mills. Plenum, New York, 1983. 228 pp. $15.95.

Allosteric Enzymes. Kinetic Behaviour. B. I. Kurganov. Translated from the Russian edition by R. F. Brookes. V. A. Yakovlev, Ed. Wiley-Interscience, New York, 1983. xviii, 344 pp., illus. $64.95.

American Design Ethic. A History of Industrial Design to 1940. Arthur J. Pulos. MIT Press, Cambridge, Mass., 1983. xii, 442 pp., illus. $50.

Analytical Aspects of Environmental Chemistry. David F. S. Natusch and Philip K. Hopke. Wiley-Interscience, New York, 1983. xii, 268 pp., illus. $40. Chemical Analysis, vol. 64.

BKSTS Dictionary of Audio-Visual Terms. Focal Press, London, 1983 (U.S. distributor, Butterworths, Woburn, Mass.). vi, 138 pp., illus. $24.95.

Born Too Soon. Preterm Birth and Early Development. Susan Goldberg and Barbara A. DiVitto.

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