ever, some important areas of investigation are treated too cursorily.

The author should be commended for an admirable biblography and for the ambitious scope of the book's contents. The chapter and subsection organization of the volume obviously aims at an exhaustive examination of the biological underpinnings of dreaming and its extraordinary significance for mind, brain, and body. Hartmann need not change the framework of the book at all in order to provide a fuller treatment of the data in a later edition.

HOWARD P. ROFFWARG
Division of Psychiatry, Montefiore Hospital and Medical Center, New York 10467

Origins of Some Nuclides

High-Energy Nuclear Reactions in Astrophysics. A Collection of Articles. B. S. P. SHEN, Ed. Benjamin, New York, 1967. x + 281 pp., illus. $9.75.

Relative abundances of the light elements deuterium, lithium, beryllium, and boron in nature, although very low, are still too high by many orders of magnitude to have resulted from thermonuclear reactions in stellar interiors. Excess abundances of other rare elements, both radioactive and stable, ranging from tritium to xenon, have been detected in the terrestrial atmosphere or in meteoritic, cosmic ray, and solar flare materials intercepted by the earth. The origins—some well understood, others not—of these nuclides in nonthermal high-energy nuclear reactions in various astrophysical environments are examined by the authors of the ten review articles which make up this volume.

The emphasis of *High-Energy Nuclear Reactions in Astrophysics* is somewhat more specific than the rather general title might suggest. Six of the nine chapters following Shen's excellent introduction and a lead-off "state of the art" discussion of the physics of high-energy nuclear reactions by Miller focus entirely or in major part on the rare light nuclides H^2, He^3, Li, Be, and B. Light-element production by fragmentation of cosmic rays is examined by Shapiro and Silberberg, with particular emphasis on the Be/B ratio in the primary radiation and the confinement age of galactic cosmic rays. In a closely related chapter Reames discusses the urgent need for extensive spallation cross-section measurements in the interpretation of cosmic ray data. Danziger's review of stellar observations of light elements is largely devoted to a comprehensive, up-to-date discussion of Li and Be abundances as indices of stellar age and evolution. Mitler, in a significant and well-written chapter on the origin of the rare light nuclides, evaluates earlier theories on H^2, Li, Be, and B production in solar system matter, using current abundance and cross-section data, and sketches the tentative outlines of a two-source hypothesis for these elements: H^2 and Li^7 surviving from the primordial fireball, with Li^6, Be, and B produced by spallation during a solar T-Tauri phase. Here, as elsewhere in these discussions, cosmological interpretations of the abundances of these nuclides require precise information on production cross-sections in spallation reactions. In this context there are two chapters of key importance from Bernas's Orsay group, presented by Gradsztajn and by Audouze, Epherre, and Reeves, on the laboratory measurement of cross-sections for the production of Li, Be, and B isotopes and other nuclides from a variety of targets. The impact of the Orsay experiments is considerable, particularly in casting doubt on the feasibility, at least with present techniques, of determining cosmic ray "age" by measurement of Be/B, and—if the experimental results are confirmed—in ruling out any significant modification of the spallogenic B^{11}/B^{10} ratio (and consequently of H^2/H^1 and Li^7/Li^6 as well) by neutron irradiation of primitive matter in the early history of the solar system.

Three papers on high-energy nuclear reactions in solar flares and on the interaction of cosmic rays with the terrestrial atmosphere and with meteorites round out the book. Lingenfelter and Ramaty present a detailed and quantitative analysis of solar flare interactions leading to the production of secondary particles, gamma radiation, and the heavier isotopes H^2, H^3, and He^3. Korff and Mendell's short discussion of neutrons in the earth's atmosphere ranges pleasantly and rather lightly over the neutron spectrum, the usefulness of Be^{10} as a chronological tool, and cosmic ray acceleration mechanisms. Finally, the great wealth of experimental data on nuclide production by cosmic rays in meteorites and by accelerator proton beams in various thick targets is beautifully systematized and interrelated in an important and useful paper by Kohman and Bender.

This is an interesting collection, and certainly a useful one for workers and students in astrophysical disciplines. Credit is due to Shen both for skillful editing and for a comprehensive introduction which smoothly bridges inevitable discontinuities in the subject matter of the separate papers. Its value as a ready reference work is somewhat diminished by lack of any but the most rudimentary subject index. The photographically reproduced typescripts are uniform and remarkably free of errors. Bibliographies are generally excellent. The fields of study discussed here under the unifying theme of high-energy nuclear reactions are for the most part clearly in a state of rapid development. The volume is essentially a valuable review of the status of these fields as of September 1967.

ROBERT O. PEPIN
School of Physics and Astronomy, University of Minnesota, Minneapolis

Topic in Developmental Biology

The Cell Surface. A. S. G. CURTIS. Logos Press, London; Academic Press, New York, 1967. x + 405 pp., illus. $18.

A. S. G. Curtis's book reminds me of an apocryphal story about Linnaeus, the great systematist, who implicitly believed in the theory of special creation as opposed to the theory of evolution. One day he saw a bug which his expert eye immediately told him strongly supported the evolutionist viewpoint. Linnaeus stepped on the bug and buried it deeply in the sand; thus he missed the chance of being Darwin. The stakes in Curtis's book are, of course, infinitely smaller, but the opportunity that it misses is nevertheless important and the loss is equally regrettable; a good text on the cell surface would have been timely and welcome.

There are at present three or four "schools of thought" on the nature of the mechanisms of cell contact in developing multicellular systems. Objectively, the differences between the various viewpoints are less significant than the similarities; in fact, it is becoming apparent that, as the semantic and methodological discrepancies become ironed out, a common ground and productive general concepts are emerging. It would have been timely and constructive for a book on this topic to present the problems, accomplishments, and prospects of studies on the cell surface and its role in differentiation, placing them in a wider biological context.

From the title, introduction, and length of this book, one might have expected it to do just that or at least to provide a fairly objective review and evaluation of facts and views on the role of the cell surface in morphogenesis. Instead, Curtis's book bypasses this chance in favor of promoting his speculations about "cell stickiness"; it also includes a lengthy description of some elementary aspects of embryology, an account of much-reviewed work on inervation, a very incomplete description of the migration of primordial germ cells, and a digression on cancer cells.

This is not the place to describe the author's theories on cell stickiness or to examine their scientific validity, except to say that they do not come out clearly from this text and seem to be so permissive as to elude decisive testing. Many statements are based on unpublished work, others on unconfirmed results. The basic views and arguments of the author cover essentially the same ground as his 1962 article in *Biological Reviews*. The reader will look in vain for up-to-date discussions of more recent work on the properties of cell surfaces and cell contact phenomena, such as that of R. Dulbecco, L. Warren, P. K. Vogt, H. Rubin, P. I. Markus, C. Grobstein, H. Holtzer, and their groups; or of the studies on contact inhibition from the laboratories of L. Sachs, H. Eagle, M. Stoker, and others, whose contributions were either overlooked or given short shrift. Equally baffling is the absence of references to some of the major reviews on the role of cell contact and cell aggregation in morphogenesis, for example those by Trinkaus, de Haan and Ebert, Mercer, and others.

Perhaps the most striking and significant feature of the book is its tendency to endlessly juggle presumptions rather than evaluate facts, to magnify what should be simple issues into extremely troublesome ones, and to fan the flickers of pointless controversies. This, together with the glaring omissions of excellent factual work, makes reading the book unrewarding. It is, of course, anyone's right to be preoccupied with Newton's apple's pull on the earth rather than with the earth's pull on the apple; however, by losing sight of the common principle the author sets himself up in artificial disagreement with many others in this field and, to support his position, runs up a good list of snap judgments. Some are unintentionally quite amusing. One fellow's "theories are of course unsatisfactory . . . even if true"; Sperry's theory "goes entirely against the evidence"; Trinkaus's "assessment of adhesiveness is entirely subjective"; Holtfreter's work on gastrulation is "almost entirely theoretical"; Weiss's hypothesis "is difficult to operate"; "there is no evidence" for the suggestions of B. Jones and P. Jones; Steinberg's "results were probably due to a failure to take account of the fact that cell movement ceases below c. *p*H 6.0"; the isolation of cell-binding materials is a "logical mistake"; and so on. Occasionally, the author disagrees even with himself and describes some of his previous statements as made "rashly and entirely without good evidence." One is to assume that his judgment is now sounder, although his discussions of some well-established facts are shrouded in mystifying uncertainties while various highly speculative conjectures are expounded in detail. With puzzled consternation one turns the pages back to the motto of the book, a quotation from Mark Twain: "There is something fascinating about science. One gets such wholesale returns of conjecture from such trifling investment of fact."

According to the subtitle, the book purports to be a molecular analysis of the problem; yet, one fails to find in the index the usual guidemarks of "molecular" processes such as "RNA," "DNA," "nucleus," "virus," "ribosomes," "genes," "hormones," "induction," "receptors," "chromosomes," "differentiation." It is equally baffling that the "enzymology of the cell surface" (p. 9) is disposed of in 14 lines and that there is no serious discussion of the burgeoning problems of the genetics of cell surfaces. The work on the cell surface in ciliates, on mating contact, and on surface antigens in microorganisms is overlooked; so are plant cell walls in relation to plant morphogenesis. The genetics of histocompatibility is treated lightly, and so are the problems of transport across cell membranes. No serious consideration is given to the significance of membrane and cell fusion to differentiation. And why is there no discussion of the author's experiments on the grafting of the cell cortex in amphibian embryos widely reported some years ago? When it comes to specifics, the poignant omissions and preferences are too numerous to be listed in this short space and they all contribute to the disappointingly inadequate and lopsided character of this curiously subjective document.

It is a dangerous book for the nonexpert and the untrained reader. Like a modern Procrustes the author chops things down to his narrow view of the cell surface; that which cannot be fitted is conveniently overlooked, summarily dismissed, or finely counterpointed with a supercilious "but." When it is all over, the field is so strewn with the wreckage of viewpoints and so darkened by the clouds of speculations that one can pick up nearly anything. The earnest student should not identify this book too closely with the field which it purports to represent. It would be regrettable if he were discouraged by it from becoming seriously interested in the role of the cell surface and intercellular communication in morphogenesis and differentiation. That, however, is unlikely, since the real challenges and accomplishments of this focal area of cellular and developmental biology are too important and too appealing to be blurred or deflected even temporarily by a book which the author himself considers to be but an "ephemeral attempt."

A. A. MOSCONA
Department of Biology, University of Chicago, Chicago, Illinois

The Zoo World

International Zoo Yearbook. Vol. 8. CAROLINE JARVIS and RUTH BIEGLER, Eds. Zoological Society of London, London, 1968. vi + 414 pp., illus. $18.75.

Time was when zoological gardens were merely menageries, collections of wild animals exhibited in cages or pens for the edification and amusement of the public. The emphasis has changed in recent years. Moats now replace the restraining bars; attempts are made to simulate the animals' natural habitats; modern medical and husbandry techniques improve the condition of the inmates; an awareness is present of the vast scientific knowledge that can be attained from the captive specimens; a realization exists of the role that zoos can play in the conservation of dwindling species. These happy developments are portrayed by this series of annual *International Zoo Yearbooks,* begun in 1960 and spearheaded by the Zoological Society of London, which operates one of the oldest and best zoos in existence. These volumes not only serve as the authoritative record of the zoo world, but also provide a medium for the international exchange of information on all aspects of the care, behavior, and