Book Reviews

Cosmology

L'Origine du Système Solaire. Symposium on the Origin of the Solar System. Nice, France, April 1972. Edition du Centre National de la Recherche Scientifique, Paris, 1972. x, 384 pp., illus. $8.

It is impossible to contemplate the spectacle of the starry universe without wondering how it was formed: perhaps we ought to wait to look for a solution until we have patiently assembled the elements, and until we have thereby acquired some hope of finding a solution; but if we were so reasonable, if we were curious without impatience, it is probable that we would never have created Science and that we would always have been content with a trivial existence.

—POINCARÉ (1913)

The scientific investigation of the origin of the solar system dates back to the early history of civilization. In modern times, numerous articles, reviews, and even very substantial books have been devoted to this subject. Thus the addition of yet another volume to this extensive literature makes us wonder whether it is presenting us with just another discussion of the same problem along the same old lines—or does it bring us closer to a real solution?

L'Origine du Système Solaire, in some sense, does both. In section A, which constitutes the first quarter of the book, distinguished scholars review the well-known models for the origin and evolution of the solar system. Section B, comprising the bulk of this large-format (8 by 11½ inches) book, treats in very considerable detail a substantial number of the important recent results in astrophysics, solar physics, meteoritics, and planetology that have direct bearing on the formulation of cosmogonical hypotheses.

This leads naturally to section C, the most interesting part of the book. Entitled Conclusions and Anticonclusions, it presents some valid criticisms of several of the leading models for the evolution of the solar nebula. Thus the present, still weakly developed state of the Genesis art is highlighted in a constructive fashion that offers guidance for future approaches to the problem.

This appears most succinctly in H. Reeves's concluding article, aptly called "Some unwritten chapters of our book." Yet to be discussed adequately is the detailed fragmentation of the massive cloud in which protostars are born. Also in question are the hydrodynamics and the stability considerations of the protosun nebula. Most important, there remain to be specified (and carried out!) the crucial experimental tests that can distinguish between the available viable theories. It is particularly disappointing that we have almost no useful information on the specific solid state processes at work in the accretion phase.

In another contribution to the volume, editor Reeves poses seven fundamental questions:

Do the sun and planets originate in the same interstellar cloud?
If so, how was the planetary matter separated from the solar gas?
How massive was the nebula?
How did the collapsing cloud cross the thermal, magnetic and angular momentum barriers?
What were the physical conditions in the nebula?
What was the mechanism of condensation and accretion?
How did the planets, with their present properties and solar distances, form?

The contrast among the models is especially evident in the postulated accretion processes. A fundamental problem here is to keep the relative velocities of the colliding bodies sufficiently low. In Safronov's theory the motions of the small solids are determined by the gas flow. Alfvèn and Arrhenius suggest a mechanism that produces "jet streams" of orbiting solids with small relative motions. Cameron invokes turbulence in the nebular collapse phase, indicating an earlier origin for the accreting masses. Cold welding is crucial to several hypotheses.

New observations and experiments should help. The detection of the "interstellar" molecules methyl cyanide and hydrogen cyanide in Comet Kohoutek, which has just been reported, and the further analyses that will be based on the vast amount of data being collected on this presumed sample of primordial matter, should provide real insight into chemical and solid state investigations of the protosolar material. Pioneer 10 and 11 investigations of the massive planets (already we have found helium on Jupiter) will lead to better estimates of the composition of the photoplanetary gas in a somewhat later stage of evolution. Perhaps Mariner 10 can find on Mercury's scarred face some clues to the radial gradient (taking into account what we already know of the lunar and Martian surfaces) of large collisions at a still later stage, after the planets reached roughly their present sizes. The next book on the origin of the solar system will, it is to be hoped, integrate much of this new material. But the present volume is still an extremely useful reference and certainly is the best starting point for the reader who is intrigued to join us in this fascinating, still very speculative pursuit. At $8 it is a Best Buy.

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Historical Account

A Revolution in the Earth Sciences. From Continental Drift to Plate Tectonics. A. HALLAM. Clarendon (Oxford University Press), New York, 1973. x, 128 pp., illus. $9.75.

The sensational title emblazoned on a gaudy dust jacket suggests a revolution at Oxford's distinguished Clarendon Press. After the visual shock one is pleasantly surprised to find between the covers of this book a concise text, well written in an engaging style. The author states that he intends the book to be a history of a scientific revolution and that he is writing not just to geologists but to a general readership.

It is obviously much easier to write from a distance in space and time. I cannot and do not dispute Hallam's evaluation of the significant developments up to the mid-1950's. He has clearly taken more care than many writers on this subject in reading the original papers he reviews, and he dem-

onstrates his capacity to understand and to distill the material—and history, after all, is what is recorded and is not necessarily what actually happened. Using the same material Hallam used I might have given a closely similar evaluation.

For the history for the past 15 years we have in addition to the imperfect published record the memories and documents of many of the principals in the revolution, which if properly weighted should allow a detailed account. To me the part of the book dealing with this era is less satisfying. Hallam, though again he has done better than most writers on this subject, still has not made as much use of such material as one might have hoped. He takes some pains to point out that Holmes proposed a convection-current model of plate tectonics in 1929. Yet, curiously, he later attributes the convection-current model to Hess and gives 1962 as the date, noting that Dietz, who proposed his similar model in 1961, got the idea from a preprint Hess had distributed in late 1960. But from whom had the then-landlubber Princetonian geologist gotten it? Was it from his seagoing rivals at nearby Columbia University, who he often complained were so busy making discoveries that they took insufficient time to publish their findings or to contemplate the ramifications of their observations? An armchair is undoubtedly a great place to sort out thoughts; it is also without doubt that someone has to go fetch the data. Hallam, I feel, at least has an inkling of these derivations.

Hallam is concerned with what constitutes a revolution. Is it when the central idea or observation is made and announced, or is it when a majority accepts it? And if one accepts the latter definition, what constituency is to be polled to determine the consensus?

The real revolution in thought occurred in the 1950's when the reality of continental drift was confirmed by the divergence of polar wander curves determined by paleomagnetism and when the Mid-Oceanic Ridge and its rift valley were discovered and recognized as the line of divergence beween major crustal segments. The 1960's were a time of amplification and proselytization when the bandwagon began to move. To an individual contemporary scientist the answer to when the revolution occurred depends on when he joined. The revolution is over when a majority of active workers are converted, after which the movement becomes an establishment bandwagon. Hallam's book will no doubt be appreciated by revolutionary, would-be revolutionary, neophyte, and last-ditch reactionary alike. It is a good little book on an important subject.

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Respiratory Pigments

Cytochromes. R. LEMBERG and J. BARRETT. Academic Press, New York, 1973. xii, 580 pp., illus. $24.50.

This volume is a valuable research tool to those working with cytochromes, but is a book to be referred to rather than read. It is an encyclopedic guide to the literature up to 1971, written in the compressed, telegraphic style familiar in *Annual Reviews* volumes. The book format is an advantage in permitting a completeness that is denied to the writers of shorter reviews; on the other hand, the customary delays of book publishing mean that this book, considered as a review, was obsolete before it was published. The authors have recognized this difficulty and have provided a 12-page chapter-by-chapter appendix which covers the literature through 1971–1972, but the papers cited there are not mentioned in and have not influenced the text itself.

After two introductory chapters, separate chapters are devoted to eukaryotic cytochromes a, b, and c, bacterial cytochromes and oxidases, the structure of the respiratory chain, physiological aspects of cytochromes, and cytochrome biosynthesis. There is a rather sketchy concluding chapter on cytochromes and evolution. In the sections where the reviewer is most competent to judge, the literature coverage appears to be exhaustive. The authors are not content merely to state the conclusions from current work; they trace in detail the historic development and twists and turns of thinking that preceded what we now know. This frequently makes for heavy going for someone who is trying to learn about cytochromes from the book, and some of the dense summaries packed with literature citations could have been better presented in the form of tables, with less interruption to the narrative text. Much valuable information is present, but uncovering it is often a painful process.

As a result of this tendency to be historical and encyclopedic rather than selective and critical the book is sometimes misleading. For example, a tentative proposal for the conformation of the amino-terminal region of cytochrome c inferred in 1968 from the low-resolution x-ray analysis, and the true structure as presented in 1971 from the 2.8 angstrom analysis, are shown in two successive figures with no indication in the legends that the latter completely supersedes the former. Even more, this book is essentially a "pre-x-ray" treatment of cytochromes. The oxidized horse cytochrome results of Dickerson are summarized, but have little impact on the discussions of the chemistry elsewhere in the book. The name of Scott Matthews does not appear in the book, even though his cytochrome b_5 x-ray analysis was reported in detail at the Cold Spring Harbor Symposium in 1971. (A *Nature New Biology* publication on this work is listed in the appendix.)

I would never give this book to a beginning student who wanted to learn about cytochromes; but I would give it to a graduate student who was moving into unfamiliar territory in the field and wanted to make sure that he had missed nothing among earlier work. It is a valuable research aid, but the ultimate treatise on cytochromes remains to be written.

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The Development of Penicillin

Rise Up to Life. A Biography of Howard Walter Florey Who Gave Penicillin to the World. LENNARD BICKEL. Scribner, New York, 1973. xxii, 314 pp. + plates. $9.95.

In the three decades that have elapsed since penicillin was first used to treat a patient, Alexander Fleming's name has become a household word. Around him has grown the myth of the solitary worker whose destiny "floated in through the window" and who seized the opportunity to give penicillin to the world. Howard Florey, the leader of the Oxford University team that proved that penicillin could actually be used successfully in human diseases, has