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-