

III

JOINT DISCUSSIONS

A. THE ORIGIN OF THE EARTH AND PLANETS

(Edited by B. M. Middlehurst)

Organizing Committee: Dr B. Levin, (Chairman),
E. Anders, H. Elsässer, J. S. Hall, F. Hoyle, Z. Kopal, P. Swings.
Scientific Editor: B. M. Middlehurst

Session I: Origin of the Solar Nebula

CHAIRMAN: F. L. Whipple, Smithsonian Astrophysical Observatory, Cambridge,

INVITED SPEAKER: F. Hoyle, Astrophysical Institute, Cambridge, England

PANEL MEMBERS: E. L. Schatzman, Institut d'Astrophysique, Paris; G. H. Herbig, University of California, Santa Cruz; T. Gold, Cornell University, Ithaca, N.Y.; A. G. W. Cameron, Belfer Graduate School of Science, Yeshiva University, New York

Session II: Internal Constitution and Thermal Histories of the Terrestrial Planets

CHAIRMAN: F. L. Whipple

INVITED SPEAKER: B. Levin, O. Schmidt Institute of Physics of the Earth, U.S.S.R. Academy of Sciences

PANEL MEMBERS: H. Jeffreys, Cambridge, England; K. S. Runcorn, Newcastle University; R. T. Reynolds, Ames Research Center, Palo Alto; Z. Kopal, University of Manchester; E. Anders, Enrico Fermi Institute, University of Chicago

Session III: Internal Constitution of Giant Planets

CHAIRMAN: F. L. Whipple

INVITED SPEAKER: W. De Marcus, University of Kentucky

PANEL MEMBERS: R. Wildt, Yale University; R. L. Wildey, Center of Astrogeology, U.S. Coast and Geodetic Survey, Flagstaff, Arizona; R. Smoluchowski, Princeton University; E. Öpik, Armagh Observatory; R. Hide, Geophysical Fluid Dynamics Laboratory, Meteorological Office, Bracknell, Berkshire, England

Session IV: Open Discussion

CHAIRMAN: J. S. Hall, Lowell Observatory, Flagstaff, Arizona.

The Joint Discussion on the Origin of the Earth and Planets, August 21, 1970, took the form of three half-hour invited discourses each of which was followed by panel discussions and questions from the floor. The fourth session was an open discussion.

After a welcome to the speakers and delegates and remarks about the organization, opening remarks were made by the Chairman of the Organizing Committee, Dr Levin.

Levin: It is a great honour for me to open the Joint Discussion on the Origin of the Earth and Planets here in England – in the country of Newton, Darwin, Jeans and many other illustrious scientists whose ideas illuminated the development of planetary cosmogony.

During the last decades the approach to the study of the origin of the solar system has changed markedly. For about two centuries the essential features of its formation process were derived from its modern mechanical properties and then this process was, if necessary, adjusted to explain the major physical and chemical properties of planets. The development of astrophysics decreased the role of purely mechanical studies and now, besides the gravitational attraction, electromagnetic forces are taken into account and the methods of plasma physics are applied to the study of the origin and development of the solar nebula. Moreover, two new approaches to the problem appeared during last decades – one based on physical chemistry and the other based on nuclear physics. Both of them were developed on the bases of innumerable new data on meteorites obtained by application of new experimental techniques – neutron activation, electron microprobe, mass – spectrometry and others. Both these new approaches give evidence of the environment in which the studied specimens were formed.

New sources of data about our solar system have appeared during recent decades. Among them by far the most important is the development of space sciences. This permitted us not only to observe from outside of the terrestrial atmosphere but to carry our instruments to the Moon, Venus and Mars. About a year ago this development culminated in a first landing of a man on the Moon.

New data on the Moon, Venus and Mars secured by space probes and by the Apollo program opened new possibilities for studying planets and these possibilities have attracted many geophysicists, geochemists and geologists.

Thus, at the present time, a thorough discussion of all aspects of the problem of the origin and evolution of the Earth and planets requires the participation not only of astronomers but also of representatives of several related branches of sciences and would require not only day but at least a week, or even a month. These considerations had to be taken into account by the organizers (organizing committee) of this discussion when choosing topics to include in the program.

At the moment one of the most important problems in the planetary cosmogony is that of condensation of dust in the solar nebula. The experimental approach to this problem is based on analysis of meteorites and – for a few months – of lunar samples. The theoretical approach is closely connected with the early thermal history of the solar nebula and the latter depends on its origin. If the solar nebula originated along the lines suggested by Hoyle or by Schatzman, then its cooling rate depended on the rate of increase of the distance between the given element of the nebula and the Sun, and on the changes of solar luminosity. On the other hand for a massive nebula suggested by Cameron its cooling rate depended also on the liberation of gravitational energy on its contraction towards the equatorial plane. It was regarded as appropriate to bring together the authors of different ideas on the origin of the solar nebula and this topic was included in the program.

Several authors have studied the internal constitution and thermal histories of the terrestrial planets. They start from different assumptions but sometimes important implications of these assumptions for other problems of planetary cosmogony are not taken properly into account. The problem of the internal constitution and thermal histories of the terrestrial planets is included in the program with the hope that its discussion will clarify the different points of view.

The third problem – the internal constitution of the giant planets – is closely related to such interesting problems as the source of internal heat probably radiated by Jupiter, the origin of its magnetic field, and others.

We will have three panel-discussions devoted to the three topics mentioned above.