PART I

INTRODUCTION

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REPORT BY THE CHAIRMAN

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1. Formation of Working Group 3 of Commission 17

A relevant observation regarding the First Lunar Science Conference at Houston, Texas, in January, 1970, was made by Dr A. Dollfus as Chairman of a Special Working Session on lunar geology, geophysics and returned lunar samples, held at Brighton, England, in August 1970 on the occasion of the Fourteenth General Assembly of the International Astronomical Union: Dollfus remarked that very few astronomers were present at Houston. Clearly, the highest efficiency in the study of the Moon will be achieved only if a suitable forum is created for the exchange of views of scientists from a variety of disciplines bearing on the lunar problem. Accordingly, Commission 17 (The Moon) of the International Astronomical Union set up a Working Group to assist with the geological and geophysical interpretation of the Moon in close connexion with the relevant astrophysical topics. Two meetings of this Working Group 3 were held during the IAU Symp. 47 'The Moon', at Newcastle-upon-Tyne, in April, 1971. The following recommendations and problems derive from these meetings and from correspondence with IAU members not present at the meetings.

2. Recommendations of Working Group 3

(i) Working Group 3 stresses the utility of interdisciplinary, international collaboration in future lunar exploration. Joint studies should be encouraged between Commissions 17, 7 (Celestial Mechanics), 16 (Planets and Satellites), 19 (Rotation of the Earth), 22 (Meteorites) and 40 (Radio Astronomy).

(ii) Working Group 3 should assist the ICSU's Inter-Union Commission for Study of the Moon (IUCM) to provide a forum for discussing the application of lunar sample analyses to the advancement of lunar science in general. Such a forum has the potential of defining the lunar problem on an international level by scientists from different, but interconnected, fields. Through such a forum, nations can extract a balanced view on the magnitude and nature of the effort to involve in future lunar exploration, with the aim of achieving the highest scientific rewards.

(iii) The IAU should foster the development of cosmogenic theories which draw on modern space data as well as the older, astronomical data pertaining to the Moon. Commission 17 should bring this problem to the attention of Commission 7. Should there be a revived interest in this field, it would provide an opportunity to bring scientists in some of the smaller astronomical institutes into the main current of modern thought.

(iv) The IAU should foster the international exchange of lunar reports. Investi-

Urey and Runcorn (eds.), The Moon, 3–5.

gators should send copies of their reports to the World Data Centres. Astronomers, in particular, should have access to the principal geological results deriving from the analysis of returned lunar specimens. Catalogues and charts of lunar photographs, and supporting data such as bibliographies stemming from the lunar exploration programme, should be distributed to those members of the international scientific community who would wish to participate in cooperative studies of the Moon. The Working Group hopes that the U.S.A. and U.S.S.R. World Data Centres will be in a position to provide interested members of the IAU with lunar reports, photographs and scientific supporting data.

(v) The IAU should foster the international exchange of returned lunar specimens and the collaborative study of them. Working Group 3 considers it of high scientific importance that lunar samples for analysis be drawn, in the future, from at least one, non-flooded highland site typical in terms of albedo, radar reflectivity, thermal behaviour, polarisation and crater number-density.

(vi) Study of the lunar samples has been more thorough than the study of many terrestrial rocks. Together with the experiments which have now been placed on the Moon, the results are adequate to shed light on some basic problems of lunar history and processes; but these base-line studies are not sufficient to enable geologists to describe with any certainty the chemical and petrological evolution of the Moon. More intensive sampling is required, the use of roving vehicles is to be commended; and every effort should be made to identify the precise location (and orientation) of lunar material sampled in the future. Nevertheless, the space programmes have already provided a backlog of data and have raised questions which can lead to productive theoretical and other Earth-based studies, and Working Group 3 considers that it would not be undesirable to consolidate interpretative studies and thought on lunar problems over a period of several years.

3. Questions that Need to be Answered

A. THE MOON'S FIGURE AND HISTORY

Many well placed laser retroflectors are required to provide (a) a net of points of accurately known relative altitude; (b) modern data for rediscussion of the Moon's physical libration (following the treatment being developed by A. Cook); and (c) the value of the Moon's secular acceleration in recent time (over a sufficiently long period).

Treatments of past evolution of the Moon's orbit are particularly prone to weakness. At what stage of the Moon's evolution did the terrestrial oceans come into being and to what extent and for how long did each contribute to the dissipation of the Earth's angular momentum? Is dissipation in the Earth's core negligible? How have the shallow seas, the distribution and area of continents, and the internal structure of the Earth (and Moon) changed over the ages? Is it clear that hamonics higher than the second should be neglected in discussing tidal friction? R. Hipkin has raised the question "Was the Moon over trapped in a resonant orbit?" Have there been major

fluctuations in the secular acceleration of the Moon; and is it even possible, at the present time, to produce a reliable model of the evolution of the Moon's orbit?

B. MASCONS AND THERMAL HISTORY OF MOON

Topographic profiles are required across mascon areas. Used in conjunction with the gravity measurements they will enable closer definitions of mascons to be made.

Many heat flow measurements using instruments above and beneath the Moon's surface are desired; an accurate determination of the amount of heat flowing from the Moon's interior is required, at least by remote sensing methods. Improved magnetic observations are required to provide better conductivity and temperature profiles in the Moon. There is a need for more sophisticated theoretical work on the melting and thermal history of the Moon, taking full regard of the lunar sample analyses as well as of the heat flow and the magnetic measurements.

C. LUNAR VOLCANISM

Samples of lunar highland material are required to test for defluidisation. The distal zones of lunar flows should be examined with a view to studying the behaviour of materials moving under vacuum conditions. The Straight Wall should be examined for evidence of layering; and a means should be found for the mapping of subsurface layering. A close-up study should be made of lunar domes; and of craters related to, and in, rilles. The further study of tektites should be encouraged.