

COMMISSION 17: THE MOON (LA LUNE)

Report of Meetings

PRESIDENT: A. Dollfus.

SECRETARY: J. A. O'Keefe.

During the IAU General Assembly of Sydney, Commission 17 'The Moon' held meetings for each of its 3 Working Groups, an Administrative Session, a Scientific Session and a Joint Discussion with Commission 16 on 'The Origin of the Moon and Satellites'. The Secretary for the session was Dr J. A. O'Keefe. The minutes of these sessions are available at the Office of the retiring president, A. Dollfus – Observatoire de Paris, 92190 Meudon, France.

WORKING GROUP: FIGURE, MOUVEMENTS ET POSITIONS OBSERVÉES DE LA LUNE

Scientific and Working Session, 21 August 1973

The Chairman of the WG, Dr Th. Weimer, having had unforeseen plane delays, the meeting was chaired by the President of the Commission, A. Dollfus.

The Scientific part of the session prepared by Th. Weimer was a series of 5 invited review papers summarizing the major problems and latest results in the field:

L. V. Morrison: The Current Program of Occultations.

L. A. Schirmerman: The Apollo Metric Camera Selenodetic Program.

P. N. Bender: Selenodetic Coordinates of the Apollo Retroreflectors.

J. G. Williams: Determination of the Lunar Libration from Laser Range Measurements.

C. Counselman: Precision Selenodetic and Lunar Libration through Very Long Base-line Interferometry.

Each presentation was discussed at a rather high level, due to the presence of the appropriate experts in the audience.

The working session which followed was centered on the problem of the list of craters which should be standard points for all future lunar geodetic work. One of the assignments of the WG coordinated by Th. Weimer was the analysis of the problem and the preparation of a proposal already discussed by experts. A sub-group has been appointed with Weimer, Moutsoulas and Gavrillov as members to study the resolution. In Dr Weimer's absence, Dr Moutsoulas presented the results to the whole WG. The careful discussion which followed suggested some additional detailed improvements. The final resolution was unanimously adopted by vote to be submitted to the Administrative Session of the whole Commission 17.

WORKING GROUP: GEOLOGY AND GEOPHYSICS OF THE MOON

Working Session, 22 August 1973

The Chairman of the WG, G. Fielder, being unable to attend, had asked to be replaced in the chair by A. Dollfus. The topic to be discussed was the problem of scientific priorities for the study of the Moon during the next decade. Invited by ICSU to try and prospect a balance between the different aspects of their scientific needs in research, the different International Scientific Unions belonging to ICSU initiated action within their committees, commissions and working groups.

Within this framework, both the Inter-Union Commission for Lunar Studies (IUCM-CIUL) and

the IAU Commission 17 'The Moon' undertook the difficult task of trying to identify research studies on the Moon in the context of present and future scientific effort, to define its impact on mankind, to sum up the state of the art, knowledge already acquired, the major gaps remaining to be filled. The minimum level of effort to be made during the next decade was estimated; a strategy for developing lunar science was discussed. The Chairman had collected by correspondence and discussions the views expressed by a large fraction of the Commission members interested. He also analysed the work done by IUCM in its conference of November 1972 in Paris; IUCM involves lunar studies through its different disciplines: astronomy, geophysics, geology, space research, radio science.

The Chairman summarized for the WG the major points of agreement between views expressed by individuals and the draft proposal issued by IUCM. A long discussion followed during which new views were exchanged, and new balances between the emphasis on different priorities were suggested. Finally, the President A. Dollfus and the Secretary J. O'Keefe were invited to prepare a draft of a document summing up the discussion to be submitted to the Administrative Session of the whole Commission 17.

WORKING GROUP: LUNAR NOMENCLATURE

Chairman: D. H. Menzel, Members: B. Levin, H. Masursky.

Prof. Levin was unable to attend.

The Working Group held two open sessions on 22 August afternoon and 25 August morning. The attendance was around 15–20 members.

The WG had been entrusted with the responsibility of defining the system of nomenclature for the craters and topographic features at smaller scale than the telescopic resolving power and to apply it on the new detailed lunar cartographic program. In order to meet this assignment, the WG had particularly intensive activity during the past three years, to arrive at a proposal reaching a general consensus. After several meetings in 1971 to explore the field, it held formal sessions on 17–18 May 1972 in Madrid, on 27 November 1972 in Paris, on 9–10 March 1972 in Houston, on 21–23 May 1973 in Constance, plus working sessions at the IUCM General Assemblies of 15 November 1971 and 28 November 1972.

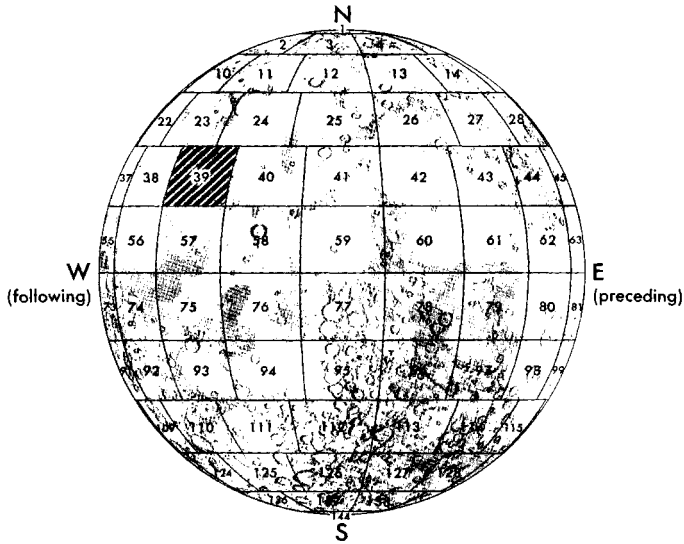
The Chairman, D. H. Menzel, summarized the work done, presented the scheme proposed for the designation of small lunar features and opened the proposal to discussion. A 2-hours discussion followed in which at least 10 participants expressed comments, remarks, first on the general scheme, then on more precise points. The Chairman ended the session by proposing that although the general spirit of the first draft remained unchanged, he would prepare for the second session of the WG an improved version of the draft, accounting for the new balance of consensus on details resulting from the advices of the participants.

At the second session, the new draft of the resolution was presented to the audience. Again, about 10 members participated actively in the improvement of certain aspects, although clearly the consensus on the general principles was already reached at the beginning of the discussion. A final proposal was then agreed upon to be presented for adoption at the General Assembly of the Commission, and adopted with unanimity of the voting members, as follows:

Resolution on Lunar Nomenclature

"Commission 17 recommends for adoption the following resolutions concerning lunar nomenclature.

- (1) The abundant data secured by space vehicles have made possible new programs of lunar mapping, which require a more precise and detailed system of nomenclature than the current system originated by Mädler. The revised system employs a geometrical grid of Regions and Provinces.
- (2) In the new system, parallels of latitude and meridian arcs divide the lunar surface into 144



EAST-WEST DIRECTION
 Orientation of cardinal directions is in accordance with resolution adopted by the IAU General Assembly, 1961.

Figure 1

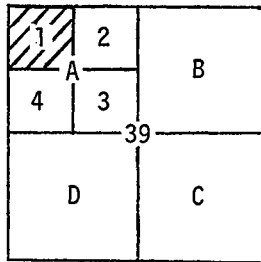


Figure 2

Regions, as in the NASA Lunar Aeronautical Charts (LAC), on the scale 1:1000000, Figure 1. (For details see Robert Carder, *The Moon*, IAU Symposium 14, p. 17). Each region is subdivided into sixteen Provinces, as in the NASA Lunar Topographic Orthophotomaps (LTO), on the scale 1:250000. Each Province carries a code designation, consisting of its LAC Region number, followed by a letter A, B, C, or D and a number 1, 2, 3, or 4. For example, Figure 2 illustrates the coding for Province 39 A 1.

(3) Consistent with standard cartographic practice, each Region and each Province will also bear the name of some prominent feature (preferably a crater) within it. Names of Provinces will not duplicate those of Regions.

(4) A grid system may be used for further identification of features within a given Province. Abscissae are indicated by one of the capital letters A–Z (I and O are omitted), from west to east. Ordinates are indicated by one of the lower-case letters a–z (i and o omitted), from south to north. This letter system is primarily for identification and reference and will not generally be used on the maps.

(5) The Greek letters previously indicating lunar elevations will be dropped. Craters previously designated by Roman capital letters will progressively be assigned new and distinctive names. To facilitate cross correlation between the current and the new system, the old names should be listed on the larger-scale maps. At an appropriate time a complete cross-reference table will be prepared.

(6) Elevated regions will generally require new designations. Ridges, previously unnamed, will be called Dorsum, plural Dorsa. Rimae and Rima systems will receive new and more appropriate designations. Crater chains will be designated Catena, such as Catena Davy.

(7) Whereas previously assigned lunar names have been, with few exceptions, those of distinguished deceased scientists, future assignments may also contain the names of distinguished, deceased contributors to human culture and knowledge, such as writers, painters, musicians, etc., chosen on an international basis. Excluded, however, are political, military, and religious figures, as well as modern philosophers.

(8) Very small features requiring identification for some special reason may be assigned, with IAU approval, first names, male or female, from an international list. Excluded, however, are names having more than three syllables.

(9) For operational purposes, such as designating areas specially explored or sampled, Apollo missions have assigned names to certain features in the vicinity of the respective landing sites. The list* was corrected and revised by the Working Group in consultation with the astronauts and Principal Investigators of the Apollo missions. The IAU requests that future lists of this type be submitted to the IAU in advance of the mission.

(10) The complete corrected list of the adopted names is published in Appendix I. The list contains the name of M. Minnaert, who died shortly after the 1970 General Assembly. It contains also the name of Abbot (C. G.), who is still living.** It was assigned to honor Abbot's 100th birthday.**

ADMINISTRATIVE SESSION OF THE WHOLE COMMISSION 17

The meeting was called to order on August 28 morning by A. Dollfus, President. He presented, in French, the following agenda:

- (1) Resolution on fundamental craters.
- (2) Recommendation on scientific priorities.
- (3) Resolution on lunar nomenclature.
- (4) Composition of Commission for 1973–76.
- (5) Structure of Working Groups.

The Agenda was agreed upon.

Under Item (1) of the Agenda, the following Resolution was presented by Th. Weimer, read by G. O'Keefe, and accepted after a short discussion with unanimity.

Resolution on Selenographic Reference Points

Commission 17 recommends:

“(1) That in selenographic catalogues as many reference points as possible from the 211 listed in Appendix I should be included, so that direct comparisons between the corresponding networks can

* Copies are available at the office of Dr H. Menzel.

** C. G. Abbot died after the XVth General Assembly.

be made; thus the establishment of a common selenographic control system could be ultimately achieved;

(2) That, in the catalogues, reference to the constants used for the reductions be given."

Under Item (2), A. Dollfus presented the proposed priorities on the study of the Moon. He noted, however, that this document is only for use at the level of Commission 17 and IUCM, since IAU decided that it appeared not feasible to reply to ICSU's request for a list of scientific priorities between the different aspects of research within Astronomy. The draft was then read. A number of language corrections were proposed to the members of the Commission and were adopted. The text was finally voted and still slightly re-worked later on by the President, to care for the new views expressed in September–October 1973 after the General Assembly, by members and experts unable to attend the Sydney Conference. The final wording of the Priorities in the study of the Moon is given at the end of the Report of Commission 17.

Under Item (3) of the Agenda, the resolution on lunar nomenclature which improved during the last sessions of the WG was read by D. H. Menzel. The discussion went on with some changes in wording. D. H. Menzel noted that most of the name changes replaced y by ij in Russian names. A large unnamed crater near the South Pole was assigned 'Minnaert'. Finally, the resolution on lunar nomenclature was adopted unanimously.

For Item (4), composition of the Commission for 1973–1976, President A. Dollfus proposed for adoption the new board as follows.

President: Runcorn, S. K.

Vice-Presidents: Anders, E., Florenskij, K. P.

Organizing Committee: Dollfus, A., Dzhapsishvili, V. P., Koziel, K., Kuiper, G. P., Mulholland, J. D., O'Keefe, J., Sonett, C. P.

Ex-officio-members: President IAU Commission 16: Mayer, C. H.; Chairman COSPAR Working Group 7 'Space related studies of the Moon and Planets': Kuzmin, A. D.; Vice-Chairman COSPAR Working Group 7: Sagan, C.

Consultant: Chairman of IAU–COSPAR Working Group on laser study of the Moon: Alley, C. O.

The new list of members as appended in the 'Proceedings of the IAU General Assembly', and the list of consultants, will be circulated by the new President.

The new President, S. K. Runcorn was then invited to take the Chair and to explain his views about the future activity of the Commission. He stated that he plans to continue the 3 existing Working Groups.

After some discussion, the title of Working Group 1 was changed to: *Figure and Rotation of the Moon*. Under this title, however, the occultation work will still be included; S. K. Runcorn stated that he includes occultations under this title on account of their contribution to the figure of the Moon. He proposed to retain Th. Weimer as Chairman of this group. The permanent members will be Gavrilov, Gurstein, Moutsoulas, Mulholland. A number of experts will be added later by the Chairman Th. Weimer.

Under Working Group 2, 'Geology and Geophysics of the Moon', S. K. Runcorn proposed to drop the prefix 'Geo' since it refers to the Earth. After discussion, the following title was decided on: *Physics, Chemistry and Geology of the Moon*. J. O'Keefe was appointed new Chairman of this group with members Dollfus, El Baz, Levin, Sonett, Urey. The WG has also the possibility to appoint consultants.

For the problem of lunar nomenclature, the frame will be slightly modified. The chair was again turned to A. Dollfus. He noted that during the next coming years, the Moon, Mars, Venus, Mercury and the galilean satellites of Jupiter will all involve nomenclature problems. The experience gained in past years shows that a certain level of organized coordination is needed between these different aspects of nomenclature. Moreover, the speed of response of a heavy body such as an IAU Working Group reporting to an IAU Commission and then to the General Assembly meeting every three years is too slow for the modern needs of space research work. Hence, a new organisation is being prepared which will allow the appropriate IAU Commissions (17, 16) and IUCM to report directly to the IAU.

The new organisation will be a Working Group for 'Planetary System Nomenclature' with the following structure: (1) there being several Task Groups, one for each celestial body (the Moon, Mars, Venus, Mercury... etc.). The lunar Task Group is traditionally nominated by the Executive Committee, the others by the Executive Committee on proposal of Commission 16. (2) the WG as such, consists of the Chairmen of the Task Groups, and in addition, the Presidents of Commissions 16 and 17 and a representative of IUCM. It is headed by a President nominated by the Executive Committee, not necessarily from among members of the WG.

In this new scheme, the responsibility of lunar nomenclature will no longer be the exclusive concern of Commission 17. The question of delegating this authority to the Executive Committee was voted on and approved unanimously.

The membership of the new 'Task Group' for lunar nomenclature will be: D. H. Menzel (Chairman), A. Dollfus (Vice-Chairman), F. El Baz, K. Florenskij, H. Masursky (for IUCM) and S. K. Runcorn (ex-officio). This composition decided by the Executive Committee was agreed upon by the Commission.

The new President S. K. Runcorn thanked the retiring President A. Dollfus for his many years on the Commission and adjourned the meeting.

Scientific Sessions

On 28 August 1973 afternoon, four invited review papers were presented to summarize the knowledge recently acquired on the following basic aspects of lunar research:

A. T. Strickland: U.S. Cartographic and Selenodetic Lunar Programs.

J. D. Mulholland: Lunar Dynamics and Observational Coordinates Systems

H. Masursky: Geology of the Lunar Crust.

S. K. Runcorn: Interior of the Moon.

On 29 August morning and afternoon, a Joint Discussion between Commissions 16 and 17 was held.

Priorities in the Study of the Moon (1973)

"The *International Astronomical Union* and the *Inter-Union Commission for Lunar Studies* having, at the end of 1973, reviewed and discussed the scientific priorities to be recommended for the continuation of the study of the Moon, realize that:

– The underlying justification for lunar studies is the light which it can cast on the origin and evolution of the Solar System as a whole.

– Extensive programmes of investigation and exploration have been developed over the past few years, including: six manned lunar missions; the operation of instrumentation on the lunar surface, aboard both fixed and mobile automatic stations; remote sensing by lunar orbiters; ground-based optical, radio, radar and laser techniques; and the analysis of lunar samples returned to Earth. Coordination of many of these programmes has been particularly well developed.

– As a result of this intensive effort, very basic progress has been made in elucidating fundamental problems such as the origin of the Moon, the ages of various surface features, the effects of meteoroidal bombardment, the Moon's thermal history, the formation of a thick lithosphere, processes of melting and magmatic differentiation, etc.

– Because of gaps which remain, both in the data presently available and in our theoretical understanding, a number of important questions about the nature of the Moon cannot yet be answered.

– In connection with these studies of the Moon, research on other Solar System bodies is likewise being directed toward laying bare the overall structure and history of the Solar System.

This research includes coordinated fly-by, orbiting or landing missions for all planets out to and including Saturn, as well as the study of some of their satellites; it will be accomplished in parallel with ground-based operations and theoretical studies. Work on asteroids, comets, meteorites and the interplanetary medium will be intensified.

– These studies will permit major advances in our knowledge of planetary processes, and will

enhance the value of the lunar work; at the same time, they will be dependent on lunar studies for clarification of many points in the overall history of the Solar System, such as accretion processes, cosmochemistry, bombardment histories, etc.

From these considerations it is clear that the study of the Moon should be pursued at an intense level during the next coming decade. The *International Astronomical Union* and the *Inter-Union Commission for Lunar Studies* recommend the following further objectives for the study of the Moon.

(1) Data concerning the shape, orbital motion and dynamics of the Moon need to be improved. For this purpose both a continued extensive ground-based observational programme and high-precision tracking of lunar orbiters are required.

(2) A programme of in-situ lunar surface studies should be continued. The importance of remotely controlled roving vehicles is stressed; these offer the possibility of reaching lunar terrains of different types, of returning samples and of carrying sophisticated geophysical, chemical and imaging instrumentation.

(3) Physical and chemical parameters relating to the lunar surface and interior, having been evaluated in detail at landing sites and to a lesser degree but more widespread extent by orbiting vehicles, should now be extended to achieve whole-Moon coverage and to include new techniques. This task could be undertaken by high-inclination orbiting vehicles, supported by ground-based research.

(4) Increased activity should be fostered at an international level and on a pluridisciplinary basis, both with regard to the interpretation of available lunar data and to the mutual interaction with results from other Solar System objects. Special importance should be attached to the safeguarding, processing and wide dissemination of the body of material acquired.

It is anticipated that, with this basic minimum programme for the Moon, combined with the simultaneous studies of the other bodies of the Solar System, the fundamental problem of the origin of the Solar System could be greatly clarified during the next decade.”