COMMISSION 16: PHYSICAL STUDY OF PLANETS AND SATELLITES (L'ÉTUDE PHYSIQUE DES PLANÈTES ET DES SATELLITES)

Report of Meetings: 20, 24, 25 and 26 August 1970

PRESIDENT: John S. Hall.
SECRETARIES: C. Sagan, B. Middlehurst, and G. H. Pettengill.

The Commission sponsored the Joint Discussion with Commissions 15, 17, 21, 22 and 35 on the Origin of the Earth and Planets, which took place on 21 August. A joint meeting, sponsored by Commission 40, and including also Comissions 16 and 17, was held on 24 August.

Presentations of the Mariner 6 and 7 results, given on August 26, included visual imaging, infrared and ultraviolet spectroscopy. Descriptions of projected NASA missions to Mercury, Venus, Mars and Jupiter were presented on August 25.

The abstracts of the individual papers, presented by members of Commission 16 only, were submitted by Sagan, the reports on the Joint Discussion were compiled by Middlehurst, and those of the joint meeting with Commissions 17 and 40 by Pettengill.

RESOLUTION ON NEW PLANETOGRAPHIC COORDINATE SYSTEMS

A. *Guiding Principles*

1. The rotational pole of a planet or satellite which lies on the north side of the invariable plane shall be called north, and northern latitudes shall be designated as positive.

2. The planetographic longitude of the central meridian, as observed from a direction fixed with respect to an inertial coordinate system, shall increase with time. The range of longitudes shall extend from 0° to 360°.

B. *Definitions and Numerical Values for Mercury and Venus*

1. For Mercury (having a direct rotation) the origin of planetographic longitudes is defined by the meridian containing the subsolar point at the first perihelion passage of 1950 (J.D. 2433292.63). The rotational axis shall be provisionally defined as perpendicular to the orbital plane of Mercury (1950). For purposes of obtaining longitude at earlier or later time, a provisional value for the sidereal rotational period of $58^{d}.6462$ is adopted.

2. For Venus (having a retrograde rotation), the origin of planetographic longitudes is defined such that the central meridian of Venus as observed from the center of the Earth is 320°.0 at 0^{h} on 20 June, 1964 (J.D. 2438566.5). The rotational axis shall be provisionally defined as having a north pole direction of $\alpha = 273°.0$, $\delta = +66°.0$ (1950.0). For the purposes of obtaining longitude at earlier or later time, a provisional value for the sidereal rotational period of $243^{d}.0$ is adopted.

RESOLUTION ON MAKING JUPITER INFORMATION MORE READILY AVAILABLE

In order to place on a systematic basis the collection, reduction and reporting of the rotation periods of Jupiter's radio sources and visible features (e.g. Great Red Spot), together with related information such as the appearance, position, and dimensions of the feature observed, Commission 16 recommends:

1. that a comprehensive bibliography be compiled without delay;
2. that copies of reports in preprint or reprint form be sent by authors to a 'central office' for inclusion in supplements to the bibliography;

3. that the bibliography supplements and summaries of the rotation periods, presented with error estimates, be published annually in one of the regular international journals (e.g. *Icarus*);

4. that the President and Organizing Committee be invited to implement these proposals.

ACTION ON MARTIAN NOMENCLATURE

The Martian Nomenclature Committee, consisting of Gerard P. Kuiper (Chairman), A. Dollfus, John S. Hall and Robert Leighton held two meetings between General Assemblies XIII and XIV. There was also an exchange of information by mail between other members of Commission 16 and the Subcommittee. All members of Commission 16 were invited to participate in the discussions and were kept fully informed by News Letters.

The Subcommittee met at Brighton and drew up the following proposals which were subsequently approved by the members of Commission 16:

(A) The hundred or so largest and most prominent craters on Mars are to receive names of deceased persons whose works were related to the Planet Mars.

(B) For smaller features deserving names, about 110 of the 125 names adopted by the IAU in 1958 (*Transactions* **X**, 262, Plates I and II) that cover *regions* (*bright* or *dark*) rather than 'narrow features', be used as *provinces*. The names are to be *abbreviated by 4-letter* symbols (not unlike the 3-letter abbreviations of constellations), in such a manner as to retain the alphabetical arrangement of the 1958 table. These are to be followed by Roman letters *A*, *B*, ... to designate the approximately 25 largest topographic features within a province. *Two-letter designations*, Aa, Bb, etc., are to be used to designate several hundred *smaller* features requiring symbols, with the *first* letters in each case referring to a *sub*-province (or district). This scheme can be continued indefinitely, as far as may be required.

(C) A Working Group is to be appointed, charged with *three tasks* to be completed before the next General Assembly of the IAU to:

1. substantially define the province boundaries and, in the process, possibly add or delete a few provinces, as may appear desirable; and circulate among members a map showing coordinates and proposed boundaries;

2. apply the principles of topographic nomenclature to the regions adequately covered by the Mariner 1969 data, and by such 1971 data as may become available;

3. propose appropriate names (cf. A above) for some prominent Martian topographic features (with reference to the lists of names already submitted by Commission 16 members).

The President of the Commission, with the advice of the Subcommittee, appointed the following members to the Working Group on Martian Nomenclature: de Vaucouleurs (Chairman), Miyamoto, Sagan, Dollfus, B. A. Smith and M. D. Davies (consultant).

BETTER COMMUNICATION BETWEEN ASTRONOMERS AND GEOSCIENTISTS

Commission 16 recommended that:

(A) The IAU *records* its view that recent developments in the observation and theory of the planets and of the earth make it timely to improve communication between geologists, geochemists, geophysicists and astronomers.

(B) The IAU *invites* the members of the IUGG, the IUGS, and other interested Unions to participate more fully with the Members of the IAU in exchanging knowledge of fundamental concepts and data of their disciplines and to facilitate the collaboration of their members in new terrestrial and planetary investigations.

(C) The IAU *notes* the promotion of, and *would welcome* liaison with, the inter-union geodynamics commission, the work of which has relevance to planetary interiors.

MERIDIAN LONGITUDES FOR SATURN

Members of Commission 16 expressed the urgent need for a continuous table of central meridian longitudes for Saturn and recommends that a Working Group be established to undertake a study of this matter with a view to proposing a definitive system for adoption as soon as practicable.

JOINT MEETING OF COMMISSIONS 16, 17 AND 40 ON 'RADIO AND RADAR STUDIES OF THE MOON AND PLANETS'

First Morning Session

J. E. B. Ponsonby: 'Moon Mapping by CW Radar at 162 MHz'.

The mapping of the Moon has been carried out at Jodrell Bank using a CW-radar technique similar to aperture synthesis. By observing the echoes in the same sense of circular polarization as the transmitted waveform, sensitivity only to diffuse scattering by small-scale surface roughness is assured. It is possible that a significant fraction of the energy is reflected from a depth of some 20 m. Observations were reported for several days in early 1970, when the lunar-terrestrial geometric configuration was favorable for the application of this technique. Angular resolution as viewed from earth was about 2′ arc, with the crater Tycho forming a particularly prominent scattering feature.

I. I. Shapiro, M. E. Ash, R. P. Ingalls, G. H. Pettengill, A. E. E. Rogers, M. Slade, W. B. Smith, and S. H. Zisk: 'Topography of the Moon, Mercury and Venus'.

Four radar methods of gaining topographic information on the surfaces of the Moon and planets were discussed. The first method depends on the accumulation of measurements of the radar time-of-flight to the sub-earth point. As the target rotates these may be used to explore the topography along the sub-earth track. Resolution is determined by the pulse-width used. The second method uses both delay and Doppler resolution to derive a profile along the equator of apparent rotation which may be compared with that expected from a spherical target. The third method involves stereoscopic comparison of delay-Doppler maps taken at different rotations. While applicable to large areas of the target, this method does not possess high accuracy. The fourth, and most sophisticated, method uses interferometry to fill in the coordinate otherwise missing in delay-Doppler mapping.

The second and fourth methods have been applied at M.I.T. to derive contours of the lunar surface good to an absolute accuracy of better than 500 m, while the first two methods have been applied to Venus and Mercury. The preliminary lunar results so far obtained show good agreement with optically-derived lunar maps over short distances, but seem to indicate 'drifts' in the absolute control of the optical method over longer distances. Very little topographic variation, at least at the resolution so far available, has been found on Venus in the equatorial belt, with only one region of about 2 km height in evidence. No departure from sphericity can yet be reliably reported for Mercury.

C. C. Counselman, M. E. Ash, G. H. Pettengill, A. E. E. Rogers, I. I. Shapiro and W. B. Smith: 'Radar Map of Martian Topography'.

Observations of Mars with the Haystack Radar ($\lambda = 3.8$ cm) during the oppositions of 1967 and 1969 have been combined to map variations of surface elevation, reflectivity, and roughness for nearly all longitudes and for latitudes from 2° to 22° North. Variations in height of approximately 15 km have been found. The radar maps show that the locations of dark visible markings are not systematically high or low, but certain prominent dark features occur on slopes. The dark visible features Syrtis Major, Trivium Charontis, and Cerberus are relatively smooth and have high radar reflectivity.

Following this paper, *R. A. Wells* presented his interpretation of Martian topography based on optical maps and an assumed internal structure.

G. C. Pimentel called attention to topographic results for Mars obtained from spectrographic observation of CO_2 pressures during the Mariner 6 and 7 flyby's. These consisted of a number of spot measurements between 0° and 40°S.

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