★ STAR DUST

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McCARTHY TO DISCUSS EARTH — MASS SHIFTS

DR. McCARTHY

The November 5 meeting of NCA will hear Dr. Dennis McCarthy of the U. S. Naval Observatory discuss astronomical determinations of the Earth's motions and the effects of Earth-mass shifts.

The description of the motion of the Earth about its center of mass has been a concern of astronomers and physicists for centuries. Knowledge of the Earth's motion is, of course, absolutely necessary for constructing a celestial coordinate system and for making observations therein. Precise astrometric observations are now making it possible to improve some parts of the rigid-Earth theory of nutation for the Earth's motion. These improvements will not only result in a more accurate representation of the orientation of the Earth but also lead to a better understanding of the nature of the interior of the planet.

Some features of the Earth's motion cannot be modelled at this time. The motion of the pole of rotation with respect to the crust cannot be accurately predicted and its nature is poorly understood. Similarly, the angular speed of rotation is not predictable and an explanation of some of the rotational accelerations is still unknown.

Observations made with the Photographic Zenith Tubes of the U. S. Naval Observatory are contributing to an improvement in our understanding of the motion of the Earth about its center of mass. This instrument will be outlined and the kind of observations will be explained. The results of these observations and other such results will be described along with their effects on our knowledge of nutation, polar motion, and rotational speed of the Earth.

Dr. Dennis McCarthy received his B.S. degree from Case Institute of Technology in 1964 and his M. A. in 1970 and Ph. D. in 1972 from the University of Virginia. He is currently Photographic Zenith Tube Project Leader, Time Service Division, U. S. Naval Observatory. He has been on the staff since 1965.

Dr. McCarthy is a member of the American Astronomical Society, International Astronomical Union, Sigma Xi, and the American Geophysical Union.

NOVEMBER CALENDAR — *The public is welcome.*

Friday, November 4, 11, 18, 25, 7:30 PM — Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

Saturday, November 5, 6:15 PM — Dinner with the speaker at Bassin's Restaurant, 14th Street and Pennsylvania Avenue, NW. Reservations unnecessary.

Saturday, November 5, 8:15 PM — NCA monthly meeting at the Department of Commerce Auditorium, 14th and E Streets, NW. Dr. McCarthy speaks.

Monday, November 7, 14, 21, 28, 7:30 PM — Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.

OCTOBER LECTURE

The astrophysics of the solar system's 33 known natural satellites and thousands of asteroids was Dr. David Morrison's topic at the October 1 meeting of NCA. He is Assistant Deputy Director for Lunar and Planetary Studies at NASA. Throughout his talk Dr. Morrison emphasized the vast differences in properties and environmental origins of these objects.

Jupiter's Gallilean satellites, Io, Europa, Ganymede, and Callisto, follow the same progression of decreasing density as Mercury, Venus, Earth, and Mars. Ganymede and Callisto may be mostly ice, while Io and Europa are denser and drier.

Mathematical evolutionary models of planets are derived from models of stellar composition by decreasing the initial temperature. Satellite masses are known to within 2 or 3 percent, diameters to 5 percent, and therefore their densities to within 15 percent. Once condensation generates sufficient heating, liquification and sinking of the heavier elements leads to a self-driving process of heating as potential energy is converted to kinetic energy. A mostly rocky core is formed with lighter materials above.

Europa, Ganymede, and Callisto are believed to have rocky cores only 50-100 km in diameter surrounded by a liquid mantle in the first, and icy ones in the other two, which may have moving glaciers. Io and Europa have relatively little water. According to some widely accepted models of Jupiter's evolution, its core once exceeded 25,000 K and it radiated energy at one-hundredth of the Sun's rate — enough to drive off most of the water from the two nearer Jovian satellites. These models indicate that Jupiter's satellites formed early in its history.

Io, perhaps the strangest Jovian satellite, has nearly the albedo of snow but unlike water, has a bright infrared spectrum. It shows no molecular water bands. This albedo is due to a 10,000-km-thick atmosphere of ionized sodium. The intense radiation of Jupiter's trapped radiation belts expels some of the sodium into Io's orbit as an ionized torus almost completely around Jupiter. An even larger torus of Hydrogen is also created. Io is thought to have a surface of mixed salts, primarily of sodium and sulphur, left by the outgassing of water. The spectrum of soluble matter leached from some meteorites by distilled water resembles that of Io.

Of the nine other Jovian satellites, the largest is only 200 km in diameter, and the rest appear asteroid-like. They differ from the Gallileans in origin and evolution. Not enough photographs of a possible 14th satellite are available for orbit determination.

It is not clear how the evolution of Saturn's mile-thick rings is related to that of the planet. They may be the fragments of a too-close satellite disintegrated by tidal forces, or, more likely, icy aggregates a few centimeters in diameter condensed from the solar system nebula. Three of the four large planets may have rings; Jupiter probably was hot enough to vaporize any primordial rings. A spacecraft passing through Saturn's rings would be destroyed by collisions.

Most of Saturn's inner satellites are icy. Tethys, Dione, and Rhea have water ice spectra. Eighth-magnitude Titan, largest satellite in the solar system, is about Mars' size. With a density lower than that of Callisto, it may be mostly water.

Recent infrared data indicate a surface atmospheric pressure at least as as that of the Earth. Strong spectral bands show a greater proportion of methane than in the atmospheres of Saturn or Uranus. Polarization studies of scattered sunlight show Titan's surface to be completely hidden by clouds whose red color is not that of the spectrographically observable upper atmosphere. Dr. Morrison speculated that in Titan's upper atmosphere sunlight may generate

OCCULTATION EXPEDITIONS PLANNED

Dr. David Dunham is organizing observers for the following grazing lunar occultations in November. For further information call Dave at 585-0989.

August	UT		Vis Mag	Pcnt Sunlit	Cusp Angle	Min Aper
1	05:41	N of Sil Spg MD	7.7	76	8N	6"
2	06:51	N of Sil Spg MD	8.3	67	5N	6"
5	09:33	Faison NC	7.1	37	2S	2"
6	08:53	N of NY City	6.3*	28	0N	2"
6	09:19	S of Ptrsbrg VA	8.4	28	1S	6"
8	09:44	N of Sil Spg MD	9.5	11	0S	8"
14	23:50	35 m NW of DC	8.3	19	4S	4"
15	00:31	N of Richmnd VA	8.3	19	4S	4"
15	22:39	N of Richmnd VA	8.6	28	4S	6"
17	01:30	N of Richmnd VA	8.4#	40	6S	6"
December						
5	07:40	N of Frdrksbrg VA	8.6	35	1N	6"

*Double, secondary magnitude 7.4. #Double.

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organic compounds which sink to a lower altitude and account for the coloration and opacity.

Saturn has at least 11 satellites. Among them, Iapetus is unique in having one hemisphere six times as bright as the other; in synchronous orbit about Saturn, it thus appears much brighter when on one half of its orbit than when on the other. The bright surface has recently been determined to be water ice; the dark side is not known, but is probably rocky. Since the density of Iapetus is not known, it has not been determined which material, if either, constitutes the bulk of the satellite; either may be a layer on the other.

The ring system of Uranus, recently discovered by stellar occultation, is quite unlike that of Saturn. While the density is sufficient to occult starlight, the albedo is only 3 percent — entirely too dark to be ice. The rings are narrow, the gaps wide. The composition is not yet known.

Of the tens of thousands of asteroids in orbits between those of Mars and Jupiter, there are two basic populations: large ones in the main belt and tiny ones in orbits that approach the Earth. The albedo distribution is also bimodal, eighty percent of all asteroids having albedos clustering around 3-4 percent, the remainder around 15 percent. Spectrophotometry suggests that the dark asteroids are carbon compounds, while polarimetry shows rough, granular surfaces. At present, Vesta is unique in showing a basaltic surface indicative of volcanism, and a pyroxene band.

Asteroids constitute a fragment population in equilibrium, the result of countless collisions since the beginning of the solar system. Although one cannot extrapolate backward to determine how their number varied in the past, some clues remain; dark ones concentrate toward the outer part of the asteroid belt, bright ones toward the inner part.

There are about 1,000 Earth-approaching asteroids more than 700 meters in diameter. The largest asteroid *crossing* Earth's orbit is 2 km in diameter.

Our knowledge of asteroids is very limited; it is unknown whether both populations originated in the main belt, whether meteorites are asteroids, or whether cometary material is involved.

Dr. Morrison concluded with brief summaries of present and future NASA planetary mission plans. ww

EXCERPTS FROM THE IAU CIRCULARS

1. October 3 — Hoffman, Marshall, and Lewin, M.I.T., observed the rapid X-ray burster MXB1730-335 with the SAS-3 from September 27 to October 3, recording 50-250 bursts per hour, each lasting 3 to 10 seconds. Seventeen slow bursts from the same region were also detected.

2. October 5 — C.W. McCracken, L.W. Brown, and R.W. Hobbs, Goddard Space Flight Center, obtained a spectrum of Comet Kohler (1977m) with the 91-cm reflector using an image intensifier. Emissions from NH, CN, C_2, (OI) and possibly C_3 were detected. The continuum was weak.

3. October 9 — H.E. Schuster, European Southern Observatory, discovered a 17th-magnitude comet in Sculptor. Comet Schuster (1977o) was diffuse, with a 20-second tail, and moving north and west.

4. December 31 — A positive leap second will be inserted in Universal Coordinated Time (UTC) at the end of 1977.

This listing courtesy R.N. Bolster.

FOR SALE

Telescope — Criterion RV-6. Seven eyepieces, including solar; camera mount and adapter; declination slow motion; end rings; built-in level; adjustable legs; wooden carrying cases. $250. Criterion variable speed control, $50. Carl Rose, (301) 933-1272 (after 5 PM); 13005 Vandalia Drive, Rockville, MD 20853.

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