



The 155-cm astrometric reflector used to discover the satellite of Pluto

The highly magnified image of Pluto showing elongation by the satellite

Captain Joseph C. Smith, Superintendent of the U. S. Naval Observatory, announced on July 7 that astronomer James W. Christy has discovered a satellite of Pluto.

In the course of astrometry using plates taken with the Naval Observatory's 155-cm astrometric reflector at Flagstaff, AZ, Christy noted a periodic elongation of the image of Pluto on April 13 and 20, and May 12, 1978. Dr. Robert S. Harrington, USNO dynamicist, noted that the apparent period was approximately equal to the 6-day rotational period of Pluto, as indicated by its 6-day magnitude variation. Since the position angle is such that eclipsing is not possible, and suggests an equatorial orbit, Harrington surmised that the circumstances indicate a satellite in synchronous rotation with the planet, the end result of tidal friction. Based upon his assumption, he calculated the position angles at the times of available earlier plates taken June 13, 15, 16, 17, and 19, 1970, and April 29 and May 1, 1965. Close agreement with Christy's independent, plate measurements corroborated Harrington's assumption of synchronous rotation, thus substantially shortening the time necessary for confirmation. On these circumstances Harrington then based predictions which were subsequently verified in detail by the U. S. Naval Observatory Flagstaff, AZ station on exposures made between June 30 and July 4, 1978, and by Dr. J. A. Graham, using the 4-meter telescope at the Cerro Tololo Interamerican Observatory in Chile on July 5, 1978.

The period of the satellite is 6.3867 days, the same as that of Pluto's rotation. Maximum elongation is 0.9 arcsecond in position angle $170-350^\circ$. The orbit is

circular at a distance of about 20,000 km from Pluto. The satellite is two to three magnitudes fainter than Pluto; Pluto is 15th magnitude.

The satellite makes possible for the first time a direct determination of the mass of Pluto, which is about 0.23 percent that of the Earth, or less than one-fifth that of the Moon. Pluto's inferred diameter is about 2500 km, that of the satellite a few hundred km.

Christy's discovery represents the first known case of a planet and its satellite having reached synchronous rotation — the ultimate condition resulting from tidal friction in both bodies. The Earth-Moon system is on the way toward that relationship; the Moon already rotates once per revolution, keeping one face toward the Earth. Tides are slowing the Earth's rotation until someday it will always keep the same face toward the Moon. The Moon's orbit will then be quite circular and equatorial, and much farther from the Earth. Through the tidal friction, the Earth's rotational energy is being converted to orbital acceleration of the Moon.

While asteroids are traditionally named for people — often the wife or husband of the discoverer — satellites are customarily named by their discoverers for characters of Greek mythology. We are told that Christy's efforts to find a *Charlene* (Mrs. Christy) in Greek mythology were not entirely successful. He did, however, find the first four letters in *Charon* (Kā-rōn), a particularly appropriate character for association with Pluto, the god of the underworld. Charon was the ferryman who shuttled to and fro about Pluto, carrying the souls of the dead across the river Styx into Hades.

Until Charon is officially recognized by the IAU Nomenclature Committee, however, the satellite will be designated prosaically, 1978 P 1.

AUGUST CALENDAR — *The public is welcome.*

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

Monday, August 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.

Saturday, August 26, 8:30 PM — *Exploring the Sky*, presented jointly by NCA and National Park Service. Glover Road South of Military Road, NW. near Rock Creek Nature Center. Planetarium if cloudy. Information: Bob McCracken, 229-8321.

Saturday, September 2, 4:00 PM — NCA picnic at Manassas Battlefield Park. See article on page 44.

JUNE LECTURE

Dr. Albert Holm, Computer Sciences Corporation, described the international Ultraviolet Explorer (IUE) satellite at the June 3 meeting of NCA.

The design goal of the IUE is to collect data on celestial UV sources in both high and low spectral resolution, with continuous real-time control. Controlled from stations at Madrid, Spain and Greenbelt, Maryland, the satellite is in a synchronous orbit above South America. The capability of real-time, interactive observation is unique to the IUE, our speaker said.

Well baffled against solar and terrestrial sources, the 45-cm Cassegrain can observe 10th-magnitude UV objects 20 degrees from the Earth. An échelle spectrograph with cross grating provides a high-resolution spectrum to a UV image sensor. The cross dispersion can be used alone for low-resolution (6Å) spectra of weaker sources. Slit-jaw reflection of the surrounding 16-arcminute field to a second television-type image sensor provides for fine error sensing or star tracking. Scans of both the object and its surround are presented. The two television cameras were furnished by England.

Following the January 21, 1978 launch, the first 60 days were devoted to calibration, operator training, and certain high-priority observations. These

GRAZING OCCULTATION EXPEDITIONS PLANNED

Dr. David Dunham is organizing observers for the following grazing lunar occultations in August. For further information call Dave at (301) 585-0989, except during August 20-27, when Wayne H. Warren, Jr. will coordinate observers. Home: (301) 474-0814, Office: (301) 982-2133.

August	UT	Place	Vis Mag	Pcnt Sunlit	Cusp Angle	Min Aper
25	06:01	Nr Richmond, VA	8.3	52	5N	6"
26	09:24	Ladysmith, VA	7.2	41	5N	2"
28	07:11	Bowie, MD	9.2	24	4N	8"
28	08:30	Doswell, VA	7.6	24	4N	2"
29	07:45	New Castle, PA	3.6	16	3S	2"

SATELLITE OF ASTEROID DISCOVERED; DUNHAM PREDICTIONS CREDITED

Dr. David Dunham's persuasion and prediction updates have led to the discovery that asteroid (532) Herculina has at least one satellite.

A June 7, 1978 occultation of the 6.2-magnitude star, SAO 120774 by the asteroid had been predicted by British astronomer G. E. Taylor, over a Pacific path inaccessible to land-based observatories. Because late updates could indicate a possibility of observation from California and Australia, Dunham surveyed the intentions of major observatories; little interest was found. An earlier occultation by Pallas, however, was widely observed in the United States and showed a large shift of the predicted path. Dunham dispatched notices and telephoned key observers in California. Dr. William Penhallow, University of Rhode Island, made several astrometric plates of (532) 32 hours prior to the occultation, from which Dunham derived final corrections. Dunham distributed the new predictions to the observers by telephone. K. Horne, Rosamond, California, J. McMahon, China Lake, California, T. Howell and M. A'Hearn, at Lowell Observatory, Flagstaff, Arizona, reported successful observations. Dunham telephoned McMahon, who reported a possible problem. His photoelectric record showed, in addition to the expected occultation, six other complete disappearances within 2 minutes before and after the main event, lasting from 0.5 to 4 seconds. Three days later, after carefully rechecking, McMahon telephoned Dunham to express his belief that his data were valid. Dunham called Howell, who was surprised, having seen no secondary occultations with the 106-cm reflector.

After phoning McMahon, Howell reexamined his photoelectric record to find a 5.2-second total occultation whose central time agreed within 0.2 second with that reported by McMahon, 92 seconds before the main event.

Horne reported that there were no secondary events at his location. From the two observed chords, Dunham calculated the diameter of the satellite to be 50 km, assuming sphericity, which placed Horne 4 km south of the south limit. Similarly, from the three observed chords, Dunham calculated the diameter of Herculina, again assuming sphericity, to be 243 km. This diameter would place Fresno, California on the occultation path. No occultation was reported from Fresno; Herculina apparently is not spherical.

Dunham announced the discovery of the satellite, designated 1978 (532) 1, on July 7, the same morning that Christy's discovery of the satellite of Pluto was announced by the Naval Observatory.

included η Carinae, in whose spectrum were found four strong emission lines between 1750 and 1950 Å, unidentified and previously unknown; the 13th-magnitude quasar 3C273; and the 12th-magnitude dwarf nova SS Cygni during an 8th to 9th-magnitude outburst.

While the IUE is in a synchronous mean orbit, its excursions between the 25-Mm perigee and the 40-Mm apogee traverse the Van Allen belts whose radiation may limit its useful life. Helm said

rbm

NCA TO HOST MERAL

The Middle East Region of the Astronomical League will convene at the Lathrop E. Smith Environmental Education Center, 5110 Meadows Lane, Rockville, MD, beginning Friday, August 18 with a 7:00 PM social.

The Saturday session will begin at 9:00 AM. After the 6:00 PM dinner, Dr. Albert Boggess, Goddard Space Flight Center, NASA, will speak on the International Ultraviolet Explorer satellite.

For further information call Daniel Lewis, (301) 881-1834.

NCA PICNIC AT MANASSAS BATTLEFIELD PARK ON SEPTEMBER 2

Bring your picnic dinner, telescopes, and guests, and enjoy another NCA outing at Manassas Battlefield Park on Saturday, September 2, at 4:00 PM.

Go west on I-66 approximately 17 miles from the Beltway to Route 234, right on 234 1.7 miles to the site on the left. Follow the dirt road to the picnic tables. Picnic will be held regardless of weather short of rain at the time.

EXCERPTS FROM THE IAU CIRCULARS

1. June 2 — Grindlay, Center for Astrophysics, and McClintock, Canizares, and van Paradijs, MIT, detected two optical bursts from the X-ray burster MXB1735-44 with the 150-cm reflector at Cerro Tololo. An X-ray burst coincident with the second optical event was observed with the SAS-3 spacecraft.

2. June 7 — Predictions by Taylor and Dunham of the occultation of SAO 120774 by (532) Herculina resulted in successful observations of the event by Bowell and A'Hearn at Lowell Observatory, McMahan near Boron, CA, and Horne near Rosamond, CA. A second occultation was seen from Lowell and Boron, indicating the presence of a 50-km companion 975 km from Herculina.

3. June 27 — Polidan, Princeton University, Sanford, White and Pollard, University College, London, and Locke, Appleton Laboratory, reported that Copernicus satellite data indicate that the eclipsing binary star V861 Scorpii is also an eclipsing X-ray source. The X-ray eclipse occurs when the type B01a primary star occults the optically invisible secondary.

4. July 7 — J.W. Christy, Naval Observatory, reported confirmed elongations of images of Pluto indicating the presence of a satellite having a period of 6.39 days.

STAR DUST may be reproduced with proper credit to National Capital Astronomers.

* S T A R D U S T



Published eleven times yearly for NATIONAL CAPITAL ASTRONOMERS, INCORPORATED, a non-profit, public-service organization promoting interest and education in astronomy and related sciences. President, James H. Trexler. *Star Dust*: Robert H. McCracken, 5120 Newport Avenue, Washington, DC 20016. Deadline: 15th of preceding month.

FIRST CLASS MAIL