cals is required if cancer is to develop.

Evidence implicating saccharin and sodium cyclamate as promoters rather than as true carcinogens comes from the laboratory of R. Marian Hicks at the Middlesex Hospital Medical School in London. In the absence of a carcinogen, Hicks and her colleagues found a very low incidence of bladder tumors in animals fed the sweeteners. In Hicks' cautious words, the incidence was "so low that it cannot be stated unequivocally that either sweetener is a solitary bladder carcinogen." The incidence of bladder tumors was very high, however, in ani-

New Moons: Encounters of the Serendipitous Kind

Earthbound planetary astronomers, who are forced to peer through a turbulent atmosphere and then across millions and billions of miles of space, obviously must take second place in some cases to the wave of unmanned probes that are sweeping the solar system. But it appears that less glamorous telescopic observations can still lead to unexpected significant discoveries. Recent confirmed telescopic discoveries include the rings of Uranus, which continue to pose difficult problems of celestial mechanics, and an asteroid-like body, Chiron or Object Kowal, circling the sun in an unlikely orbit beyond Saturn. Two more telescopic discoveries were announced on 7 July, a proposed moon of Pluto and a possible moon of the asteroid Herculina, the first ever suggested for such a small body.

Like the earlier finds, these were stumbled upon while the observers were intently studying something entirely different. James Christy of the U.S. Naval Observatory (USNO) was attempting to measure more accurately the orbital characteristics of Pluto when he noticed a small bulge in its image on a series of photographic plates taken through the USNO's 155-centimeter telescope at Flagstaff last April and May. After satisfying himself that poor atmospheric conditions or faulty tracking by the telescope were not to blame, he checked plates of Pluto taken in 1965 and 1970 and found seven that showed the same phenomenon. Christy then decided that the bulge was a moon so close to Pluto that it could be noticed only when they were at their greatest apparent separation. Using the 1978 observations and reported variations in the brightness of Pluto to estimate the period of revolution, Robert Harrington, also of USNO, was able to predict future appearances of the bulge as well as explain its appearance in the past.

Initial reaction to the announcement of a Plutonian moon seemed to depend on the availability of the USNO plates. Those who have seen them are convinced of the reality of the proposed new satellite, while those who have not tend to remain "interested but not convinced," as Daryl Mulholland of the University of Texas at Austin describes himself. Explaining his own hesitation, Mulholland points out that the apparent separation of Pluto and its proposed satellite, now estimated to be 0.8 second of arc, would be difficult to distinguish even under the best of viewing conditions. Some of those hesitating to accept the claim would prefer that the two bodies be completely resolved photographically or subjected to more sophisticated instrumental analysis. Unfortunately, the opportunity to gather new data, as opposed to searching photographic archives, passed for this year shortly after the announcement, when Pluto moved too close to the sun in the sky.

Apart from confirming unequivocally the existence of a satellite, better data would help further refine estimates of Pluto's mass. The interrelated properties of mass, diameter, and density have never been known accurately for Pluto, it turns out, although estimates predate the discovery of the planet. Its mass was first estimated as ten times that of the earth, but that value plummeted by the early 1970's to about 17 percent of the earth's mass at most. Using a distance of 17,000 kilometers estimated from the USNO photographs as the separation of Pluto and its moon, the observed period of revolution, and Kepler's Third Law, Harrington has calculated that the mass of the planet-moon system is more like 0.17 percent of the earth's mass. The actual separation is still rather uncertain, falling somewhere between 15,000 and 20,000 kilometers, according to Harrington. The effect of this uncertainty on the estimated mass is considerable, since it is the cube of the separation that enters the calculations. Improvements will probably be made when Pluto again moves into a better sky position, but the ultimate accuracy of the determination remains to be seen.

Whatever the end result is, Pluto is likely to be the smallest of the major planets. Dale Cruikshank and his colleagues at the University of Hawaii have made an estimate of 3000 kilometers for its diameter on the basis of its reflectivity (*Science*, 23 April 1976, p. 362). This estimate was based on the assumption that Pluto was a single body. Harrington suggests that the moon is only two to three times smaller than Pluto, whose diameter would thus be even smaller than Cruikshank's estimate. Apparently, Pluto forms a "double planet" with its satellite. By comparison, Mercury has a diameter of 4680 kilometers, whereas Pluto's nearest neighbor, Neptune, has a diameter of 44,800 kilometers. Mulholland quips that, if the satellite does exist, the pair might better be considered a "double asteroid" system.

Just such a system has been suggested by Edward Bowell of Lowell Observatory as the most reasonable explanation of observations made by him and Michael A'Hearn at Lowell, and by Keith Horne of the California Institute of Technology and James McMahon, an amateur, in two locations in California. They were hoping to measure the diameter of the asteroid Herculina during its occultation of a star. In addition to the predicted single blinking out of the star as Herculina passed in front of it, a secondary extinction was observed 2 minutes before the predicted occultation at two of the three locations. The observations, including the failure to see the secondary extinction at one location, are consistent with Herculina having a satellite with a diameter of 46 kilometers, about one-quarter that of Herculina itself, at a distance of 977 kilometers. Bowell favors this explanation but acknowledges that other objects in the vicinity of Herculina might have been responsible. Visual confirmation is probably impossible, but more data on similar phenomena may be available from other anomalous occultation observations that have been reported recently. In any case, both Pluto and the asteroids will be receiving particular attention in the near future from earthbound planetary astronomers.—RICHARD A. KERR

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