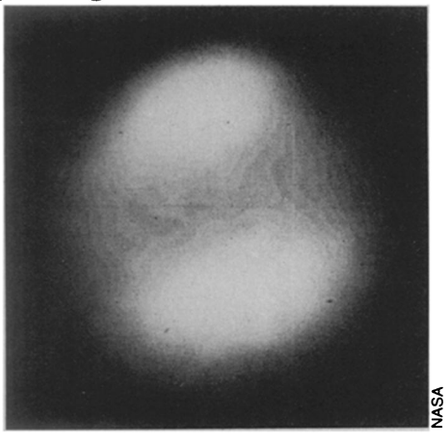
SPACE SCIENCES

Jonathan Eberhart reports from Clayton, Mo., at the annual meeting of the Division for Planetary Sciences of the American Astronomical Society

Neptune: Capturing the clouds



NASA

Neptune, about 30 times farther from the earth than is the sun and three times farther even than Saturn, the next most distant planet, is an understandably difficult target to observe through earth-based telescopes. Nevertheless, a team of scientists at the University of Arizona have taken its picture clearly enough for them to discern what they call "discrete cloud features" in the distant world's atmosphere (SN: 11/3/79, p. 308).

The images were made using a camera built around a detector called a charge-coupled device, or CCD, consisting of a 500-by-500 array of individual light-sensitive elements, or "bins," that are read out sequentially to form the picture. A CCD camera will be aboard the planned Galileo Jupiter orbiter, and another will be used for wide-field and planetary observations aboard the 2.4-meter Space Telescope, to be launched into earth orbit by the Space Shuttle.

The Neptune photos were made through the university's 1.54-meter Catalina telescope, recording light reflected from the planet at the characteristic methane absorption bands of 7,260, 8,900 (shown) and 10,000 Angstroms. (Lower contrast in images made at wavelengths between the methane bands indicates that the features are indeed defined by methane absorption.)

The photos show a pronounced dark band across Neptune's equator, separating two bright regions. The northern-hemisphere feature, the researchers report, appears "longitudinally resolved," suggesting that it is a relatively narrow region, while the southern feature appears to cover much of that hemisphere south of about 30°S latitude. The bright features, says H.J. Reitsema (who collaborated in the work with B.A. Smith and S.M. Larson) probably represent high-altitude clouds of methane ice crystals, which overlie the gaseous methane that does the absorbing. In 100 minutes of observation, the features appeared to be rotating in the prograde direction, consistent with the planet's presumed direction of rotation on its axis.

Venus: Bollixing Bode's law

A rule of thumb for predicting the strength of a planet's magnetic field has been the "magnetic Bode's law," according to which a planet's magnetic moment is proportional to its angular momentum. Saturn's magnetic moment, however, was recently shown by Pioneer 11 to be weaker than the "law" predicted, and now Venus looks like another trouble-maker. The law predicted a magnetic moment for Venus of about 5×10^{22} Gauss per cubic centimeter, says James A. Slavin of the University of California at Los Angeles, but data from the Soviet Venera 4 craft in 1967 cut the figure to an upper limit of only half that amount. Now, Slavin says, the Pioneer Venus orbiter has lowered the boundary about another seven-fold, to $3.6 (\pm 3.6) \times 10^{21}$, which is about one 20,000th of earth's and which includes an uncertainty that is at least consistent with Venus having no intrinsic magnetic field at all. "The magnetic Bode's law," he notes, "is beginning to look like a worse and worse predictor of what planetary magnetic fields actually are."

Mars: Volcanic cosmetics

Unlike the earth, most of whose surface is either covered by oceans or being constantly eroded by weather, Mars still presents much of its ancient surface to view. A major factor in determining the planet's present appearance has been its long history of volcanic activity, which has left flow scarps, wrinkle ridges, basaltic flood plains, lava channels and numerous pits and calderas. Analyzing such features in photos taken by the two Viking orbiters, Ronald Greeley and Stephen Spudis of Arizona State University have concluded that such volcanic doings have been significant indeed, possibly resurfacing nearly two-thirds of the planet.

From the photos, they added up such presumably volcanically modified features as the Martian intercrater plains (18.6 percent of the surface of Mars), the "flood lavas" of Chryse Planitia (5.6 percent) and others. A best estimate, they report, is that volcanic activity has resurfaced some 59.4 million square kilometers of the planet, or 41.3 percent of its surface. If one includes the more ambiguous morphologies of the northern plains as well as some other plains regions characterized by fracturing and erosion, the total could be as high as 92.7 million square km, or 64.4 percent of today's visible Mars.

Asteroids: Moonwatch

One of astronomy's current controversies, with strong opinions on both sides, concerns the possibility that some asteroids may have their own natural satellites. Some astronomers think the idea improbable at best, while others believe that evidence for it already exists in the form of several instances in which observers noting the occultation of a star by an asteroid have reported the occurrence of "secondary occultations," as though some other object near the principal asteroid had also blocked the star's light. But Alan W. Harris of Jet Propulsion Laboratory believes that, in a sense, both groups are wrong.

First of all, Harris asserts, the idea is far from impossible. "If we looked at the 10 or 20 biggest asteroids and didn't find a satellite," he says, "I'd be a bit surprised." Asteroid satellites bigger than about 20 kilometers, he calculates, could have survived in stable orbits around larger asteroids for the age of the solar system, neither escaping nor crashing into their host objects. (This is at odds with previously published calculations by other researchers, who concluded that such orbits could probably last for only tens of millions to hundreds of millions of years. This would make any extant asteroid satellites relatively recent phenomena, supporting the idea that the asteroid belt between Mars and Jupiter formed about that long ago from the destruction of a single, large "parent body.")

Harris also disagrees, however, with claims that the evidence is already in hand in the secondary-occultation reports. "The maximum density of satellites which can exist in mutually stable orbits about an asteroid," he says, "would yield a low probability of even one secondary occultation event by a single observer placed along the track of a primary occultation by an asteroid." The chance, he maintains, would be as low as 1 in 25 or 1 in 50, and the odds of seeing two or more secondary events — which would require the asteroid's path in front of the star to be precisely aligned with the plane of the satellites' orbits — shrink to 1 in 1,000 or less.

The required confirmation, he says, would be a case in which such a multiple occultation has yielded a clear photometric record to two or more observers in different locations, thus indicating that the secondary events are real and demonstrating that they really represent objects orbiting the asteroid. The other approach would be to wait until the shuttle-borne Space Telescope is in orbit around the earth, and take an actual look.