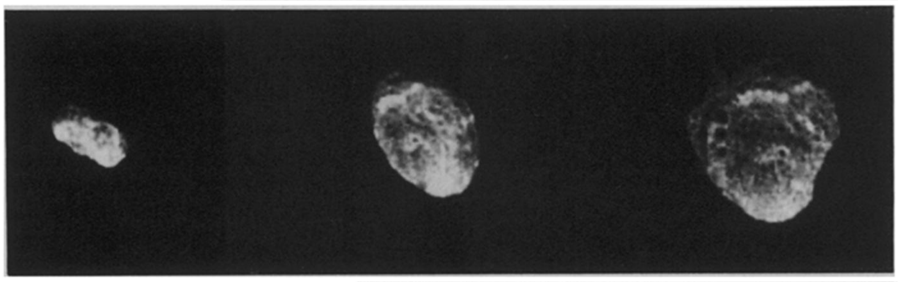
SCIENCE NEWS OF THE WEEK

Voyager 2's Saturn: Still Surprising

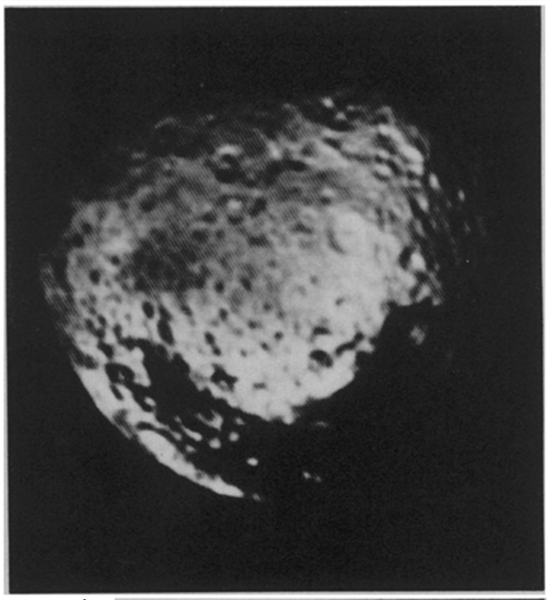
The Voyager 2 spacecraft's close encounter with Saturn began amid a disconcerting combination of excitement at the planet's still-unfolding mysteries and gloom at the realization that it was to be the last U.S. planetary encounter until the same probe reaches Uranus in 1986. Saturn, with its amazing rings and diverse moons, kept the throng at Jet Propulsion Laboratory in Pasadena, Calif., wide-eyed with amazement during the early part of the flyby — until a spacecraft problem almost exactly at the mission's climax threatened at least temporarily to cripple the rest of the endeavor.

Right: Bright arc behind Saturn's rings (left) is sunlight reaching planet through Cassini division.

Clicking off scientific observations minute by minute as it zoomed toward the planet and its at least 17 recognized satellites, the spacecraft was already traveling at more than 40,000 kilometers per hour and still accelerating when it encountered the bizarre first target on its list: Iapetus. Earth-based observations had long puzzled astronomers by indicating the object's trailing hemisphere (in its orbital motion) to be five to six times brighter than its leading face. Besides revealing a heavily cratered and apparently ancient surface, Voyager 2 showed the difference in reflectivity to be far greater — perhaps 15-fold or more, like that between clean, shiny snow and lampblack. Various ideas have been proposed to account for the odd asymmetry, including a recent suggestion by the University of Hawaii's Dale Cruikshank and colleagues that the ice comprising most of Iapetus (whose density was measured by Voyager 2 to be 1.1 ± 0.1 grams per cubic centimeter) could be mixed with some dark carbonaceous chondrite material that has been exposed on the leading hemisphere by bombardment of material from Phoebe, the next satellite out.

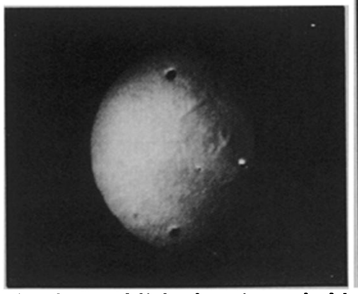


Above: Hyperion's strange disk shape is revealed in photos taken by approaching Voyager 2.



Right: cratered Iapetus.

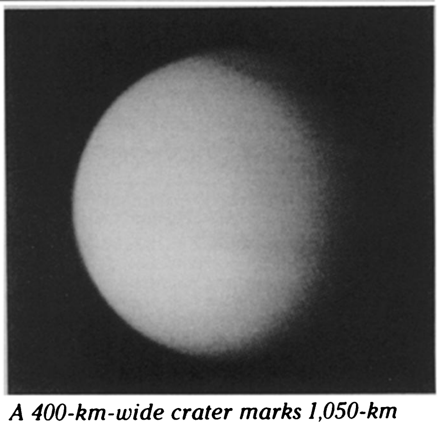
Below: Titan's dark polar hood is now a collar.



Then came Hyperion, once presumed to be an undistinguished little moon — until Voyager 2's cameras showed it to be roughly in the shape of an oblate disk, measuring about 200 by 300 kilometers and 100 kilometers thick. Stranger still, however, was its orientation. Such an object would normally be expected to be rotating on its short axis, with its long axis pointing toward Saturn. Instead, early looks suggested that Hyperion might be tilted so that its rotation axis passes through it at an angle — a presumably unstable situation. Further analysis was still underway at SN's deadline, with scientists uncertain as to whether the cockeyed moon was wobbling from an impact or had simply established an improbable sort of equilibrium.

Titan, of great interest because of its dense atmosphere but a limited photo target because of that atmosphere's surface-hiding smog, did reveal a change when the dark polar hood photographed by Voyager 1 turned out to have evolved into a ringlike collar.

Then there was Tethys, about 1,050 km in diameter, which revealed, on a side unphotographed by Voyager 1, a vast crater fully 400 km across. The earlier flyby had showed a proportionately large crater on another Saturnian satellite, Mimas, but the whole of little Mimas would fit into Tethys' great scar. However, noted imaging team leader Bradford Smith of the University of



A 400-km-wide crater marks 1,050-km Tethys.

Arizona, "Mimas had a lot closer call than Tethys did," since the smaller satellite would have had less strength to resist being shattered from its mighty blow.

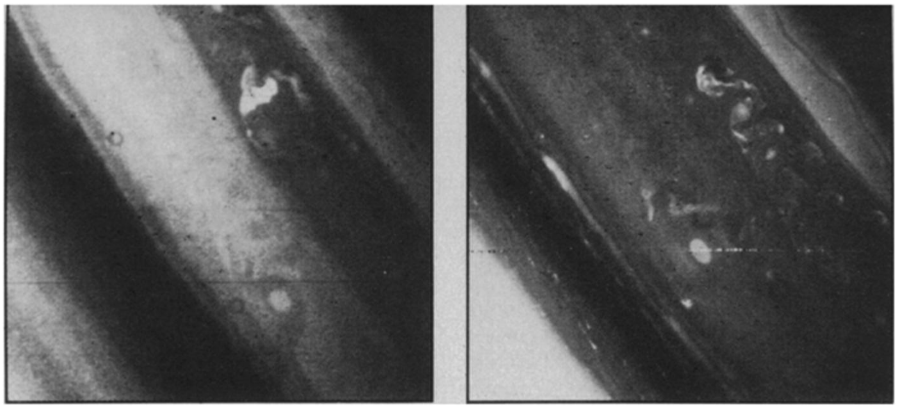
Not all of the Saturn system's aspects were grist for Voyager 2's cameras. The planet's magnetic field, associated with radiation belts, radio emissions and other phenomena, has been of particular interest, in part because it was hypothesized that the spacecraft might find Saturn immersed in a filament of Jupiter's extended magnetic tail. At least eight times, Voyager 2 apparently passed through the Jovian tail on the way to Saturn, and a consequence of such immersion might have been to block out the solar wind and thus eliminate the conspicuous "bow shock" formed where the supersonic solar wind encounters the Saturnian magnetosphere. But the spacecraft did find such a shockwave, implying to Frederick Scarf of TRW that Jupiter's tail, weak and variable so far from its source planet, was elsewhere during the flyby.

Saturn itself was also a source of surprises. "The weather," said Garry Hunt of University College, London, "has absolutely changed." Since Saturn takes nearly 30 years to circle the sun once, the seasonal change in the nine and a half months between the visits of Voyagers 1 and 2 was the equivalent of barely a week on earth. One large, white spot in the northern hemisphere, thousands of kilometers across, had completely lost its dark border; huge, irregular storm systems had evolved into entirely new shapes—yet they did remain visible, suggesting that, as on Jupiter, such storms are much longer-lived than their counterparts on earth.

Such studies were made easier by the fact that the vidicon tubes in Voyager 2's cameras, selected from a presumably identical group made available by the manufacturer, have turned out to be as much as twice as sensitive as those aboard Voyager 1. This has also enabled Voyager 2 to discover far more detail in the Saturnian cloud tops, including vast numbers of individual circulation patterns in the polar regions, which appeared far less turbulent in the less discriminating eyes of the previous craft. The better cameras further allowed Voyager 2 apparently to dispel a misconception about the cause of Saturn's overall blandness compared to Jupiter. Many researchers had assumed the culprit to be a cold, high-altitude haze that washed out the colors and hid small-scale circulation features. The new improved photos, however, showed the brightness contrasts in cloudtop patterns to remain the same even over at the planet's limb or edge (see cover), where the angled viewing path would make such a haze seem the thickest and most opaque (it does show up in ultraviolet light). The generally muted tones, says Smith, may instead be due simply to the better mixing of the materials that give the atmosphere its colors.

The star of the show, however, was Saturn's incredible ring system, discovered by Voyager 1 to include hundreds of individual, thin ringlets. Voyager 1's two most baffling discoveries, in fact, were the multi-stranded, seemingly "braided" appearance of the thin, outer F-ring and the "spokes" apparently formed radially across the wide B-ring. Voyager 2's detailed photo-studies of both phenomena were still in progress at SCIENCE NEWS's Aug. 25 deadline, but it was already clear from the improved images (also aided by better lighting conditions) that the hundreds of ringlets were more like thousands. Then a quick look at a photometric recording of the light of the star Delta Scorpii as it blinked on and off behind the ring system suggested that the number might be higher still. One quandary at the time was the failure to detect any of the small "moonlets" hypothesized to lie between the ringlets and to account for their separation.

Just after the spacecraft flashed through the plane of rings, however, flight controllers discovered that the moveable platform carrying the cameras and three other instruments was stuck. At press time, with the rest of the mission at stake, the situation was a cliff-hanger. □



Cloud feature changes show in Voyager 1 and 2 photos taken of the same region nine months apart. Bright oval in lower right of each frame is about 2,500 km long.

Bone loss and vitamin D hormone deficiency

The causes of osteoporosis, a bone loss common in older women that leads to fractures, are being slowly discovered. For instance, because osteoporosis affects women most severely once they pass menopause and the condition can be improved with estrogen therapy, it is thought that inadequate estrogen production is probably one of the factors predisposing to osteoporosis. Calcium deficiency also has been implicated in osteoporosis, since intestinal absorption of calcium is lower in osteoporotic patients than in healthy subjects and dietary supplements of calcium seem to be almost as effective as estrogen therapy in decreasing osteoporotic bone loss. Now another determinant of osteoporosis appears to have been identified, David M. Slovik of the Massachusetts General Hospital in Boston and colleagues report in the Aug. 13 NEW ENGLAND JOURNAL OF MEDICINE: It is a deficient secretory reserve of 1,25-dihydroxyvitamin-D, the active vitamin D hormone, in the kidneys.

When vitamin D is consumed as a vitamin it is first converted in the liver to 25-hydroxyvitamin D. Then the kidneys change that compound into 1,25-dihydroxyvitamin D. Two recent studies found that osteoporotic patients have lower levels of active vitamin D hormone in their blood than do healthy subjects, implying that a defect in kidney secretion of this hormone has a place in the development of osteoporosis. A third study didn't show such a finding. Slovik and his colleagues attempted to resolve the question with their own investigation. First they measured the blood levels of active vitamin D hormone in six healthy volunteers ages 22 to 44 years and in five osteoporotic patients ages 50 to 80 years, then gave each of them a 24-hour infusion of parathyroid hormone, which is made in the parathyroid glands and useful in evaluating active vitamin D hormone secretion from the kidneys into the bloodstream.

There was no statistical difference in blood levels of active vitamin D hormone between the controls and patients prior to parathyroid hormone infusion, Slovik and his co-workers found. During parathyroid hormone infusion, however, blood levels of active vitamin D hormone nearly doubled in controls, but did not change significantly in patients. So this study, like two previous ones, suggests that a deficient secretory reserve of active vitamin D hormone in the kidneys may play a role in osteoporosis. The challenge now, Slovik and his colleagues say, is to determine whether such a deficient reserve is unique to osteoporotic victims or common to many older persons.

Meanwhile, the therapeutic effects of active vitamin D hormone on osteoporotic patients should be carefully evaluated, Slovik and his team contend. In 1979, for example, Christopher Gallagher and Lawrence Riggs of the Mayo Clinic, along with Hector F. DeLuca of the University of Wisconsin, preliminarily reported that the hormone helped osteoporotic patients (SN: 3/24/79, p. 181). That study is now finished, and the final results still look good, DeLuca told SCIENCE NEWS. □