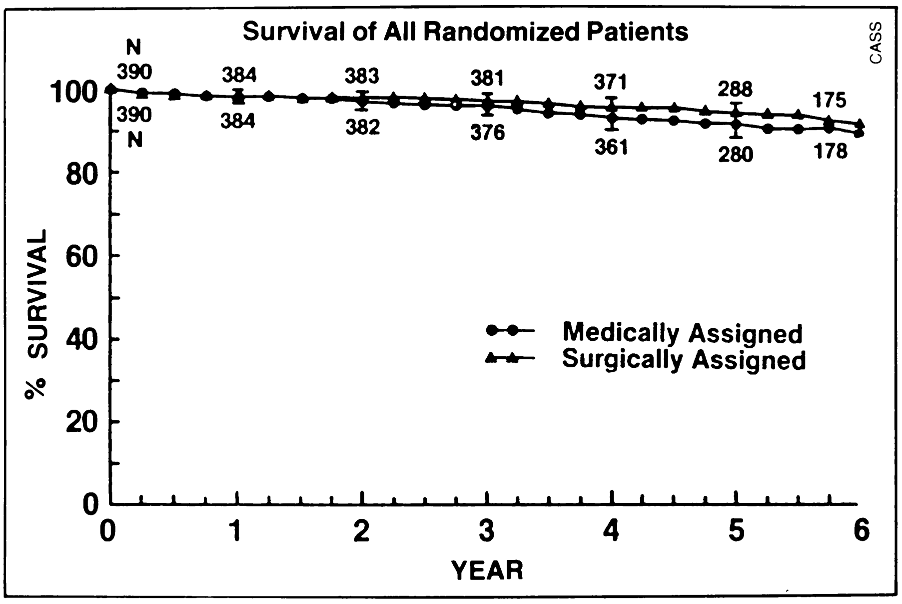


any impact on medical practice, at least one physician thinks they won't. Cardiologist Bernadine Healy Bulkley, director of the coronary care unit and professor of medicine at the Johns Hopkins Medical Institutions in Baltimore, Md., said, "In many institutions it won't change what happens. For instance, here we never operate upon patients like these [in the study]. I'd say more than 50 percent of cardiologists do not recommend surgery for these patients." —*J. C. Amatniek*

Around and around with planetary rings

Even Galileo, with his primitive telescope at the beginning of the 17th century, could see the strange shapes flanking the disk of Saturn, though it would be nearly 50 years before they were concluded to represent a ring. The dark, narrow rings of Uranus eluded discovery until 1977, when their presence was revealed by their blockage of a star's light. It took a close-up look by Voyager 1 in 1979 to show Jupiter's rarified ring, which appeared as a thin streak in a single one of the spacecraft's thousands of photos.

Additional data, and improved ways to analyze them, have since revealed some of the complex and exotic details of these ringed worlds, but the questions still vastly outnumber the answers. At the recent annual meeting of the American Astronomical Society's Division for Planetary Sciences in Ithaca, N.Y., for example, it was clear that new surprises continue to abound.

Jupiter's ring has been taken to be a thin disk, far less substantive than the Saturnian ring system, possibly extending all the way in to the Jovian cloud tops from a bright outer edge. Now, however, Joseph H. Burns and Mark R. Showalter of Cornell University in Ithaca, together with Jeffrey N. Cuzzi and James B. Pollack of the NASA Ames Research Center in Mountain View, Calif., have proposed that it is not a disk at all but a doughnut-shaped torus, perhaps 10,000 kilometers thick at its maximum and about 15,000 km in radial width, with a thin, bright ring around it. The doughnut's thickness, the researchers hypothesize, is due to the fact that small particles would be perturbed out of the ring's equatorial plane by Jupiter's tilted magnetic field. Voyager 2, which took most of the photos, was looking down at the ring from only 2° out of the horizontal, says Burns, so the line of sight through the bulging doughnut's near and far sides made it appear like a continuous disk.

There is also a gossamer-thin disk-like portion, however, the authors report, based on special processing of a few of the photos. But it is outside, not inside, the bright band, and appears to extend about 4,000 km to the orbit of the satellite Amalthea, which probably defines the ring's periphery.

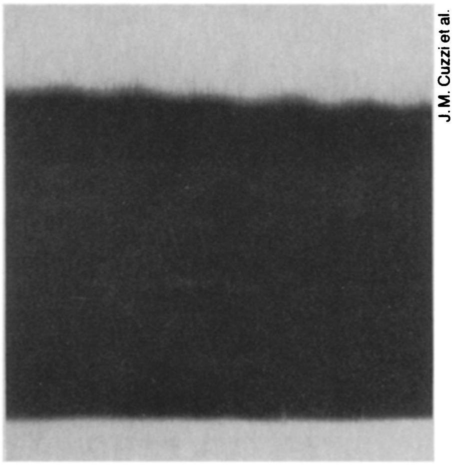
Saturn's rings, too, appear to have a "gossamer" portion, filling the region between the outer edge of the wide A-ring and the narrow F-ring beyond it (whose "braided" appearance in some Voyager 1 photos is still a mystery).

Another unresolved issue in the study of Saturn's rings is the search for several tiny "moonlets" that have been hypothesized to account for some of the circumferential gaps in the ring system. Cuzzi and others combed photos of one such gap, called the Cassini division, between the A- and B-rings, for "embedded" moonlets that might have been keeping it open, but found none down to their resolution limit of about 5 km diameter. Along the edges of the A-ring's Encke division, however, Cuzzi and colleagues have now found regions with a wavy, scalloped appearance which Cuzzi says is just what would be produced by the gravitational effects of moonlets. Unfortunately, although the Voyager photos show enough scalloped regions to suggest the presence of three or more moonlets about 20 km across, the presumed moonlets are all just off-camera in any photos sharp enough to show them.

One of Saturn's major ring mysteries is the strange, "spoke-like" features shown by the Voyagers to be forming radially across the rings (mostly the B-ring), each disappearing after a few hours' existence. Possibly formed by electrostatically charged particles levitated out of the ring plane, they have seemed to start distorting almost as soon as they appear, as particles at different radial distances from Saturn move at different orbital velocities by the established laws of Keplerian motion. Yet now, Bradford Smith and colleagues from the University of Arizona in Tucson have identified a spoke or two that seem to avoid Keplerian laws at first, growing radially while rotating with Saturn's magnetic field. Perhaps, he suggests, whatever charges the particles in the first place (a localized plasma cloud?) keeps them charged enough to remain under the magnetic field's influence for a while, until the weakening charge lets Kepler enter the fray. The best example, he says, held out for about two hours.

And Voyager 2 is on its way to Uranus.

—*J. Eberhart*


J. M. Cuzzi et al.

Voyager photo shows a scalloped edge along the inside of the Encke division in Saturn's rings, possibly due to waves caused by gravitational effects of an otherwise undetected "moonlet" (which would be out of photo to the left) in the gap. The waves would be propagating along perhaps 20° to 40° of longitude "downstream" from the little moon, while other waves propagate upstream along the gap's outer edge. To make the scallops more visible, the photo has been computer-processed to exaggerate their amplitude about 10-fold, as well as to straighten out the gap's (and the rings') normal curvature. The distribution of scalloped areas suggests that there may be three more more such moonlets in the gap, though the moonlets' proposed locations, frustratingly, seem not to have been photographed at high enough resolution to reveal them.