monocot protoplasts, denuded cells that have been stripped of their cell walls.

In a last-minute addition to the congress program, Michael Fromm, who works with Loverine Taylor and Virginia Walbot at Stanford University, described his group's achievement in introducing an antibiotic resistance gene into maize protoplasts. The investigators used a technique called "electroporation" that is becoming generally popular for gene transfer. The method involves subjecting cells to an electric current that induces the formation of transient membrane pores through which large molecules may pass.

Simply incubating protoplasts with the DNA to be transferred can also work. Horst Lörz and his colleagues at the Max Planck Institute in Cologne have transformed protoplasts of the primitive wheat *Triticum monococcum* with an antibiotic resistance gene by this method, and Ingo Potrykus and his colleagues at the Friedrich-Miescher-Institute in Basel, Switzerland, have done the same with protoplasts of the ryegrass *Lolium multiflorum*. The efficiency of gene transfer may be better with electroporation, however.

Transformation of monocot protoplasts is thus becoming a reality. The main problem remains the difficulty in regenerating whole plants. There is a bit of a paradox here. Whole monocot plants can be regenerated from some types of cells, particularly those derived from embryonic tissue, but these cells have walls and investigators have not been able to get foreign DNA into them. They can now introduce new DNA into protoplasts, but as Edward Cocking of the University of Nottingham, England, points out, "No publication clearly states that you can go from protoplasts to whole plants in monocots."

Indra Vasil of the University of Florida in Gainesville described the apparent regeneration of sugarcane plants from protoplasts, but during the discussion period was closely questioned about whether he had eliminated the possibility that the plants might have been derived not from transformable protoplasts but from small clumps of cells that had retained their walls. Vasil maintained that the experiment had indeed been carefully done to exclude that possibility.

The new demonstrations of transformation of monocot protoplasts should provide additional impetus for investigators to solve the long-standing regeneration problem. If that can be done, it would put genetic engineering of monocots on the same firm footing as that of the dicots.—**Jean L. Marx**

Neptune's Ring Arcs Confirmed

No one claims to know what it is exactly, but for the time being astronomers are calling it an arc. Its reality seems certain, although its exact location about Neptune, its extent, and its very nature remain unclear. There may even be more than one of this new sort of partial or broken planetary ring. Astronomers have again detected the arc that was reported earlier this year and possibly a nearby arc, while clearly demonstrating how abrupt the breaks are in Neptunian broken rings.

At the recent annual meeting of the Division for Planetary Sciences of the American Astronomical Society in Baltimore, four groups of observers* reported on the latest efforts to catch Neptune's mysterious arc as it passes in front of a star. Three such stellar occultations by an arc have now been detected in addition to the discovery event of July 1984†. No one has yet succeeded in recording a conventional set of ring occultations at Neptune, when a star blinks once as it passes inside a ring as viewed from Earth and again when it passes to the outside of the ring. With Neptune, it has always been one event or the other, if anything happens at all. Perhaps one out of seven observations of a star passing close to or behind the planet will detect any arc occultation at all.

Most of the Neptunian ring or rings may be missing, but when caught in front of a star their effect is a normal one and fairly consistent. An arc blocks 15 to 40 percent of the light of the star. The durations of the dimming require an arc width of 8 to 23 kilometers. Such opacities and widths are similar to those of most of the nine complete rings around Uranus. How many arcs Neptune has is not certain, but it would appear that at least two are required if they are in the equatorial plane—one at a distance of about 54,000 kilometers and another at roughly 66,000 kilometers.

What is particularly striking about the arcs, aside from their existence, is how abruptly they come and go. Corbin Covault of the MIT group reported that the star of the 7 June 1985 occultation turned out to be a double star, only one of which passed behind a detectable arc. Presumably, by the time the second star passed behind the orbit of the arc about 5000 kilometers farther along its 400,000-kilometer circumference, the particles constituting the arc had thinned out to the point of undetectability. Likewise, Lawrence Wasserman of Lowell Observatory at Flagstaff failed to detect an occultation on 20 August when the Cornell/Caltech and European groups recorded the same unmistakable event through separate telescopes farther south in Hawaii, implying a disappearance of the arc over a space of no more than 4000 kilometers.

Relatively frequent reports of the detection of the ends of arcs suggest that there is more than one arc per orbit, in effect clumps of particles separated by empty space or an undetectably tenuous ring. Mark Showalter of Cornell University and his colleagues reported at the meeting that the clumpy ringlet in the Encke gap of Saturn, a possible analog of the Neptune arcs, must have a single moonlet embedded in it. The moonlet revealed its presence by gravitationally creating a wake in the ring outside the gap. The moonlet would plow back ring particles to keep the gap open, as shepherding moonlets are thought to confine the Uranian rings, and possibly share its orbit with ringlet particles, as proposed early on for the Uranian rings by Stanley Dermott and Thomas Gold of Cornell University.

Other possibilities for the form and confining mechanism of the Neptune arcs are numerous—a recently disrupted satellite, shepherded complete rings of varying width and thus opacity, or an inclined ring. In the first formal proposal, Jack Lissauer of the University of California at Santa Barbara has pointed out that an arc might be confined ahead or behind an unseen satellite (at its L4 or L5 Lagrangian points) by a single shepherd inside or outside the satellite's orbit‡.—**Richard A. Kerr**

*MIT group, led by J. Elliot; Cornell/Caltech group, led by P. Nicholson and K. Matthews; European group, led by A. Brahic, Observatory of Paris, Meudon; F. Vilas and W. Hubbard, University of Arizona.
†A. Brahic *et al.*, *Nature (London)*, in press.
‡J. J. Lissauer, *ibid.*, in press.