The Rings of Uranus: News and Views

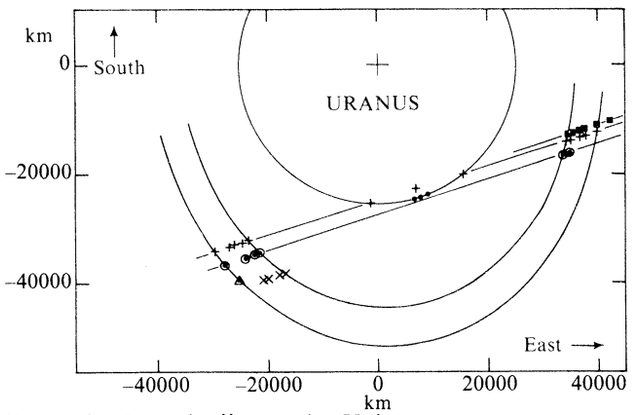
The completely unexpected discovery of what appear to be rings around the planet Uranus has produced as much excitement among astronomers and others as any solar-system find in recent years. The discovery took place on March 10, when observers in various parts of the world, waiting at their telescopes for a star to be blocked off or occulted by Uranus, saw the star first "blink on and off" several times and later repeat the trick after the planet had passed (SN: 3/19/77, p. 180). Since then, the original observers and others have been looking back through earlier data for possible signs of the rings' presence, and at the same time trying to understand what seems to be their surprising configuration.

Among the best photos ever taken of Uranus are a series made through a 91-centimeter telescope that was carried by a balloon to an altitude of about 24 kilometers in March 1970 as part of a project called Stratoscope II. The resulting images were processed (deconvolved) by the late Robert E. Danielson of Princeton, Martin G. Tomasko of the University of Arizona and B.D. Savage of the University of Wisconsin, and published in 1972 in the ASTROPHYSICAL JOURNAL (178:887). The researchers were looking for possible belts or other features on the planet itself, and had no idea that the rings might exist.

Now at least two other researchers, William Sinton of the University of Hawaii and Giuseppe Colombo of the University of Padua in Italy, believe that the deconvolved images show what may be the actual shadow of the rings on the planet. Danielson and his colleagues found only hints of the kinds of features they were then seeking, but, says Sinton, "it does appear . . . that the Stratoscope II photographs recorded the projection of the rings on the disk of Uranus."

Some other scientists who have also looked back at the Stratoscope photos are less certain that the ring-shadow is really there, as opposed to, say, an artifact of the image processing. Following the original discovery, several researchers felt that the planned orbiting Space Telescope, or even a visting spacecraft, might be necessary to make the extremely thin rings visible. The Stratoscope photos, however, are not the only ones that show promise.

Last year, several images of Uranus were made through the 61-inch telescope at the University of Arizona's Mt. Lemmon Observatory in the first formal astronomical application of a relatively new and extremely sensitive detector called a charge-coupled device, or CCD (SN: 3/12/77, p. 169). While the rings may or may not be there—at least they're



The inner and outer rings of Uranus, deduced from stellar occultations reported from the March 10 event by six groups of observers.

"down in the noise," says the University's Bradford Smith—the sensitivity of the CCD makes it possible to conclude that the ring particles must be very dark, with a reflectivity of only a few percent. If current estimates of the rings' density and widths are correct, Smith reports in NATURE (July 7), then the average reflectivity of the individual particles must be "much closer to that of carbonaceous chondritic material than to the ice-coated particles in the rings surrounding Saturn."

Furthermore, Smith has also rephotographed the planet with the CCD in 1977, using improved supporting electronics and longer exposures. It is too early to be sure, but a preliminary look at the new data suggests that this time the rings may actually have shown up.

Several researchers, meanwhile, have been combining data from the various observations of the March 10 occultation to improve estimates of the rings' shapes and positions. One striking conclusion, reported (also in the July 7 NATURE) by William B. Hubbard and colleagues from the University of Arizona, is that "neither the inner four rings nor the outer ["epsilon"] ring are truly concentric circles to within their widths." Since the time of Kepler, astronomers have been aware that the body around which other bodies revolve in circular orbits should be at the center of those orbits. The rings of Saturn, for example, are believed to be both circular and concentric. If the rings of Uranus are not concentric, then it would seem that all (or all but one) of them are elliptical, unless some other influence is affecting their motion and complicating the picture. Barring such influences, the different elliptical orbits of the individual particles should then be precessing around the planet at different rates. This ought to—but apparently doesn't—spread the particles out into a broad, more disklike pattern.

How much of a mystery is this? Theories are young yet, but it has been suggested that possible perturbing factors could include irregularities in the mass distribution of Uranus, or resonance effects of the planet's moons. The moons, in fact, also play the key role in the one published theory of the rings' origin. Stanley F. Dermott and Thomas Gold of Cornell University have proposed (in the June 16 NATURE) that the rings' structure could be explained by orbital resonances between the ring particles and the satellites Ariel, Titania and Oberon. □

Jupiter orbit mission survives House vote

Aided by a last-ditch lobbying effort by planetary scientists and others, a proposal to send a spacecraft to Jupiter with a probe to descend into the huge planet's atmosphere has survived an attempt to kill it by a House of Representatives subcommittee. In a remarkable show of support this week, the full House voted by 280 to 131 essentially to repudiate its own subcommittee, clearing the way to fund the $375 million mission.

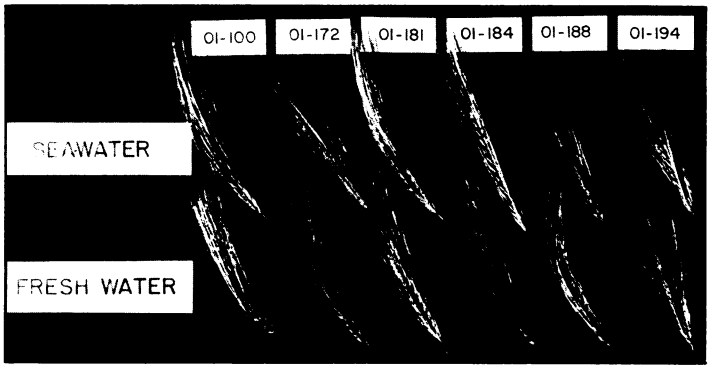
The mission, known as the Jupiter Orbiter and Probe (JOP), is to be launched in early January of 1982, arriving at Jupiter in late November of 1984. The orbiter is to circle the planet for at least 20 months, making seven close passes by the huge moon Ganymede, four near Callisto, one near Io and possibly one near Europa. Early in the mission, the probe would be detached from the orbiter and sent down through the Jovian atmosphere, taking measurements to a depth equivalent to at least 10 times the earth's atmospheric pressure at sea level.

Numerous sources in and out of government maintain that the National Aeronautics and Space Administration was virtually unaware that the long-discussed mission faced any problems with Congress until it was cut from the fiscal 1978 NASA budget-appropriations bill by the House Appropriations Sub-

committee on HUD and Independent Agencies, headed by Edward P. Boland (D-Mass.). The "Boland amendment" to delete the approximately $20 million in "new start" funding for JOP was sustained by the full appropriations committee but was forced into conference when the Senate committee voted to keep the mission in the budget bill. In conference, both sides firmly stood their ground, leading to this week's (July 19) surprising House vote, in which the House chose to defeat the amendment before passing the rest of the conference bill, 326 to 85.

The intensive lobbying that preceded the House action was motivated by concern for the continuity of planetary research as well as for the JOP itself. Past experience with such programs as Landsat C, the Space Telescope and Pioneer Venus (which was nearly cut out in its second year, with six times as much money at stake) suggests, however, that NASA should be wary of assuming an automatically rosy future. □

Salty irrigation: Bringing in the sheaves



Barley irrigated with seawater and fresh water: Biochemical contents are similar.

Two scientists have achieved dramatic success by harvesting significant yields of barley grown in soil irrigated with seawater. This is a breakthrough in the general attempt to utilize the oceans' resources in agriculture.

A number of experiments during the past 15 years have investigated the tantalizing prospect of growing plants using seawater (SN: 6/22/74, p. 406). Unlike this one, however, they have generally dealt with plant species not commercially cultivated and used saline solutions about one-tenth as concentrated. This experiment illustrates that varieties of a "cash crop" can be selected, albeit painstakingly, to grow in highly salinized soil.

With a few exceptions like sugar beets and barley, commercial crops cannot tolerate even slightly salinized soils. Emanuel Epstein and J.D. Norlyn, of the University of California at Davis, reasoned, however, that it might be possible to ferret from the medley of barley varieties a few exceptionally salt-tolerant ones. This was like guessing that from the world's population of humans, there likely would be some candidates suited for an unusual task.

The researchers began their search by subjecting an assemblage of experimental barley (collectively known as Composite Cross XXI) to something resembling a two-round, single elimination tournament.

Initially there were 7,200 contestant-seeds. During the first round, 4,320 were allowed to germinate, mature and set seed in an increasingly saline (pure sodium chloride) environment. Only 5.9 percent actually did so. The other group of 2,880 seeds participated in a similar contest that involved, instead of table salt, a synthetic sea-salt mix. Only 9.2 percent of this group survived the ordeal.

First-round survivors advanced to the finals. These seeds were allowed to germinate in special loam treated with a solution that was 85 percent seawater. Following a few more procedures, the lone survivors emerged: Only 22 plants successfully withstood the rigors of a severe selection process.

Seeds from seven of these "spartan" varieties (genotypes), together with seeds from three kinds of commercial barley (Arivat, California Mariout and U.C. Signal) and one other experimental barley from Arizona (S-68-1-11-22) were planted in eight plots. Each contained rows of the 11 test seeds arranged in random order.

The various plots were irrigated with different dilutions of seawater: from fresh water to full-strength (3.5 grams of salts per 100 grams of water). Until a month before harvest, this was done weekly and after each rainfall in order to minimize dilution effects of precipitation on the controlled salinities.

Because of California's much-publicized drought, there was very little rain (180 millimeters) to disrupt the experimental conditions during the crop's growth between January and June 1976, when it was harvested. At least one similar study, in Norway, was adversely affected by persistent winter rains that leached the salt from the soil.

The harvest from seeds treated with undiluted seawater ranged from 92 to 1,243 kilograms for each hectare (about 2.5 acres). The three commercial varieties (called cultivars), remarkably, produced a mean of 833 kg/ha. By comparison, the estimated yield of barley in the United States was 2,370 kg/ha in 1975.

The biochemical content of grain harvested from the seawater trials was similar to that of freshwater specimens. This included comparable assay values of protein, ash, fat, fiber and sodium. Actual feed tests will require larger harvests, which still are several years away, said Epstein.

These results are a "breakthrough," according to University of Delaware biologist G. Fred Somers, himself a noted researcher in the field. The study represents a different point-of-view, one that he hopes will start a trend. Previous experiments, he says, have concentrated on ways to modify the soil to suit the plants.

The authors, reporting in the July 15 SCIENCE, claim that their experiment underscores the remarkable adaptive capabilities of a species. The three cultivars, normally accustomed to an unsalinized environment, nonetheless were sufficiently versatile to burgeon in disparate conditions.

In addition to experimenting with barley, Epstein says he has obtained preliminary success with wheat, "the premier grain crop." He has grown seedlings in salinized conditions, but hasn't yet grown wheat through maturity. He is also working with tomatoes.

A major general limitation of seawater-irrigated farming is that land be sandy enough to provide adequate drainage of the salty residue. If not, Epstein said, the salts will eventually accumulate and cause effective concentrations far exceeding that of seawater. The ideal locations, therefore, are sandy coastal areas, like the one of this experiment. □

Japan joins weather satellite network

The Geostationary Meteorological Satellite (GMS), built and launched in the United States for Japan's National Space Development Agency, is the newest member of a planned worldwide network of weather-watching satellites. Launched on July 16, GMS was aimed at a fixed (geosynchronous) position over the equator south of Japan, providing photographs and other data 24 hours a day.

It is part of a network known as the Geostationary Operational Environmental Satellite system, which will include five similar eyes in the sky: two from the United States, one from Japan, one from the multinational European Space Agency and one from the Soviet Union. Both U.S. probes are now aloft; the latest, GOES-2, was launched on June 16. Europe's contribution, known as Meteosat, is scheduled to be launched for ESA by NASA on Sept. 15. The Soviet entry presumably will follow at a later date, with the completed network providing overlapping, global coverage. □