Voyager: Science and sweat

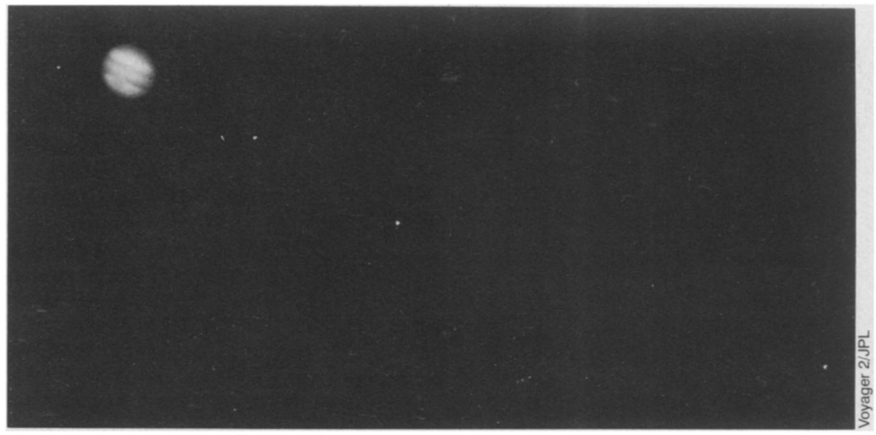
"There's nothing like having spacecraft problems to make you worry about the mission," said one Project Voyager scientist last week, "just when you're looking at data that show you how good the mission might *really* be." The comment, from a conversation at the meeting of the American Geophysical Union in Miami Beach, reflects something of the emotional quandary facing earthbound participants in the ambitious, dual-spacecraft flight to Jupiter, Saturn and perhaps beyond.

Both of the Voyager craft, launched last summer, have developed difficulties in recent weeks that, if they worsen, could significantly affect the complex scientific plans for the scheduled "flybys." Even as flight controllers at Jet Propulsion Laboratory in Pasadena were working to understand the malfunctions, however, researchers at the AGU meeting were reporting results from the early part of the mission that underscore the potential gains in store from the upcoming planetary encounters.

Voyager 1's problem stems from the fact that the movable "scan platform" carrying its cameras and some other instruments stuck during a test in February. The platform is intended to move its instruments around as the spacecraft flies its way among the moons of Jupiter and Saturn, and in subsequent tests it has successfully been moved at all four of its different "slew rates." Controllers have pointedly avoided moving it through the position in which it stuck, however, and it is not yet known whether its sequence of movements will have to be modified. An alternative would be to move the whole spacecraft, but that could affect the aiming of one or more of the instruments that are not mounted on the platform.

Voyager 2's trouble is entirely different, but at least as fundamental. A few weeks ago, flight-team engineers believe, both fuses (one the supposed emergency backup unit) blew out in one of the craft's two receivers, and the alternate receiver, now in use, has a frequency-tracking problem that apparently prevents it from compensating for the Doppler shift in transmissions from earth. An alternative transmission scheme has since allowed the compensation to take place at the transmitting end, rather than on the spacecraft, but it imposes some constraints on the transmission procedure. More to the point is that the less-than-perfect receiver is on Voyager 2, whose mission could include extensions to Uranus and even Neptune, which will require it to last until as late as 1989.

The scientific instruments, meanwhile, are already proving their abilities. S. M. Krimigis of the Johns Hopkins Applied Physics Laboratory, for example, told his AGU session audience that the low-energy charged-particle experiments on the spacecraft are yielding solar-particle compositional spectra with "better results in a single day than we have been able to get in the past 15 years."



Jupiter with (l to r) Europa, Io, Ganymede and Callisto, recorded by Voyager 2.

The planetary radio astronomy experiments, designed to measure low-frequency emissions from Jupiter and Saturn, have confirmed early indications that they had recorded the first direct measurements of the polarization of earth's own kilometer-wave radio "noise." The emissions are almost entirely left-hand circularly polarized, said James Warwick of the Univerity of Colorado, head of the experiment team, compared with the near lack of polarization in, say, a solar radio burst. The measurement, says team member Anthony Riddle, also of UC, "gives us a good handle on emission mechanisms. It makes certain emission theories possible and others impossible."

One center of attention, of course, is the cameras, two of which are on each Voyager's scan platform. On Feb. 8 (admittedly before the platform stuck), the narrow-angle camera aboard Voyager 2 took a photo showing not only Jupiter — complete with stripey detail—but all four of its major (Galilean) satellites: Europa, Io, Ganymede and Callisto. And the remarkable photo was taken with Jupiter still 437 million kilometers and 13 months away. When the spacecraft gets really close, says project scientist Edward C. Stone of California Institute of Technology, the Galilean satellites will be photographed with resolution as good as that in Mariner 10's strikingly crisp photos of Mercury.

Though the giant planets and their moons are the primary goals, almost everything in between is grist for Voyager's mill. The cameras, for example, have also photographed earth and its moon. The photopolarimeters, important in studying aerosols, dust particles and other atmospheric and surface components, have already made what the University of Colorado's Charles F. Lillie says are the first whole-body polarization studies of the earth from a spacecraft, as well as the first such measurements of earth by ultraviolet light. ("It can very accurately be said," Lillie reports, "that earth is indeed a blue planet.") Mars has also been "seen" by the instruments — it is, not surprisingly, red — and there have even been preliminary observations of Jupiter and Saturn. With luck, says Lillie, future plans may also include "one or more asteroids," which have never been studied close-up at all.

The Voyagers have also been involved in what amount to cooperative studies with other spacecraft. On Oct. 26, 1977, for example, a major solar event was recorded by the Voyagers as well as by the International Sun-Earth Explorer satellites in earth orbit, thus letting the same phenomenon be observed from different positions and distances from the sun. Other multi-spacecraft studies have linked Voyager's data with that from such probes as IMP 7 and 8. Now if the Voyagers can only get to Jupiter in working order.... □

Protein clipping in lab and cell

Proteases used to be just a nuisance. Released into the fluids of homogenized cells, the protein-breaking enzymes destroy interesting activities and decrease the apparent sizes of molecules.

Recently, however, biochemists are regarding these molecular shears in a more favorable light. The researchers now have a firmer grip on the scissor handles and have come to appreciate the skill with which an intact cell snips and trims its proteins.

At the International Conference on Limited Proteolysis in Microorganisms held at the National Institutes of Health last week, biologists reported on the use and observation of protein-cleaving enzymes. Proteases can be used in cut-and-test experiments to identify what portion of a large protein binds a substrate or cofactor or hugs a membrane. The toxins produced by bacteria have at least two functional areas, says R. John Collier of the University of California in Los Angeles. By breaking tox-