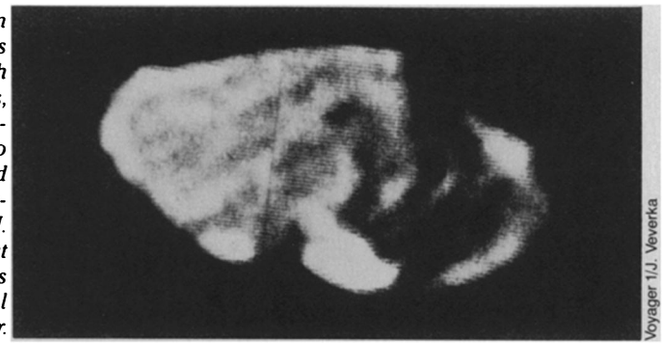
Planet Week: The Solar System on Parade

Three Viking spacecraft are still studying Mars, while a Pioneer orbiter is circling Venus (adding to data from a cluster of probes that pierced that planet's atmosphere only last December). Voyagers 1 and 2 went by Jupiter in March and July, Pioneer 11 in September took the first close look at Saturn, and other worlds have come under the scrutiny of increasingly sophisticated ground-based instruments. It has been a record year for planet-watching, and the teeming annual meeting of the American Astronomical Society's Division for Planetary Sciences in St. Louis last week proved the point. Hundreds of scientists gathered to see and hear nearly 250 presentations of new data and analyses on all of the solar system's worlds, most of the talks compressed to five minutes to accommodate the huge influx.

Yet all is far from rosy. Beyond the Voyager encounters with Saturn in 1980 and 1981, only a single planetary spacecraft project is now in the budget, and the launching of that one — the Galileo orbiter and atmosphere probe of Jupiter — was recently postponed two years due to problems with the space shuttle, so that it may not reach its target planet until mid-1986. In a disheartening address to the DPS assemblage, Geoffrey A. Briggs, deputy director of the National Aeronautics and Space Administration's planetary division, pointed out that there is likely to be a period of as long as four years — from late 1981 through much of 1985 — when no new information at all will be coming back from spacecraft visiting other worlds. The science at the meeting was bountiful, but almost every planet occasioned insights about the state of studies to come.

Mercury: Close to the sun, Mercury is difficult to observe from earth, and only a single spacecraft, Mariner 10, has ever been there (though its sun-circling orbit took it by three times), in 1974 and 1975. Thus, when the University of Pittsburgh's Bruce Hapke presented a "color-ratio" map of the planet, made by reprocessing photos taken by Mariner 10 through orange and ultraviolet filters, he was using data gathered about half a decade ago — a fate likely to affect watchers of other worlds in years to come. The map, meanwhile, showed Mercury to be spectrally homogeneous on a large scale (more so than earth's moon), implying, according to Hapke, a similarly broad chemical homogeneity ("at least as far as those elements which affect color, such as iron, are concerned"). The numerous scarps on the surface showed no characteristic color differences from their surroundings, thus suggesting that the scarps indeed are, as has been hypothesized, part of a planet-wide system of faults, possibly resulting from Mercury's contraction.

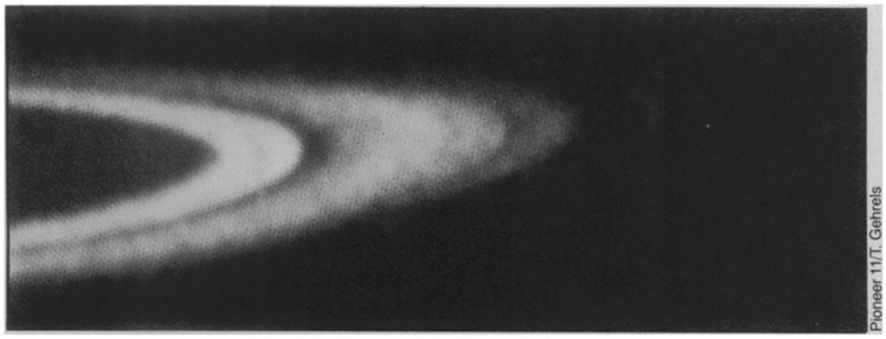


Jupiter's moon Amalthea reveals enough detail, such as possible craters, in this highly enhanced Voyager 1 photo to enable limited mapping. Its spectrum, says Cornell's J. Veverka, matches that of carbonaceous chondrite material with added sulfur.

Venus: Numerous spacecraft have been there, but only two middling photos have ever been taken (by Soviet landers) to show what the surface of earth's once-supposed "twin" actually looks like beneath the dense atmosphere. Radar is one answer, but a proposed spacecraft to take a high-resolution radar look from orbit has been repeatedly delayed, and may not even get started in NASA's budget for at least two more years. A less sophisticated version is now circling the planet aboard the Pioneer Venus orbiter, however, revealing such details as possible volcanoes the size of whole states, a canyon that would span a continent, and a towering plateau larger than Australia. Earth-based studies also help, but they can map only limited parts of the surface. The Arecibo radio telescope in Puerto Rico has now charted a swath covering about 120° of longitude by 20° of latitude in the northern hemisphere (at 12.5-cm wavelength), and several DPS scientists expressed the wish that the Goldstone antennas in California, part of NASA's spacecraft-tracking network, would resume their once-active radar-mapping role. Given some topographic data to work with, Roger Phillips of Jet Propulsion Laboratory was able to report also that the long-wavelength "highs" and "lows" in the planet's gravitational field fit much more closely with topographic ups and downs than is true for earth, possibly implying a thick crust that can support the loftier elevations.

Much of the interest and many of the toughest questions, however, are about the haze-ridden atmosphere. Does the so-called "greenhouse effect" account for the lead-melting temperatures near the surface? Depends on whom you ask. "The greenhouse effect," says Peter H. Smith of the University of Arizona, "can work even with large local variations in water abundance and/or cloud opacity." But according to the University of Wisconsin's Verner Suomi, "The infrared losses from the [atmosphere's] deep layers are too large to be supplied by the sunlight reaching the surface; thus the greenhouse effect alone is unable to account for the high surface temperatures." It is a fundamental question — with a missing answer.

Mars: The Viking spacecraft at Mars have yielded more insight about that planet than all the centuries of observation before them, and three of them — one of the two orbiters and both landers — are still on the job. One of the landers is set to gather very limited data for a decade or more, but the surviving orbiter is almost out of control gas, and may be turned off anyway in January. Viking scientists at the meeting expressed hope that NASA would provide additional funding to keep the mission alive (by judicious use of the remaining gas) for several more months, possibly until as late as August, when Voyager 1's upcoming Saturn encounter will



Pioneer 11 photo shows faint "F" ring outside Saturn's denser ring structure, as well as a satellite (far right) that may be new discovery or mere confirmation.

begin monopolizing the tracking stations through which the orbiter sends data. If the orbiter can keep going, it may be available to provide additional data on its second season of Martian dust storms and on changes in the polar caps, and even search perhaps for signs of possible dust rings and additional satellites.

Though many key Mars questions remain unanswered, there is by now a veritable mountain of spacecraft and earth-based data about the place—a problem of another sort. Analyzing such data, in all their diverse formats, can be a time-consuming and expensive task—and funds for seemingly mundane data analysis can sometimes be as hard to come by as the larger amounts for the spacecraft themselves. At the DPS meeting, therefore, Hugh H. Kieffer of the U.S. Geological Survey urged scientists with Mars data to consider contributing them to a "consortium," based at the USGS, where they would be translated into a common format that would facilitate ready comparisons with other data in the collection. Various kinds of maps and thermal measurements have already been "formatted" to the consortium's specifications, but far more, from radar to radio-occultation data, are eligible. The consortium cut its teeth on a similar project to adapt the diverse data about earth's moon.

Jupiter: Fresh from the two Voyager encounters as well as new earth-based studies, Jupiter dominated the DPS agenda almost as it does the solar system, accounting for nearly 80 separate presentations. Topics ranged from the planet itself to its spectacular, volcanic moon Io to its newly discovered ring system. Even the tiny satellite Amalthea, closer to Jupiter than any of its other moons except one discovered mere weeks ago (SN: 10/20/79, p. 263) had its moment, as Cornell's Joseph Veverka showed a highly computer-enhanced Voyager photo revealing enough surface detail to enable a crude map. (This despite the fact that Amalthea measures only an irregular, and approximately 270 by 165 by 153 kilometers, says Veverka, and was seen by Voyager from no closer than about half a million km.)

But again, major questions remain unanswered, such as the nature of the substances that color Jupiter's brilliant cloud patterns, and the delays in the long-sought Galileo mission — which would actually penetrate the clouds, sampling all the way —were an oft-heard discussion topic. The probe was originally to have been carried from earth aboard an orbiter, but the combined payload proved too much for the space shuttle to carry, given the shuttle's projected development status by the original 1982 launch date. So Galileo's liftoff has been delayed until 1984, and split into two separate launchings — one each for orbiter and probe. This is also expected to add nearly 40 percent to the mission's cost, and the extra time in the budget, said one DPS member, could also make it more vulnerable to congressional trimming. NASA makes confident noises about Galileo's future; some scientists are less convinced.

Saturn: On Sept. 1, Pioneer 11 got the first close look at Saturn, but even the project's own scientists are eagerly awaiting the Voyager 1 and 2 flybys, in 1980 and 1981 respectively. Some of the Voyager scientists, meanwhile, were expressing concern at the meeting about being able to cram the same amount of science into the craft's onboard computer that was available during the Jupiter encounters. A proposed mission to send probes into the atmospheres of Saturn and its largest moon, Titan, is years in the future, but the Pioneer 11 data provided plenty to think about, including revisions in the ring structure and the possibility of previously unknown satellites. Several of these satellites — one photographed by the spacecraft, another (informally dubbed "Pioneer Rock") detected by charged-particle and magnetic-field measurements, and yet another (loosely known as S-11) noted in a previous earth-based photo — may all be one and the same, says the University of Arizona's Tom Gehrels. Charged-particle data, however, may have located what could be taken as some outer ring structure, says James Van Allen of the University of Iowa, but it may consist of large enough chunks to be described as "a belt of little satellites."

Uranus: The message here is that, for all the spacecraft, earth-based data still have a major role. The planet's rings were discovered from earth, and a rotational period for the planet (12.8 ± 1.7 hours) has been calculated by M.I.T.'s Edward Dunham and colleagues using earth-based observations of the elliptical, outer ring's precession rate.

Neptune: The earth-orbiting, 2.4-meter Space Telescope, to be lofted by the shuttle, may have to fill part of the spacecraft gap. A team working on a charge-coupled device (CCD) camera for the ST's planetary studies gave a hint of its potential with a CCD image, made through a 1.54-meter telescope, showing what the University of Arizona's H. J. Reitsema described as "discrete cloud features" in the northern and southern hemispheres of Neptune, separated by a dark equatorial band. The ST will have an improved CCD, a 56 percent greater focal length than that used for the Neptune image, and freedom, in earth orbit, from atmospheric distortion.

Pluto: It could be decades before earth-based data are supplanted by anything from closer in, but the University of Hawaii's Dale Cruikshank has been able to infer the possible presence of gaseous methane, and Larry Trafton of the University of Texas told the DPS that, if present, the methane gas would have to be mixed with a heavier gas that would not freeze out (such as argon or heavier) to keep it from escaping into space. An argon atmosphere for Pluto? □

Three Mile Island: The verdicts begin

Citing "serious weaknesses" in Metropolitan Edison Company's operations, management, radiation-health programs and emergency preparedness, the U.S. Nuclear Regulatory Commission has proposed levying the heaviest fines in its history — $155,000 — against the utility for actions surrounding the accident at its Three Mile Island nuclear-power plant last March 28 (SN: 4/7/79, p. 227). The fines would have been much higher — $725,000 —but for the existence of the Atomic Energy Act, which limits to $25,000 the total civil penalties that can be levied for any 30-day period.

NRC's action represents what may be only the first wave of measures taken against individuals and organizations involved in the chain of events that ultimately destroyed the core of the Three Mile Island #2 power plant and released significant amounts of radiation into the atmosphere.

According to NUCLEONICS WEEK, the fines NRC proposed cover 148 separate violations, infractions and deficiencies by the utility. "We believe the course of the accident would have been altered, if not prevented entirely, had compliance with NRC requirements been achieved," wrote Victor Stello, NRC's director of inspection and enforcement, in an October 25 letter to Met Ed announcing the proposed fines and outlining the findings of an NRC investigation into events surrounding the accident.

Consideration of additional action against the utility for what appear to be several reporting violations has been temporarily deferred, Stello said last week. NRC officials added that it is even possible — though not likely — that the utility will have its operating license revoked. Met Ed has 20 days to pay the fines or to appeal; utility spokesmen say there will be an appeal of at least some of the penalties cited.

Although NRC's proposed fines amount, financially, to little more than a stinging slap on the utility's wrist, it is not likely that future violators will get off as cheaply. Already legislation is moving in the Senate that would increase NRC penalties for individual violations and remove the 30-day ceiling on total fines in the hopes of providing a stronger incentive for utilities to institute more effective safety measures.

Addressing the safety issue in June 14 testimony before a Senate committee, NRC Commissioner Victor Gilinsky said, "What I think is lacking up and down the line in the commercial use of nuclear energy is sufficiently meticulous and disciplined attention to detail. The cure may require a profound alteration of the relationship between NRC and the industry: The regulators are going to have to get tougher." He