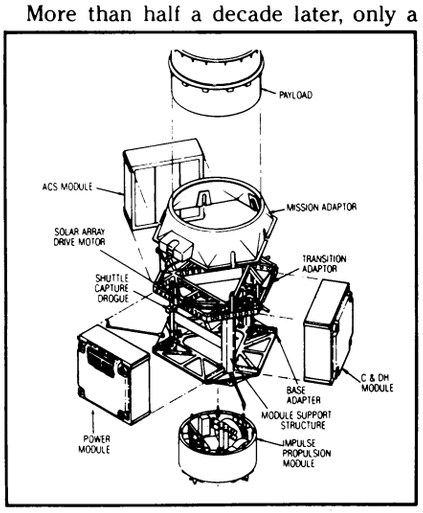
NASA Studies Rescue of Solar Max

Early in 1976, the National Aeronautics and Space Administration unveiled plans for a device called the Multimission Modular Spacecraft. Markedly different from its years of one-of-a-kind predecessors, the MMS was designed to serve as the standardized hub of a variety of diverse satellites, ranging in weight from 200 pounds to as much as four tons and carrying payloads as small as a cubic foot or as large as a Greyhound bus. But even more radical was the "modular" part: a system of plug-in "black boxes" to handle attitude-control, data-processing and other routine functions—and which could be simply replaced in orbit from the space shuttle rather than let something as trivial as a blown fuse ruin an entire mission. It may not seem like a particularly innovative engineering concept, yet it represented a fundamental change in the whole design philosophy of the Space Age's high technology, and its repairability was tightly linked with the shuttle's touted role as a cost-cutter.

More than half a decade later, only a single MMS-based satellite has ever gotten into orbit. But it is the Solar Maximum Mission, a sophisticated probe launched on Feb. 14, 1980, with a suite of instruments designed to study the sun at the high point in its 11-year cycle of activity. The "Solar Max" project has cost some $77 million (not including its non-shuttle launching) — and last November its attitude-control system, responsible for keeping the craft properly pointed in space, began to fail. Of the seven instruments on board, only one, a coronagraph, had previously had any problems. With only the imprecise pointing of the backup attitude-control system to rely on, however, three others were rendered virtually useless, all, according to Solar Max officials, condemned by essentially nothing more than blown fuses.



Not even the MMS designers had planned to find a need for their easy-fix system quite so soon. Yet at NASA's Johnson Space Center in Houston, a team of engineers is studying just that possibility. In practice, the shuttle would go into orbit carrying a ring-shaped framework called the Flight Support System, together with a remotely controlled (and yet-to-be-tried) grappling arm. Astronauts would fly the shuttle near to the ailing satellite, grasp it with the arm and manipulate it back to a firm mounting on the ring-frame. There, either using the arm or during a spacewalk, they would remove the offending module and replace it with a new one, and, after a brief checkout, send Solar Max on its way.

But when could such a mission be flown? The shuttle's next test flight, second of four, will be the arm's first test, now scheduled for Sept. 30. Flight 3 will probably carry a scientific payload of astrophysics instruments, and the Defense Department is interested in number 4 (or #3, if the latter two are switched). Fixing Solar Max, furthermore, would clearly be considered an operational mission, an ambitious undertaking in light of the basic shuttle testing likely to remain. And after that, the shuttle is due to go into operational service in earnest, with paying customers whose payloads cannot be easily deferred.

Yet NASA would like very much to demonstrate the validity of the MMS idea. Also, Solar Max is expected to reenter and burn up in the atmosphere in 1984, whereas replacing the attitude-control module might allow putting the device into a low-drag orientation that could extend its life for two more years. There is even an existing spare module, prepared for the upcoming, MMS-based Landsat D. The fix-it plan exists. But can NASA make it work? □

Standardized, plug-in components cluster around the core of the Multimission Modular Spacecraft (above). Artist's concept (right) shows the ailing, MMS-based Solar Maximum Mission satellite being maneuvered by a remote-control arm over to a repair framework in the space shuttle's cargo bay, in a "fix-it" mission now under study.

Illustrations: NASA

Voyager 2: Signs of Jupiter's long tail

On March 19, 1976, the Pioneer 10 spacecraft was cruising out beyond the orbit of Saturn when its plasma sensor suddenly reported that the solar wind (a continual outpouring of charged particles from the sun) had disappeared, or at least gotten so weak that the instrument could no longer detect it. The effect lasted barely a day, and one assumption might have been that the probe had simply flown through the tail of Saturn's magnetic field, which would have blocked out the solar wind, except that Saturn was far around in its orbit from Pioneer 10. Instead, John Wolfe of NASA's Ames Research Center in California concluded that the spacecraft had apparently flown through *Jupiter's* magnetic tail — a vast 690 million kilometers from the planet.

If the tail is indeed that long (the Pioneer 10 data were not fully conclusive), it could mean that about every 13 years, when the two giant planets are roughly on a line from the sun, Saturn itself passes through it. Wolfe and others speculate that this could wreak major changes in Saturn's magnetosphere, allowing it to expand outwards toward the sun by removing the pressure of the solar wind that usually compresses it. The passage of the tail might even change the nature of the planet's trapped-radiation belts, by temporarily cutting off the influx of solar-wind particles that normally replenish the belts and replacing it with particles carried in along the tail.

By sheer coincidence, the Voyager 2 spacecraft may be in an ideal position to find out. It will fly past Saturn in August, which could turn out to be a time when the planet is being "washed" by the Jovian magnetotail. And the probe is already reporting signs that the tail is extending at least tendrils in Saturn's direction.

Recently analyzed data from Voyager 2's plasma-wave instrument have revealed that earlier this year the spacecraft appar-

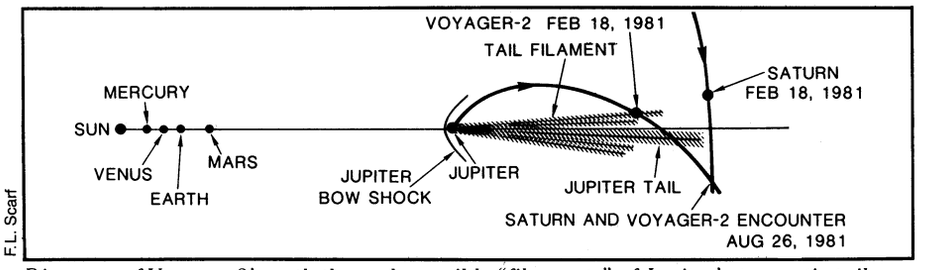


Diagram of Voyager 2's path through possible "filaments" of Jupiter's magnetic tail.

ently flew through the tail. "The way we tell we're in the tail," says principal investigator Frederick L. Scarf of TRW Inc., "is that we see noise in a certain range of frequencies that is characteristic of Jupiter. [In the Voyager data], we saw exactly the same characteristics we last saw as we were leaving Jupiter a year and a half ago. We are convinced that we were experiencing Jupiter's magnetosphere again." The "noise," according to Scarf, probably represents radio waves trapped (and possibly even generated) within the tail.

But the readings were not continuous. They showed up on Feb. 18 and 19 and again in early April, as if the tail, weakened so far downstream from Jupiter, was split into separate "filaments."

How far the filaments extend remains to be determined (though the Pioneer 10 data suggest that the distances could be vast), as does whether Saturn will be in the middle of one of them when Voyager 2 flies by. Neither of the two probes that have already visited Saturn—Pioneer 11 and Voyager 1 — did so when Jupiter's tail was anywhere near them, so the results of such an interaction are so far unknown. The now-familiar "bow shock" formed where the supersonic solar wind strikes a planet's magnetosphere could even be missing completely if the incoming flow is the much more leisurely one of particles flowing down the Jovian tail.

"I think it's extremely likely that the Saturn encounter will be different this time," says Scarf. "I think it'll be a field day for the theoreticians." □

Beware the supplies of arts and crafts

The male, middle-aged professor had taught various lithography courses in a large university's art department since 1972. By the spring of 1976 he was extremely ill, experiencing weakness, blackouts, headaches, dizziness and shortness of breath. A blood profile revealed that this artist had aplastic anemia—a disease with a 65 to 75 percent mortality rate. An investigation of his professional routine revealed that the acquired (as opposed to congenital or inherited) disease may have resulted from long-term exposure to the benzene used in photolithography.

This artist's case history is outlined in the recently published *Health Hazards in the Arts and Crafts* — the proceedings of a Society for Occupational and Environmental Health conference conducted to promote awareness of the health risks involved in prolonged exposure to the chemicals in paints, solvents and other substances used by artists. More recently, one of the book's editors — Michael McCann, an industrial hygienist at the Art Hazards Project of the Center for Occupational Hazards in New York — reported a study whose results bore the same message: Artists beware.

McCann, along with Barry A. Miller and Aaron Blair of the National Cancer Institute Environmental Epidemiology Branch, used a statistical method called Proportionate Mortality Ratio (PMR) to analyze the deaths of 1,598 white male and female artists listed in *Who's Who in American Art* between 1940 and 1969. A PRM compares the observed number of deaths from a specific cause in a sample population with the expected number of deaths from that same cause in the general population. Using this technique, McCann and colleagues found an apparent increased incidence of cancer deaths among professional artists. Specifically, the researchers found an increased incidence of leukemia and bladder, prostate and colon cancers among male artists and an increased incidence of cancers of the rectum, lung and breast among white female artists in the study. But the study, presented at the Health Risks in the Arts, Crafts and Trades meeting last month in Chicago, is only preliminary, warns Miller, and efforts now are under way to locate other suitable arts and crafts populations to study.

Studies also are under way to investigate industrial settings where workers are exposed to the same chemicals found in the artists' studios. For example, Charles Billings and colleagues of Johns Hopkins University in Baltimore, Md., have been awarded a contract by the National Institute of Occupational Safety and Health to study the health hazards of the painting trade. In the first phase of this study, a walk-through of 50 plants and a check through the NIOSH *Registry of Toxic Effects of Chemical Substances,* the researchers found that there are more than 300 potentially toxic materials and 150 potential carcinogens present in paints. Phase two of the Johns Hopkins study, currently under negotiation, will include an epidemiological analysis of workers exposed to these substances.

The Johns Hopkins and NCI investigations occur amidst a dynamic controversy concerning stricter labeling of the raw materials used in arts and crafts and certain industrial settings. At the request of the Chemical Manufacturers Association and as a part of its general reduction in regulation, the Reagan administration put aside an OSHA proposal that would require such stricter labeling. Still, a similar measure now pends in Congress.

The bill's main champion is Rep. Frederick W. Richmond (D-N.Y.). "I first became aware of the desperate need for comprehensive warning labels on toxic art supplies after receiving letters from several artists who suffered chronic illnesses as a result of using improperly labeled art material," Richmond says. "The type of symptoms they described are all too common among artists and hobbyists who have not been warned of the potentially chronic health hazards associated with art supplies."

Richmond's proposed piece of legislation — the Arts Hazards Bill — would require artist product labels to list such items as the common names of the chemicals contained in the product and precautions to take to avoid its misuse. □

The VA: Curious orange

The Veterans Administration recently took a long-anticipated step toward resolving the Agent Orange issue when it contracted a University of California at Los Angeles research team to design a study to determine whether that herbicide has caused health problems in soldiers exposed to it.

Agent Orange — composed of the dioxin-contaminated 2,4,5-T (SN: 4/18/81, p. 247) and 2,4-D—was used in Vietnam to destroy crops in an attempt to reveal enemy jungle hiding places. Since that time, thousands of veterans have blamed exposure to the herbicide for a multitude of ills—ranging from acne and headaches to birth defects in their children and cancer. Now, the UCLA team — headed by Gary Spivey and Roger Detels — has been awarded a $114,288 contract to design an epidemiological study that will investigate these claims.

The UCLA study design will be evaluated by members of various institutions, including the National Academy of Sciences' National Research Council. The VA then will consider bids from groups interested in conducting the proposed study.

The VA planned to embark on this Agent Orange strategy about a year ago, but the National Veterans Task Force on Agent Orange sued to block it, complaining that the plan was too restrictive and lowest-price bid oriented. Eventually, a federal court gave the VA the go-ahead. □