R.I.P. Solar Max: The satellite's last days

Flight controllers long anticipated the demise of the Solar Maximum Mission satellite as its orbit descended lower into Earth's atmosphere with each trip around the planet. But the first specific sign that the end was nigh appeared Nov. 14, when engineers at NASA's Goddard Space Flight Center in Greenbelt, Md., began receiving data from the craft showing that part of its attitude control system was running hot, at a temperature of 32°C instead of the usual 22°C. The message: The system was working harder to keep "Solar Max" properly positioned as it penetrated increasingly denser levels of the atmosphere.

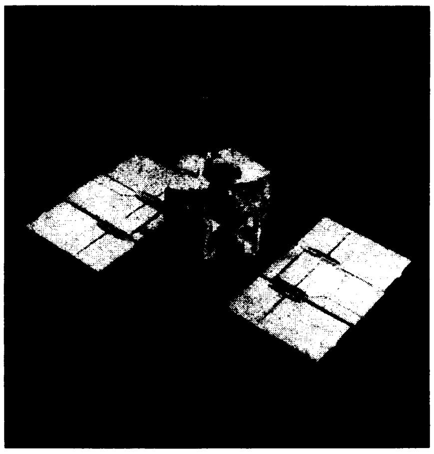
On that day, engineers conducted a "battery rundown test" for 15 minutes, turning Max's power-providing solar panels edge-on to the sun to provide the least solar energy, then waiting to see if the batteries could still recharge fully. Max passed the test, thus ensuring that its sun-watching scientific instruments could still function, that it could still receive operating instructions from Earth and that it could still radio home its all-important data.

Over the next 24 hours, however, the orbit's low point sank by 3.5 kilometers, its greatest drop in a single day. By Nov. 17, the atmosphere's fringes were so dense that Solar Max lost its ability to maintain the precise pointing accuracy required by some of its scientific instruments. Four days later, it successfully carried out a computer command to jettison the more sensitive of its two communications antennas, leaving a less efficient antenna that could relay information to and from ground-based facilities only at certain times. The other antenna had linked Solar Max with relay satellites that kept it in touch for more of each orbit.

Finally, on Nov. 24, the engineers essentially "pulled the plug," sending a radio command to disconnect the solar panels and set them adrift in space. With that, the craft had just three hours of electricity left in its batteries. During the second orbit following the release of the solar panels, the engineers ceased receiving signals from the satellite. Solar Max was dead in orbit, awaiting its fiery reentry. Goddard officials anticipated reentry around Dec. 2.

The satellite had gone into orbit on Feb. 14, 1980, designed to operate for one to three years of an 11-year solar cycle. A few months after launch, three fuses blew, silencing some experiments. The fuses, along with other damaged components, finally got replaced in 1984 by astronauts who spacewalked over from the shuttle Challenger (SN: 4/21/84, p.245).

For much of its life, Solar Max carried the only solar coronagraph in space, a key instrument for studying the sun's outer fringes. Some solar scientists expressed hopes that NASA would conduct a second repair mission, carrying out some modifications to the coronagraph and raising Max's orbit to prolong its life. That mission never flew, however, due to limited funds and NASA's decision that the shuttle program faced too large a backlog of overdue launchings after the Challenger disaster in 1986.



NASA

Solar Max, 1980-1989.

The coronagraph took about 250,000 photos of the sun. Among its discoveries were 10 sun-grazing comets—comets that fall into the sun or disintegrate from its heat. For now, the loss of Solar Max leaves no such instrument operating beyond Earth's atmosphere. The next coronagraph in space should fly aboard the Ulysses spacecraft, which the European Space Agency (ESA) has set for launch next year on a long trip around Jupiter that will then re-aim Ulysses to pass over the sun's poles in 1992 and 1993. Another coronagraph is scheduled for an ESA/NASA craft called SOHO, to study solar pulsations and the acceleration of the solar wind from a position in space called the L-1 libration point, at which gravitational forces are balanced between the Earth and sun.

The next coronagraphs planned solely by NASA will not orbit at all, but will rise aboard sounding rockets and long-duration balloons as part of a project called Max '91, to be conducted in 1992.

Besides a coronagraph, Solar Max's scientific payload included a hard-X-ray-burst spectrometer that project scientist Joseph B. Gurman of Goddard says has observed more than 12,500 solar flares. The craft's gamma-ray spectrometer, he adds, was the first instrument to detect nuclear-line emission from supernova 1987A — spectral lines produced by the nuclei, rather than the outer structures, of the star's atoms. According to Gurman, the detection of such emission from cobalt-56 in the supernova provided the first evidence that elements heavier than iron can be made only in supernovas.

Solar Max's hard-X-ray imaging spectrometer made the first observations of hard X-rays from the "footpoints" of magnetic arches formed during the brief, early phase of solar flares, Gurman says. An ultraviolet spectrometer polarimeter made the first measurements of sunspot magnetic fields above the visible surface of the sun.

The satellite's active-cavity radiometer irradiance monitor revealed that the solar constant — the total energy radiated by the sun — varies in phase with the amount of solar activity, and Gurman says coordinated observations by ground-based instruments and Solar Max's X-ray polychromator have confirmed that energy "evaporation," or explosion, from the sun's chromosphere plays a role in the development of solar flares. *— J. Eberhart*

Evolution's rapid shrinkage

Ordinarily, evolution seems to amble along at a snail's pace. But given the opportunity, it can bound ahead. Fossils from an island off the coast of France show that during a mere blink of geologic time about 120,000 years ago, local red deer evolved into dwarf deer measuring only one-sixth the normal size, reports Adrian M. Lister of the University of Cambridge (England) in the Nov. 30 NATURE.

Pygmy versions of deer, hippopotami, elephants and other animals have developed on islands in the Mediterranean, Indonesia, the east Pacific and elsewhere. In most cases, paleontologists believe these creatures descended from isolated colonies of normal-sized animals that swam to the islands. But no one knew how long the transformations took.

Lister was able to time the events on the island of Jersey because this area becomes isolated from the French mainland only for geologically brief periods. During ice ages, when sea levels drop, a land bridge connects it with Normandy. But between the last two ice ages, high sea levels temporarily turned Jersey into an island resembling today's land form. Using dates for high sea levels, Lister calculates that the island phase lasted only 8,000 to 9,000 years and that the dwarf deer must have evolved over fewer than 6,000 years. He describes this time as "geologically extremely short," noting that "mainland European red deer had existed with only minor changes for the previous 400,000 years."

Lister suggests the dwarfs arose from a group of red deer stranded on the island when sea levels rose. Resource limitations and freedom from predators may explain why the small forms succeeded in the isolated environment. The dwarfs went extinct when a drop in sea levels reconnected Jersey with the mainland. *— R. Monastersky*

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