Working Solar Monitor Shot Down by ASAT

The "dead" target of a space weapons test conducted by the Air Force was alive for the scientists who used it

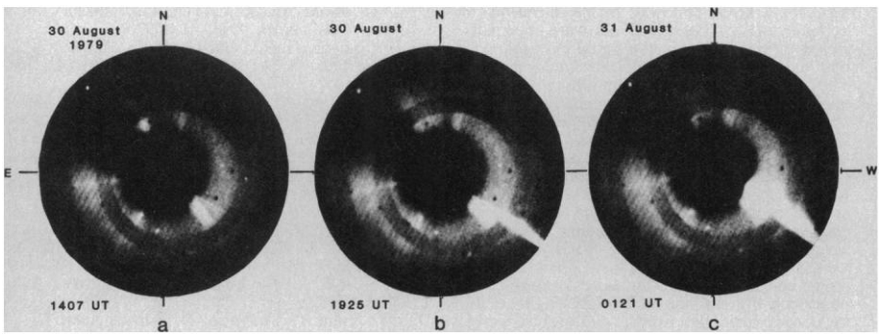
Caspar Weinberger, the secretary of defense, was "absolutely delighted" on 13 September with the destruction of Air Force satellite P78–1 by an experimental missile. It was America's first mock attack against a real satellite, and it reduced the target to an orbiting pile of rubble. A spokesman quoted Weinberger as saying it was a "great step forward" toward developing an antisatellite (ASAT) system. But physicists who were using P78–1 were not so jubilant. They were still receiving data from a unique solar corona observatory onboard when the satellite went down.

"As a patriotic American, I was glad to see the test succeed," says David Bohlin, chief of NASA's solar physics branch. But he adds, "It's really kind of sad. I worked in that research group [that analyzes P78–1's solar data]. It's a definite loss, no doubt about it."

The group Bohlin mentioned is based at the Naval Research Laboratory (NRL) in Washington.* Since the launch of P78–1 in February 1979, the NRL scientists have collected and interpreted photos of the sun's corona taken by an experiment called Solwind which was "piggybacked" as one of six tests on the Air Force satellite.

Last week, Navy Lab personnel were under instructions not to discuss the matter with the press. However, a nongovernment scientist says the researchers had their data source "shot out from under them." The NRL researchers apparently were not consulted directly, but were informed shortly before the shot that Solwind would be America's first sacrifice to space warfare. Some physicists were upset.

In response to press inquiries, the Air Force issued a statement on 20 September to the effect that P78–1 had "satisfied all of its programmatic basic research requirements" and was only "marginally" operable when it was shot down. Major Richard Ziegler added that the commanding officer of the NRL was "aware of the fact that the satellite was going to be used." He did not know whether individual researchers had been told. Although the Air Force bought a special target vehicle for the ASAT to hit, it developed electronic problems and had to be returned earlier this year for repairs. Rather than postpone the shot, the Administration decided to go ahead, using a real satellite as a target.



Original data from Solwind appeared in Science, *26 February 1982, p. 1097. These images taken in August 1979 show a previously unseen comet approaching the sun (hidden by shading device) and dissolving (middle and right).*

Alternatives to the P78–1 were considered and rejected, for reasons the Air Force declines to spell out. It is known, however, that the P78–1 flew in a low polar orbit 514 to 541 kilometers above the earth. In briefing reporters on the day of the ASAT test, Air Force Lieutenant General Bernard Randolph said that P78–1 had "outlived its useful life," and newspapers described it as a "dead" satellite.

"I was really surprised to hear it called obsolete," says David Rust, a solar specialist at the Johns Hopkins University Applied Physics Laboratory. "It has been the backbone of solar coronal research in the last 5 years because Solar Max [NASA's Solar Maximum Mission satellite] was out of business so much of the time." Rust adds: "It would have been highly worthwhile to continue with the coronal measurements."

"It was very sad to see it go," says Christopher Russell, a solar physicist at the University of California at Los Angeles. Solwind "was like an old friend up there . . . not one of the more glamorous projects, but it did a particular job very well." The loss will be mitigated, but not replaced, by data coming from the Solar Max satellite, which was out of commission for a time, then fixed in April 1984 in the first shuttle repair mission.

Like the defunct P78–1, Solar Max carries a coronagraph, an instrument that transmits images of the fiery halo around the sun. Rust and Russell say the data that came from Solwind were unique. They represent a very long (7-year) run of information from a single, consistent measuring device. The images include the full corona out to 10 solar radii while Solar Max covers only quarter-sections of the corona out to 6 radii. The narrower, fragmented view of Solar Max makes it more difficult to use its images to interpret large solar events or to correlate them with interplanetary phenomena.

The NRL research was noteworthy for several reasons, according to physicists interviewed by *Science*. One of Solwind's spectacular feats was to record the path of at least four small comets as they collided with the sun. The findings, published as cover stories in *Science* and *Nature* (February and November 1982, respectively), hinted that the number of such "stargrazing" objects was greater than assumed. Another contribution was the thorough classification of a series of dramatic events over much of the 11-year solar cycle. Solwind began operating 3 years after the last "solar minimum," when eruptions were relatively small, ran through the solar maximum of 1980, and was recording the closing phase of the cycle when it was shot down. "It's a great shame it wasn't allowed to continue through the end of the cycle," says Bruce Woodgate, project scientist for Solar Max at NASA.

An additional value of this research, according to solar physicists, was that it

*D. J. Michels, N. R. Sheeley, Jr., R. A. Howard, and H. J. Koomen of the E. O. Hulburt Center for Space Research, NRL.

confirmed the relationship between eruptions from the sun and magnetic and density shocks passing through the solar system. These shocks are of more than academic interest, for on Earth they disturb the magnetosphere, often interfering with electronic communications. They can also pose special risks for astronauts and equipment in space. "The Air Force is always interested in this kind of data," one researcher says, "because when something goes funny with a satellite, they want to know if it was the result of a natural event or something done by the Russians."

The Space Environment Services Center in Boulder, Colorado, relied on Solwind for similar reasons. The center makes regular space weather forecasts, reporting on such things as solar wind, radio emissions, and magnetic disturbances. The forecasters checked Solwind data at times in an effort to anticipate magnetic storms arriving from the sun. While the agency has put in a request for a new source of environmental data, says Joseph Hirman, the proposal may take a decade to get through the space bureaucracy. One reason for the delay is that it has become prohibitively expensive to launch new satellites, each of which must prove its worth in a competitive funding environment. Solwind was a hardy and productive gadget that far outlived its expected lifetime.

As for P78–1, it is gone but not forgotten. According to one government official, the satellite has shattered into "in excess of 100 observable pieces." Observable in this case means detectable by radar, being 10 centimeters or more in diameter. U.S. space agencies track more than 4000 bits of debris in orbit, roughly 9 percent of which were created by Russian ASAT tests since 1968. Now an American test has increased the junkpile by 2 percent. The low-orbit pieces will fall and burn up within a few years.

In the meantime, the remains of the satellite pose a certain hazard to anyone or anything wandering into its former neighborhood. Even a 4-millimeter particle can damage a spacecraft, and a 1-millimeter paint chip may be able to puncture an astronaut's space suit. The space shuttle encountered a large paint chip on its seventh mission in 1983 and suffered a damaged window. According to NASA, the malfunctioning electronics boxes recently brought back from Solar Max were peppered with paint-chip impacts. As a result, NASA scientists are asking U.S. and Soviet officials to curb the rapidly growing problem of space pollution from ASAT tests.

Satellite P78–1 thus enters a new era of macabre celebrity, becoming more glamorous in death than in its hard-working life.—**ELIOT MARSHALL**

NSA to Provide Secret Codes

The NSA proposes to supply codes to government agencies and to banks and industries in the private sector; but only the NSA will know how the codes work

The National Security Agency, concerned that the nation's communications security is grossly inadequate, is preparing to expand its role, adding a new dimension to its nature and mission. Rather than concerning itself mainly with breaking foreign codes and supplying codes for the government to use in protecting classified information, the NSA is going to supply codes to anyone who may need them. This includes banks, industries, and others in the private sector. The agency also will be in charge of the cryptographic needs of all government agencies, including agencies such as Health and Human Services, for example, as well as the Department of Defense, which already uses the NSA's codes. In short, says Michael Fleming, who is head of the new industrial relations group at the agency, the NSA will become a service agency.

The impetus for the NSA's new program is its concern that inadequate protection of computers and computer communications in this country contributes to what the agency views as a hemorrhage of U.S. technology to the eavesdropping Soviets.

The way the new program is planned, the NSA will give the code-making algorithms to qualified U.S. companies with appropriate security clearances. These companies will produce the codes in the form of small pieces of hardware. Because these codes are secret, even the users of them will not know how they work. These trusted companies will sell the hardware to U.S. companies or government agencies. The computer chips with the codes on them will be designed to prevent "reverse engineering" so that it will be nearly impossible to examine the chips and figure out the coding algorithms.

The NSA will review the communications security needs of all the government agencies—not just the Department of Defense—and will tell them which codes to purchase. It can only advise the private sector but, says Walter Deeley, who is deputy director for communications security at the NSA, "I will try to identify vulnerabilities. I will tell them where they can be had and how they can be had."

To encode with the NSA's algorithms, each user needs a key in addition to the computer hardware. Keys are individualized—like locks on doors they enable the same basic coding scheme to provide security for a variety of different users. The NSA will supply keys to all government agencies that use the new codes. Of course, anyone who has a key for a particular code can both encode and decode messages with it, but the NSA, says Deeley, will not keep the keys it supplies. "I wouldn't even know where to store them," he says.

Banks and companies in the private sector will be given three choices. They can buy keys, at cost, from the NSA, or they can buy keys from a trusted company, or they can ask the NSA for instructions on how to make their own keys. However, cautions Deeley, "It is not a trivial thing to produce a good key." Those who make their own keys do so at their own risk. The NSA will not vouch for the keys' ability to protect the encrypted information.

As might be expected, the NSA's plans are controversial. Critics are concerned by the increasing power that the NSA is acquiring and with the agency's plans to keep its encryption algorithms secret. Allan Adler, an attorney at the American Civil Liberties Union's Center for National Security Studies in Washington, D.C., remarks, "Putting the NSA in charge ensures a one-dimensional approach. The NSA operates largely in secret and has no feeling for the protection of individual privacy or access to the government's information. The NSA's ex-