Soviet Killer Satellites: U.S. Ponders a Response

After a four year hiatus, the Soviet Union has resumed the testing of "killer" satellites which could threaten vital U.S. reconnaissance, military, and navigational satellites. The new tests have revived a long standing debate in government circles as to whether the United States should accelerate development of antisatellite weapons and whether its own, apparently highly vulnerable satellites, should be further protected.

The United States has made it known that it would consider the destruction of its satellites as a highly hostile act. A full scale antisatellite attack would probably occur as a prelude to World War III, but a killer program could be used to harass U.S. satellites. U.S. officials become tight-lipped when asked whether such harassment already goes on, using current technology, and whether the United States can discriminate between harassment and simple malfunctions.

The mood of the Air Force, the Defense Communications Agency, and the intelligence agencies whose satellite networks could be affected one day by an operational Soviet killer program is difficult for an outsider to determine, since the entire subject is tightly classified. But background comments by several officials indicate that some of them are concerned. Yet there seems to be uncertainty as to the success of the Soviet tests and its ultimate aims. "We're not pushing the panic button," says one Pentagon official, "but we're not shrugging them off, either."

A killer satellite is one designed to approach another satellite in its orbit, identify it, and then explode to destroy or disable the target. Technically, the problem is similar to designing an antiballistic missile: In the vast reaches of space can you hit a bullet with another bullet? Can you at least make it pass close by?

Serious, unclassified literature on the subject is loaded with Buck Rogers–style suggestions. A killer satellite could destroy the target when it was out of range of the home tracking station. Then, as far as the tracking station was concerned, its satellite would have simply malfunctioned. Or the killer could approach a reconnaissance satellite and blind it by spraying its lenses with paint.

The five Soviet launches believed to comprise killer satellite tests were reported independently by the Soviet news agency TASS, the North American Air Defense Command, and the British Royal Aircraft Establishment. According to TASS, satellites were launched on 12 February and on 9 July. These are believed to have been the two target satellites. There appear to have been three interceptor satellites, of which a pair, launched on 16 February and 13 April, seem to have been aimed at the first target satellite. The third interceptor, launched 21 July, seems to have been aimed at meeting the second target satellite. However, it exploded early in its journey and did not get anywhere near the target's relatively high orbit.

According to unclassified sources, the United States flies several vital satellites at orbits close to those used in the Soviet series—which ranged from 2101 to 149 kilometers. Many of the U.S. photographic reconnaissance satellites fly very close to the earth—from 120 to 250 kilometers.* U.S. "electronic ferret" satellites, which collect all kinds of eletromagnetic transmissions—from radio communications to data relays—fly at from 400 to 1000 kilometers above earth. A key U.S. Navy navigational system, the Transit satellite, flies at approximately 800 to 1000 kilometers from earth. Weather and earth resources satellites are also within these ranges.

There seems to be some debate about the relative success or failure of the Soviet tests. The Pentagon's views of them, as reflected in the aviation trade press, is that they have not been successful. But Charles S. Sheldon, II, of the Congressional Research Service, a leading civilian expert on the Soviet space program, suggests on the basis of unclassified information, that the first interceptor test, launched on 16 February, may have been successful. Its orbital characteristics suggest that it may have tried to co-orbit with the target satellite. The fact that it dropped into the Pacific, instead of exploding in orbit distant from the target, suggests the Soviets retained good control over the spacecraft. Sheldon believes there may be two programs, one, for satellite inspection and identification and represented by the 16 February test, the other, a killer satellite program, using more elliptical orbits and a quick bypass of the target.

If U.S. analysts conclude that the Soviet program has any chance of success, pressures could increase to move ahead with space militarization efforts which for years have been kept in the research stages. U.S. policy, adopted since the beginning of the civilian space program, has been that its activities in space shall retain a peaceful cast.

Politically, this policy has led to an international prohibition on the placing or testing of nuclear weapons (called "weapons of mass destruction") in orbit or on "celestial bodies," and a U.S.–U.S.S.R. agreement made at the strategic arms limitation talks not to interfere with each other's "national technical means" of verification (which includes reconnaissance, but may not include electronic ferret or navigational satellites). On the other hand, no treaty, not even the 1967 Outer Space Treaty, prohibits research and testing of nonnuclear weapons in outer space.†

Thus, U.S. space policy is to some extent ambivalent. On the one hand, it places strong emphasis on peaceful activities. But, on the other hand, U.S. officials cannot safely ignore that the Soviet Union seems to be exploiting the fact that space is only partially reserved for peaceful uses.

If the United States adopts a more active military stance, a number of programs, most of them highly classified, could receive a boost. An example is the $27 million high energy laser research sponsored by the Advanced Research Projects Agency (ARPA), which in recent years has been redirected towards outer space applications—largely against other satellites ("but we're not building a satellite to put laser weapons in space" protests one ARPA official).

The Lincoln Laboratory in Massachusetts is developing for the Air Force two experimental satellites, LES 8 and LES 9 which will be radioisotope powered, rather than solar powered. Most U.S. satellites are powered with solar panels, but these are highly vulnerable to a nearby explosion—nuclear or otherwise. (In a civilian version of this sort of space war gaming, critics of plans for a giant

*Ted Greenwood, *Scientific American* **228**, 14 (February 1973).

†U.S. Senate, Committee on Aeronautical and Space Sciences, *Soviet Space Programs, 1966–70* (92nd Congress, 1st Session, 1971), pp. 461–463.

orbiting solar power station to meet future U.S. civilian energy needs have noted that such a station could be easily sabotaged.)

Still another program is the so-called "dark satellite" program, said to be an effort to design "invisible," communications satellites with minimal spectral signatures, and possibly even covered with peculiar mirrors to camouflage them in sunlight. Said to be sponsored by Defense Research and Engineering, the satellites would be placed in orbit 115,000 kilometers from earth, in a turned-off mode. Recently, Pentagon officials have been hinting darkly that there may already be such satellites, hiding deep in space and ready to take over if some other, vital satellite fails.

While the real answer is obviously classified, the outside observer asking whether U.S. satellites are indeed vulnerable must conclude that in fact they are. They could be put out of commission by an operational killer, or by a large explosion somewhere near their orbital path, or by some more sophisticated weapon, such as one using a high energy laser (which the Soviets are also developing). It is equally obvious that, even though defense communications, submarine navigation, and other vital functions rely on other systems as well, military programs in general are becoming more and more reliant on satellites. For example, the much-touted revolution in precision-guided weapons which could give the U.S. a decisive new edge over the Soviets in a tactical war in Europe, will rely heavily on satellites. "We keep preaching to everyone that what you need is a mixed bag," laments one Defense Communications Agency official. "But the plain fact is that satellites can do whatever job you need done better than other systems. The worst thing about satellites is that you come to depend on them."—DEBORAH SHAPLEY

International Biological Program: Was It Worth the Cost and Effort?

For a 7-year period ending in 1974, the United States participated in the International Biological Program (IBP)—an ambitious effort that was supposed, in this country at least, to revolutionize ecology and usher in a new age of "Big Biology." Some 1800 American scientists engaged in IBP work, supported by $57 million in federal grants plus substantial contributions from other organizations. It was the largest research effort ever launched in biology, a field which had traditionally been dominated by individual investigators working on small-scale problems.

But was it worth the money and effort expended? That question is directly addressed by an evaluation committee appointed by the National Academy of Sciences, the organization that served as home base for American IBP leaders during most of the program's active life. Curiously enough, the evaluation committee never explicitly answers its own question. It simply finds that the program produced some major accomplishments, had some acute problems, met some goals, missed others, and turned in a "creditable" performance, considering that it was greeted with apathy and hostility by key elements of the scientific community and had enormous difficulties meshing its goals with those of granting agencies.*

"It's a minor miracle the program worked as well as it did," says Paul J. Kramer, the retired Duke University botany professor who headed the Academy's evaluation team. Kramer told *Science* that, while his committee never quite stated that the program was worth the time and money, virtually all members of his evaluation team did in fact conclude that it was. "I believe it was fairly unanimous," he said. "We weren't ducking the issue. We just didn't want to take an advocacy position."

Kramer's group was established by the Academy in 1973 to review the organization and management of the American IBP effort to see if lessons might be derived to assist future international programs of similar scope.† The committee interviewed key federal officials, read IBP documents, obtained detailed statements from some 35 participating scientists, interviewed faculty members on several campuses, sent a questionnaire to 100 or so participants, and obtained comments from foreign scientists. The committee submitted its report to the National Science Foundation (NSF), which funded the evaluation effort, last December, but the document has only become available in recent months through the National Technical Information Service. It is one of two major evaluations of the American IBP program. The other, conducted by Battelle Columbus Laboratories, focused on three of the major ecosystems studies that were part of the American effort (*Science*, 28 May, p. 859).

The origins of the IBP can be traced to discussions that started in 1959, apparently inspired by the accomplishments of the International Geophysical Year, but it was not until 1964 that the international effort really got under way with a general assembly in Paris of scientists from 32 countries.

The initial American response to the program was marred by bungling among the scientific leadership and opposition or indifference among working scientists. "It started out very badly," recalls Kramer. "There was not enough groundwork done in advance. There was very little attempt to acquaint the scientific public with what was planned. It was all thought up at the higher levels by scientific politicians—those scientists who like to develop programs. The ecologists and biologists were told very little about it. So it was difficult to work out programs that would attract them."

A U.S. national committee operating under the International Union of Biological Sciences was in charge of organizing the American effort from 1960 to 1965. According to the Academy's evaluation, it strongly favored an international program but made little effort to inform the biological community or obtain funding. It just assumed that biologists would participate and that funds would be forthcoming, probably from NSF.

Both assumptions proved overoptimistic. The NSF had already been

*The committee's 81-page report *An Evaluation of the International Biological Program* is available from the National Technical Information Service, Springfield, Va. 22161; PB 253 158; $5.00 paper, $2.25 microfiche.

†In addition to Kramer, the evaluation committee included Fred R. Eggan, University of Chicago; John A. Moore, University of California at Riverside; A. G. Norman, University of Michigan; Charles E. Olmsted, University of Chicago; Frederick E. Smith, Harvard University; Earl L. Stone, Cornell University; and Roy A. Young, Oregon State University.