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THE MILITARIZATION OF OUTER SPACE:

IMPLICATIONS FOR ARMS CONTROL VERIFICATION

by

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THE MILITARIZATION OF OUTER SPACE
IMPLICATIONS FOR ARMS CONTROL VERIFICATION

Introduction

The title includes a word that is subject to various interpretations. For the purpose of this paper, "militarization" will be taken to encompass two types of activity. The first involves what could be described as "non-aggressive" applications, such as reconnaissance, surveillance, signal monitoring, communication, and many other functions that do not include destruction by active weapons in space vehicles. The second, more aggressive application in which weapons will be carried into space, could be labelled as "weaponization".

There are two aspects to the topic: the use of space vehicles as a means for the verification of arms control agreements concerning weapon systems of all types, and the problems of verifying arms control agreements that concern space vehicles as objects of control.

Quite a lot has been learned about the first, since space vehicles have proven extraordinarily successful for the verification of agreements concerning strategic weapons, and also some other types of weapons.

Not much has been learned about the second, since few arms control agreements exist regarding space vehicles, and not much has yet developed in the placing of weapons in space.

The Use of Space Vehicles for the Verification of Arms Control Agreements and also for the Monitoring of Crises

Space technology is making it possible to launch ever larger space vehicles, to construct and repair objects in space, and to maintain human astronauts in orbit for long periods. But quite apart from the increasing size, and the ability to have human operators in the vehicles, the instruments of observation have allowed remarkable results to be achieved by small unmanned satellites.

Verification of arms control treaties, and confidence in the assessments of many of the key elements of military strength, are coming to depend more and more on the extraordinarily detailed photographs now taken by reconnaissance satellites and returned to earth by actual recovery or by radio link. These have allowed the deployment of the major strategic weapons, such as ICBMs, missile-firing submarines, and bomber aircraft, to be monitored with high confidence, and have made possible the close observation of military activities in times of crisis. Because photography depends on good lighting conditions and the absence of clouds, it may require many days to build up complete coverage of a large area by satellite photography. The method is most useful in the monitoring of large static installations over an extended period.

Supplementing the information gathered by photographic means, several other types of satellite-borne sensors have been extremely successful in the monitoring of the tests of weapons, including rockets as well as nuclear devices. The launching of large rockets can be detected by the infrared emissions from the powerful boosters, while control signals, radar, and telemetry from missiles and space vehicles in flight can be detected by electronic intelligence satellites. Thus, the experimental tests of new weapons can be observed in some detail, providing the means of verifying undertakings not to develop certain systems, as well as valuable information concerning what is being developed. Explosions of a nuclear device at or above ground (or sea) level anywhere on earth would probably be detected by one of the space vehicles instrumented for that purpose.

It must be remembered, however, that much could be done to deny effective observation by satellite. Installations could be camouflaged or covered over, exposure of moving vehicles could be kept to the hours of darkness, and telemetry could be enciphered. Instead, except for a few exceptions, it has been the policy to give tacit assistance to this monitoring by non-intrusive national technical means, by not adopting passive means of interference and concealment. In fact, some arms control agreements contain clauses forbidding interference with what are described as "national means of verification".

It is far easier to verify an agreement for the complete prohibition of some type of weapon than an agreement to keep the number below some agreed (positive) ceiling. This is true a fortiori if the weapons are mobile and nearly identical, since the first detection of a weapon in a new location may or may not represent redetection of one formerly seen (and counted) somewhere else. Similarly, an agreement to confine deployment to certain restricted regions would be easier to verify than one allowing deployment anywhere. The point is that detection of one object, where none are permitted, is clear evidence of a violation, whereas an estimate that more than N are present where only N are allowed, based on x actual detections, is no more than a statistical inference, unless $X > N$. It is in the nature of high resolution photo satellites to return daily samples covering a quite limited area, rather than complete and near-simultaneous observation of a large area. Consequently, it might take quite a long time to infer with high confidence that a "breakout" beyond the agreed number of weapons in a large area had occurred.

The same photography, and recording of radar, communications, and telemetry, that is so useful for verification of arms control agreements and monitoring of the testing or deployment of weapon systems, can be used to observe military activities during a crisis, and could also be employed for the planning and conduct of military operations, including a surprise attack. For these purposes radar satellites could prove valuable adjuncts, since they can make their observations at night, and through cloud, and are better than photographic satellites for the surveillance of surface ships over large areas of ocean. But the observation of military activity during a crisis has a stabilizing character insofar as it can provide the defending party with reliable early warning of the approach of missiles, aircraft, or warhips. Today the most dependable warning of the launching of large rockets, whether from land or sea, and whether for test or for attack, comes from surveillance satellites. Although the technology is not yet proven, it is probable that tracking by satellites of aircraft and possibly cruise missiles at any altitude will become feasible.

Thus we see that the remarkable capabilities of satellites for detecting activities on the earth's surface provide an extremely valuable means of verification for arms control, as well as services to the gathering of military intelligence that could be used for crisis management, or for both offensive and defensive purposes in war.

Other Military but not Aggressive Uses of Satellites

There are several other applications of satellites which have proven of immense value for non-military activities, but which also serve military purposes, and therefore could conceivably become the objects of arms control. Of these, by far the most important is for long distance communications. The limitations of unreliable radio paths and narrow bandwidth submarine cables and telephone lines can be completely overcome by the use of communications relay satellites. Weather prediction has been advanced by enormous steps due to the observations of meteorological satellites. Mapping and delineation of earth resources owes great debts to photo, geodetic, and other types of scientific satellites. However, communications are vital for military as well as commercial operations, and it has been estimated that 70 to 80 percent of American military intercontinental message traffic is now routed by satellite, as is the "Hot Line" link enabling the leaderships of the USA and USSR to communicate in time of crisis. Meteorological forecasts can be of vital importance for the conduct of military operations, especially for the planning of a surprise attack. Accurate navigation, especially in bad weather, is important to the efficiency and safety of commercial ships and aircraft. Navigation satellites are making this possible, but can also be used to provide accurate guidance to bomber aircraft, to submarines, and to missiles in flight. And precise geodetic information is essential for the accurate delivery of long range inertially-guided ballistic missiles.

In summary, most of the new capabilities that are so useful for peaceful commerce can also be used for military purposes, some of which are offensive and some defensive.

The Placing of Weapons in Space (Aggressive Use)

The purpose of all of the functions of satellites discussed so far was to return information to earth. Two other military functions could be to attack objects on earth, or to attack other objects in space. The prohibition by the Outer Space Treaty of the orbiting of "weapons of mass destruction" forbids the mounting of nuclear weapons in a satellite. Given the high reliability and accuracy of ballistic missiles, there seems little reason to put a nuclear weapon in a satellite with the intention of returning it to attack a target on the ground. If, however, a country wished to employ an electromagnetic pulse to damage both satellites in orbit and electrical equipment on the ground over a very wide area, it is probable that this could be done by the detonation of a nuclear explosion in a satellite.

For the attack of satellites in orbit, two methods have been developed already, and at least one more is on its way. Between 1960 and 1971, the United States experimented with ground-based missiles, designed for the ABM role, launching an antisatellite (ASAT) warhead to make direct ascent to intercept orbiting satellites. At the same time the USSR developed ASAT satellites to be launched from the ground and manoeuvred into an orbit nearly coincidental with that of the target satellite. This latter method has the advantage of allowing leisurely inspection of the target satellite, if the intercepting satellite has the necessary instrumentation. The Soviet test program was reactivated in 1976, and has included explosion of the ASAT vehicle. The USA is now perfecting an ASAT interceptor, to be launched from an F15 fighter aircraft, and subsequently climbing to collide with the target satellite. None of these three ASAT systems uses a nuclear weapon, or appears to break the proscriptions of any arms control treaty. They would probably not be able to intercept satellites orbiting at high or medium altitudes.

Of all the new weapon technologies under research today, the one that appears to have the largest ultimate potential for space applications is that of Directed Energy Beams. Three possible ways of accomplishing something like this are to generate beams of charged atomic particles, beams of electromagnetic radiation with wavelengths in the optical band, or intense bursts of X-rays engendered by a small nuclear reaction. To make effective weapons, it would be necessary to generate high power, and to be able to direct the energy in a narrow beam that could be finely focussed and aimed with great accuracy.

If Directed Energy Weapons (DEWs) are to be used against satellites or missiles in flight, it is not clear whether it would be more practical to mount the projector on the earth's surface or in a space vehicle. The earth's atmosphere is likely to pose difficulties for efficient propagation of the energy, suggesting that the space-to-space path may be the most effective. On the other hand, generation of a high powered beam requires heavy equipment and large quantities of fuel or power, probably too much to be easily accommodated in a space vehicle.

Since ballistic missiles are considered to be far more of a direct threat than are satellites, there is more interest in Ballistic Missile Defence (BMD) than in ASAT. BMD is a more difficult task, since a small reentry vehicle with a protective heat shield is a much tougher target than a satellite equipped with delicate instruments and solar panels. If a BMD system attempts to engage a missile in the first part of its trajectory, the missile's booster rockets are far more vulnerable than the reentry vehicles. Moreover, any early slight deviation from the intended trajectory will probably prevent accurate delivery of the warheads. For this type of interception it would certainly be necessary to mount the antimissile device in an orbiting space vehicle. Boost phase intercept offers the added advantage of engaging before multiple warheads have separated on their separate paths.

A BMD system attempting to engage the missile in mid-course (after the end of the propulsion phase) could be based in space or on the ground, while one designed for interception in the terminal phase of the missile's trajectory (i.e. just prior to and during atmospheric reentry) would probably be based on the ground. Both might rely on information fed to them by a satellite or high-altitude rocket able to track the missile, and perhaps to distinguish actual warheads from decoys intended to confuse the defence.

When the possibility of a Ballistic Missile Defence is taken into account, two conclusions emerge regarding the "militarization of space". First, it is quite probable that, should a future BMD system emerge, it will involve space vehicles, whether as carriers of sensors or of the ABM weapons themselves, and especially if the system carries out its interception in the boost phase or in mid-course. Second, should mid-course or terminal phase BMD be deployed, it will also have an ASAT capability against satellites in low-earth orbit.

If no restrictions are placed on ASAT, and if Directed Energy Beams can be made into effective ASAT weapons small enough to be carried by space vehicles, a whole host of different types of space warship can be imagined, even if BMD should not be pursued.

In summary, the most probable reasons to put weapons into space are for the attack of ballistic missiles in flight, or of satellites in orbit. It is also possible, however, that BMD or ASAT will be pursued by methods basing the weapons on the ground, but with sensors needed for fire control in satellites.

The Detection of Weapons in Space

If a country able to put large satellites into low earth orbit chose to mount nuclear weapons in some of the satellites, the presence of the weapons would be very difficult to detect. It seems unlikely that any test program would offer the opportunity for observers to deduce that nuclear armed satellites were being prepared.

In the case of antisatellite weapon systems, it is probable that extensive testing programs would be observed, thus permitting the development of the systems to be discerned. The launching of ground-based rockets sending interceptor vehicles to orbital altitudes should be detectable, whether the intercept were direct ascent or co-orbital. The launching of a smaller intercept vehicle from an aircraft might be harder to observe. Before Directed Energy Weapons could achieve the power and degree of control necessary to attain an ASAT capability, it is probable that the experiments associated with their development would become known. If weapons under test were mounted in experimental satellites, this might be evident from the size and shape of the vehicles. However, once an ASAT system had completed development, it might be much more difficult to detect whether and in what numbers it might have been deployed in an operational status, especially in the cases of surface and air launched missile systems. An ASAT satellite might be recognizable in orbit, especially if an inspection satellite could be brought close to it, but it would be very difficult to identify an ASAT weapon on the launching pad or on an airfield. It is too early to say what ASAT DEWs may look like, but they may be large and recognizable, whether on the ground or in space. To make the task of verification difficult, it may be that a very small number of ASAT satellites could provide a very significent capability.

ABM satellites are in space today, for the purpose of launch warning. But before a space-based active ABM system were to be developed, a great deal of experimentation of an observable type would be necessary. If a system were operationally deployed, it seems probable that the large number of satellites needed for launch phase or mid-course intercept would be easily identifiable.

If these assessments are accurate, they suggest that, if an agreement is desired to prohibit ASAT, it would be very much easier to verify its compliance if it were signed before the development program had proceeded to the point where deployment had become possible. For some systems, it may be too late already. In the case of the prohibition of ABM systems, it seems that there is a reasonable probability of observing a violation of an agreement not to test, or not to deploy.

Conclusions

If "militarization" of space includes the accomplishments of reconnaissance and ELINT satellites, it must be concluded that the contributions to verification of arms control agreements and to assessment of the magnitude and direction of adversary's weapons programs have been extremely beneficial for the stability of international relations.

As a general conclusion, it would appear that the most effective way to secure a verifiable agreement to prohibit a particular space-based weapon system is to forbid testing as well as deployment, and to sign the agreement before the development program has proceeded very far into the testing phase. It will be much easier to detect forbidden tests than forbidden deployments.

Another conclusions, related to the use of photographic satellites for the verification of compliance with agreements to limit deployment on the ground of certain types of weapon, is that it is going to be much easier to verify an agreement to deploy O weapons in a particular area than one to deploy no more than N weapons.

If agreements involving weapons in space are to be negotiated, or other agreements whose verification can be aided by instruments in space, the conditions to permit adequate verification must be built into the terms of the agreement itself. Verification is too important to be fitted in after the agreement has been signed.

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