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THE ROLE OF TECHNOLOGY
IN COVERT INTELLIGENCE COLLECTION

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Background

Beginning with World War II technological methods of collecting intelligence have become increasingly dominant over the traditional agent, informer, or defector as sources of information, particularly in areas affecting national security. Stealing plans, infiltration of agents into laboratories, visual observation of new weapons have become more and more difficult and unproductive. Even if a spy might succeed in getting a look at a new weapon, he might not be able to acquire important information since this might be obtainable only with a scientific instrument. Thus, a person watching a nuclear explosion would learn little other than that it went off with perhaps some estimate as to whether it was large or small; but a seismic instrument or an acoustic listening device half way around the world could tell the explosive yield, and a filter in an aircraft at this same distance could collect particles from which the secrets of the internal design of the bomb could be determined.

Fortunately, as the usefulness of human beings for collecting intelligence has decreased, the science of technical intelligence collection has grown dramatically. Not only has collection technology improved, but the very nature of modern military weaponry has made the task easier to accomplish in less provocative ways. Nuclear explosions release tremendous amounts of energy, and modern missiles travel along trajectories observable hundreds or even thousands of miles away. Radars and communications systems frequently bounce energy off the ionosphere so that the signals can be received at long distances. Modern weapons and their logistic support are easily observable by aerial photography. As a consequence, available information on even the most secret military weapons and on the deployment of forces even in remote localities is far superior to what it was twenty years ago.

When President Eisenhower made his famous "open skies" proposal calling for unrestricted, but monitored overflight of national territories on both sides of the Iron Curtain, we considered that its acceptance would have gone a long way toward thawing the Cold War. The Russians disparaged it as legalized espionage. Today, thanks to technological improvements, our capabilities for obtaining military information far surpass any that we dreamed of under the Eisenhower plan and, surprisingly, the Soviet Union in the 1972 SALT Agreements sanctioned the right of the United States to have pertinent military information provided that it was obtained by national technical means that were not in violation of international law.

In view of the overwhelming priority of technological intelligence collection in the overall intelligence picture, it is most appropriate that the role of this technology be examined in considerable detail as a part of the Conference Study of the entire intelligence process. This paper will attempt to analyze the usefulness of the major technical methods of intelligence collection and consider the political risks and provocations which they entail. These, of course, could vary considerably depending on the conditions surrounding their use. For example, an electronic receiver on a ship far out in international waters is quite different from one planted surreptitiously within a Soviet missile test center.

Communications Intercept

One of the oldest forms of intelligence collection is the interception of other parties' communications. Early man undoubtedly watched hostile smoke signals and attempted to decipher the messages being transmitted. However, this form of intelligence collection took on a whole new significance with the advent of radio communications, which not only heralded a tremendous increase in the volume of information communicated, but also presented valuable new opportunities for listening in on the messages being transmitted. Since such listening was so inherently easy, a new field of countermeasures was developed to protect the privacy of radio communications. Encrypting messages became a standard procedure for disguising the content, and this, in turn, promoted a science of deciphering the codes. The race was on as one side attempted to improve the security of its communications system while the other side attempted to break through these barriers. Because this was a game of counter-measures and counter-counter-measures, dark secrecy was applied to efforts in this area. Successes had to be concealed in order to prevent them from being countered in future situations. The classic publicized case was the U.S. breaking of the Japanese codes before World War II. The secrecy over this success was probably in no small part responsible for our failure to take advantage of it at the time of Pearl Harbor.

Today, there is probably little question that methods are available to insure that any specific communication can be made invulnerable to being read. One time cryptographic techniques make breaking specific messages almost impossible. However, in the real world there are practical barriers toward establishing such tight security on all communications. The volume of communications, even in the national security area, is so large that it is not possible to use such methods for every message. Furthermore, the operation of any system is always subject to human or mechanical errors and, in cryptography, these can lead to the compromise of information. To minimize this problem, resort is often made to the use of land lines, short range line of sight radio transmissions, or reduction in the power of the transmitters in order to limit the opportunities for intercept.

Finally, even if a message is transmitted in an unbreakable code the intercept of the communication may still produce meaningful intelligence information. For example, the fact that points A and B are communicating gives by itself a useful piece of datum since it shows some connection between the two points; this can often be a clue as to the nature of the work at A and B. During World War II, the transmission of messages from Los Alamos, a deserted school site in New Mexico, and the War Department, to say nothing of the University of Chicago, Hanford in the state of Washington, or Oak Ridge, Tennessee, would have provided an important lead as to the nature of the activities being carried out in the Los Alamos area. The activation of communications links between a missile launch site and a missile impact point would be an important indicator that a missile might shortly be fired. Since it is well known that these types of communications could provide clues to the hordes of analysts involved in communications intelligence, communications security has to go farther than just establishing codes. It must control the volume and nature of the traffic on any communications link and frequently pass false messages in order to hamper traffic analysis. Thus, it will be seen that communications intelligence is a vast game of cops and robbers in which each side is continuously trying to outwit the other. Secrecy is an inevitable component in this game which must be played if this information source is sufficiently valuable.

There would seem to be little question that this form of intelligence collection is vital not only in the national security, but in the political area as well. Intercepting communications can provide a wealth of useful information on governmental plans and thinking. Different parts of a modern bureaucracy must communicate to operate. While the most sensitive messages can be kept secret, many of the less critical ones can be intercepted and understood. Furthermore, much useful information must be transmitted completely in the open, and occasionally this can prove to be of vital importance. For example, at the end of August, 1961, a woman listening to open radio transmissions within the Soviet Union at a receiver in the eastern Mediterranean heard an advance press release with a three-day embargo announcing that the Russians would resume nuclear testing. She recognized the significance of this message, pulled it out of the mass of transcripts which were being made routinely and forwarded it by priority to Washington. This unclassified message gave President Kennedy advance notice of the Soviet intentions to terminate the nuclear test moratorium and the opportunity to take political action to forestall this Soviet move. Unfortunately, the government decision-making bureaucracy was too cumbersome and, in the end, the President docilely allowed the Soviets to recommence testing. An important political opportunity was lost. This is a good example of where intelligence was good but was of little value because of unwillingness to act upon it.

The usefulness of communications intercept in the national security field is so great and all-encompassing that the selection of specific examples can be misleading. Almost all military activities both in peacetime and in war are heavily dependent on communications. If these can be read, then national security would be greatly enhanced. In the event that military forces were to be used in a surprise aggression, widespread communications would be needed between their various elements. The understanding of even one of these messages might give advance warning and eliminate the surprise. It could be the difference between national survival or collapse. It should be remembered that the communicator normally has to send thousands of messages, while the intelligence collection system can perhaps succeed in breaking the system by a single success. Even if the content of the messages cannot be read, the increased volume of communications could frequently be the indication that some operation is imminent. Communications between military aircraft and the ground are an important source of intelligence on military operations. In the heat of battle, communications security is frequently very poor.

As mentioned previously, messages passed on a missile test range or at other weapons test sites can provide important clues as to the nature of the weapons system involved. For example at the Atomic Energy Commission's (AEC) test sites in Nevada and Eniwetok, scientists were in constant communications between various instrumentation stations and the laboratories at headquarters. Although there were strict injunctions on communications security, any recording of these messages would certainly have provided invaluable information on the nature of the tests and their results. Security had to rely primarily, but not always successfully, on the fact that the frequencies and power used in the communications system were such as to limit the range over which they could be received.* As technology has improved, however, the ability to pick up weak signals, to use computer techniques for pulling information

* Sometimes communications can inadvertently mislead. In 1958, the Russians were obviously listening to communications at the Eniwetok test site. They heard messages sent for a rehearsal and mistook this for an actual test. Later, in commenting on the extensive U.S. testing program at the Geneva test ban negotiations, they wrongly listed this as an actual U.S. nuclear test.

out of the noise, and to understand better the nature of an anomalous radio transmission has made it easier to overcome attempts to conceal the messages. Computers are also critically important for cryptoanalysis, although never sufficient to break a truly first class communications code. The counter-measure counter-counter-measure battle continues today, albeit at a much higher technological level.

What are the political implications of intercepting governmental communications? Secretary Stimson is reported to have said before World War II that "nations, like gentlemen, do not read other people's mail." This highly moral attitude has long since disappeared from the conduct of nations, and no longer is the public horrified at the thought of such operations. All countries take for granted that attempts are being made to intercept their communications and employ the best counter-measures of which they are technically capable. This, of course, works to the disadvantage of less affluent and less developed countries since they neither have the resources nor the sophistication to carry out such operations on a sufficiently extensive scale.

The provocation from this type of operation depends primarily on the means and location by which the intercept is carried out. Much of this can be done from international waters or from friendly countries bordering the target area. In the latter case, political sensitivities can be raised since most nations do not wish it known that their territory is being used as a base for intelligence operations against their neighbors. However, such operations are so widely practiced that they now are rarely the cause for international protest. The use of friendly countries as a base does, however, create a degree of indebtedness to that country which can sometimes be a political liability. We are prone to support regimes which allow us to use their territory even though the objectives of that regime may not be compatible with our basic political goals. This is a problem which applies to cooperation in intelligence gathering generally and is probably less serious in the communications intercept area than in more clandestine or provocative operations.

For some types of communications, receiving at a distance is not practical, and this leads to operations which can be much more provocative. For example, for the intercept of certain air defense communications it may be desirable to fly very close to the border. This can be much more provocative and occasionally errors can occur in which the aircraft accidentally overflies another nation's territory. This can be the cause of major incidents. Even more provocative would be a situation in which the aircraft purposely intruded across the boundaries of a country, but this probably rarely occurs any more; certainly not by the United States over Russia or by Russia over the United States. However, both countries may have truly covert communications intercept operations inside the other nation's borders. These might be for the purpose of intercepting some highly sensitive communication link which could not be picked up at long range. Such an operation, of course, has all the political risks of any covert operation and would only be practiced under highly critical situations.

A new form of communication employs satellites as relay stations. Since these are for transmission over very long distances they are easily intercepted without the need for provocative collection operations within the territory of the communicating country. In general, therefore, such satellites would not be used for highly sensitive messages unless some unbreakable code were used. In theory, satellites can also be a platform for communications intercept, but since satellites in normal orbit traverse the nation at a very high rate of speed, they would provide only intermittent information. A stationary satellite over a particular location has to be more than 20,000 miles out which reduces greatly its effectiveness in receiving radio signals unless they are beamed directly to it. However, if it could be used for this purpose, it certainly would not be provocative since satellites for intelligence collection are now internationally accepted. (See section on Photo-Reconnaissance.)

Electronic Intelligence (ELINT)

A similar type of technological intelligence collection is the intercept of radio waves of a non-communications type, particularly those from radars. This type of intercept, known as ELINT in the intelligence jargon, first came into being with the advent of radar in World War II and has since blossomed into a very extensive intelligence activity. Radars are now the eyes of almost every aspect of military operations. In addition to detecting and tracking hostile aircraft and missiles, radio beams are used for guiding defensive missiles toward the incoming targets. Although many modern offensive missiles now rely on inertial or laser guidance techniques to avoid the chances of their being jammed, radars are often used for offensive missilry as well. Radars are critical to all manner of naval operations. Thus the collection and analysis of ELINT has become a very high priority task of all military intelligence organizations.

Radars, if they are to be of any military use, must be continually exercised. An air defense radar which is not turned on provides no defense at all. Furthermore, training must be continuously carried out to insure that they are operated properly. All of these factors provide frequent opportunities for carrying out ELINT operations. Countermeasures, such as with the coding used for communications transmissions, are not available to maintain security. The only protection is to restrict the operations of the radars to locations well within the interior of the country so that the opportunities for ELINT collection are minimized. However, even this is not feasible since most air defense radars must be located near the border, aimed out, in order to detect aircraft flying in. The same is true for ballistic missile defense radars. Moreover, even for tactical electronic equipment, maneuvers must be carried out and, particularly in Europe where the most advanced systems are likely to be employed, these must be held in regions susceptible to observation by foreign intelligence.

However, despite the increased opportunities for ELINT collection, all such operations are not necessarily nonprovocative. In order to detect anti-aircraft radars located along the periphery of a country, it is frequently necessary to fly aircraft and sail ships close to the borders in order to intercept the signals. Frequently, such operations are subjects of international incidents. The Pueblo seizure off the coast of Korea is an example of one in which the intercept platform, this time a ship, was seized in international waters, although operating in a perfectly legal manner. On another occasion of more doubtful legality a U.S. RB 47 flying along the Russian arctic coast was shot down and the crew captured in 1960. We insisted that the plane was always over international waters, but the Russians claimed we had penetrated into their air space. When the crew was returned as a part of the detente at the beginning of the Kennedy administration, the crew members admitted having been over Russian territory thus at least partially substantiating the Russian claim.

Even when over international waters, such operations can be provocative and are often a potential source of international incidents. In order to insure that the radars will be turned on and functioning in a truly operational mode, the aircraft frequently approach the coast as if intending to penetrate the national boundaries. It is not surprising that under such circumstances, trigger-happy air defense personnel are inclined to take counteraction. Furthermore, the scale and number of such operations is probably much larger than can be really justified on the basis of military need. There is always a tendency in such a situation to repeat and repeat operations with the consequent increased probability that an incident will occur. Greater restraint on the part of those authorizing such operations would probably reduce international tensions without any serious loss to national security.

A related type of intelligence collection normally classed under ELINT is the intercept of telemetry signals from new weapons testing programs. In order to develop a new missile or carry out a space mission, a nation must equip its test vehicles with instrumentation to measure the functioning of various components, and the only way in which the data from these instruments can be relayed back to the test site is by radio-telemetry. Since in many cases the telemetry signals will be receivable at long distances from the source, the opportunities for intercepting such signals from without the country are great. Interpretation of the signals may be more difficult than for the nation which was originating the telemetry, but, nevertheless, useful information can frequently be obtained on the nature of the test program. An example of conspicuously successful telemetry intercept was at the time of the first Soviet manned space flight. U.S. receivers in the Aleutians were able to pick up the television pictures of the astronauts as they were being transmitted back to the

Soviet Union so that U.S. authorities were in a position to know simultaneously with the Russians that the mission was a success. Soviet secrecy had led to considerable skepticism over their claims of space superiority, and these intercepts provided the data for an independent analysis of their achievements. Similar telemetry intercepts provided much of the information which Secretary Schlesinger and his predecessors have published on the details of the Soviet missile test program.

Since most of this collection can be carried out at long distances and outside the territories of the testing country, it is not provocative and therefore not a source of international friction. Truly covert ELINT operations within the country are rarely needed or feasible, but in some areas the territories of friendly countries are required as a base of operations. This could on occasion lead to political embarrassment and an undue dependence on the good will of that country in order to obtain permission for the operations. A case in point is Turkey which is strategically located opposite the southern border of the Soviet Union where much of the Soviet missile launching and other weapons testing occurs. It is no secret that the United States has many stations in that country for the collection of such information, and the continuance of these operations is dependent on maintaining good relations with the Turkish government. These relations were recently subject to strains as a result of our desire to persuade the Turkish government to halt the cultivation of poppies, a major source of the illicit drug trade in the United States. The United States could have been hampered in its representations to Turkey by the desire to keep these strains from reaching the point where we would lose our receiving sites there.

The reentry part of the Soviet ICBM test ranges is either on the Kamchatka peninsula or in the Pacific Ocean, so observations can be made from U.S. territory or international waters, obviating the political difficulty of dealing with other foreign governments. Intelligence on Soviet MIRV programs is thus easy to obtain without any political hazards.

Unfortunately, satellites are not ideal platforms for intercept of signals from those portions of the test ranges in the interior of the USSR because normal altitude satellites traverse the target area so rapidly that the duration of any single intercept is very short. Thus it would be easy to schedule launchings so as to minimize useful coverage by the satellite receivers. The intercept from stationary satellites at a distance of more than 20,000 miles is greatly handicapped because the long range reduces the strength of the signal to an intolerable extent.

Radars for Intelligence Collection

A final form of electronic intelligence collection is the converse of ELINT, that is the use of active radars to observe a missile in flight. This type of collection, known as RADINT, involves the transmission of easily detectable radio signals so it cannot be done clandestinely. It has been used very successfully to observe missile flight testing by operating high-powered radars within line of sight of the ballistic missile trajectory. By this method the United States was able to confirm the first Soviet ICBM test flight in 1957 and to keep track of virtually all launchings of long-range missiles since that date. The deployment of such radars on native territory is of course non-provocative since radiation has no effect on the object in space. However, as in the case of the telemetry receivers referred to earlier, the radar had to be located in Turkey in order to observe the launch ends of the Soviet medium, intermediate and intercontinental range ballistic missiles. Although there was a moderate amount of secrecy associated with this radar installation to avoid undue provocation, it could not be kept from the Russians since it was a large installation which transmitted very powerful radio waves. To the best of my knowledge no official protest was ever made to Turkey over this installation. However, it did increase U.S. dependence on Turkish good will. The more that such type of technological intelligence collection is recognized internationally as legal, the less will be the dependence on good will of the nation for its continued deployment. The United States and the USSR have now endorsed such national technical means for use in verifying arms control agreements. (see page 21.)

A new form of RADINT which can perhaps become of increasing value and which would present even fewer international problems would be the use of over the horizon (OTH) radars. Since these do not require line of sight location, they do not need to be located in sensitive areas. However, at present, such technology is not as advanced so that the quality and thus the value of the information gathered would probably be considerably lower. So far only the wildest and most impractical schemes have been suggested for using satellites as radar platforms. Side looking radars, flown in aircraft, have been developed for observing ground targets, even through cloud cover and at night, but the quality of the information obtained is relatively low when compared with optical photography. It is unlikely that overflight of hostile territory would ever be undertaken in peacetime for this type of intelligence collection so such radars would only be useful for observations of areas close to the border.

Nuclear Test Detection Methods

A special class of technical intelligence techniques includes those which have been devised for the specific purpose of detecting and obtaining information on nuclear tests. Ever since the first nuclear explosion, an important intelligence goal has been to acquire knowledge of nuclear tests carried out by foreign governments and insofar as possible to gather as much information on the nature of the explosive used. As a consequence, over a period of years a series of highly sophisticated scientific methods were developed and put into operation. Fortunately, nuclear weapons produce such large scale phenomena that they are easily observed at very long distances from the source and, therefore, do not require the intrusion into the territories of the testing country. Measurements can in many cases be made half way around the world, but since broad geographic coverage is frequently desired, particularly if information on source location is needed, collection stations have been placed in friendly countries. Although such operations were often kept secret in order to avoid possible embarrassment to the host nation, this precaution was probably exaggerated since no one has ever questioned the legality or desirability of gathering this type of information. The value and effectiveness of the various techniques were freely discussed in open negotiations which began in 1958 and led to the Limited Test Ban Treaty of 1963. There have been continued international information exchanges since then in attempts to negotiate a comprehensive test ban. Rather than being considered provocative, the collection of information on nuclear tests is looked on as a contribution toward reducing the risks of nuclear war.

These specialized techniques included seismic and acoustic receivers which could pick up the shock waves transmitted through the earth and air and provide data on the location and size of the explosion. Recordings of the electromagnetic waves produced at the moment the explosion occurred provided supplementary information. For detonations which took place in the atmosphere or which vented into the atmosphere, the collection of the radioactive debris provided unequivocal evidence that it was indeed nuclear in origin and most importantly, information on the nature of the explosive device. All of these techniques were refined until a very sophisticated intelligence collection system emerged and made the nuclear programs of any nation testing in the atmosphere relatively open. Since 1963, all tests except those carried out by France and China have taken place underground so that detailed information available from radioactive debris analysis has been denied. Since very small amounts of radioactive material are needed to carry out detailed radio chemical analyses, the debris does not need to be collected close to the source. Aircraft flying over international waters and, in many cases, on the opposite side of the world, are quite satisfactory for sampling the bomb clouds. Thus, this very useful intelligence technique does not involve any provocative action. Occasionally, bases from which the sampling aircraft take off were located in foreign countries in order to obtain cloud samples within a shorter time after the explosion, but the use of such bases has never generated any international repercussions. Overflight of non-friendly nations was never required.

Photoreconnaissance

While all the foregoing technological methods of intelligence collection are extremely useful for the maintenance of adequate information to protect our national security, they are dwarfed in importance by photoreconnaissance. A picture is worth a thousand words--and often many reels of recorded radio signals. Photography provides easily understandable evidence even when a skilled photo-interpreter is needed to describe the object on the film. It has applications in almost every intelligence area, whether it be scientific, political, economic or military.

While photoreconnaissance has long been an important tool of intelligence, recent technological advances culminating in the capability to obtain useful photography using satellites as platforms have completely revolutionized the entire intelligence collection process. No longer can any nation hide its military and industrial activities behind an Iron Curtain. Only those facilities, equipment, or forces that can be continuously kept under a non-revealing cover, such as underground or in an innocuous structure, can be concealed; this can rarely be done. The mission of an agent to procure information on troop dispositions, missile deployments, or submarine construction has now been eliminated. An entire country can be photographed within a few days, the only limitation being the degree to which clouds interfere, and almost no area in the world is continuously cloud covered. Thus, with persistence any target is now subject to photo observation.

Aerial reconnaissance dates back to the first availability of the airplane, and probably the most valuable function of aircraft in World War I was to carry out visual reconnaissance. By World War II the sophistication of both the aircraft platform and its photographic systems was greatly improved, and aerial reconnaissance was an important combat mission. However, the risk of a single aircraft operating on a reconnaissance mission being shot down was very high so that its usefulness was somewhat restricted. With the end of open conflict the value of photographic reconnaissance became very limited because of the political and physical hazards of penetration beyond foreign borders. While such overflights probably occurred, they were certainly very limited in number. They could only be justified for the most critical intelligence missions and occasionally resulted in the loss of the aircraft and crew. A few abortive attempts were made to use balloons as camera platforms, but this misguided effort collapsed without many tears being shed by the intelligence community. They were both provocative and non-productive.

In 1955, the effectiveness of the Iron Curtain in obscuring Soviet military developments became intolerable to U.S. security planners as the Russians gradually accumulated nuclear weapons of greater and greater power and sophistication. Under CIA direction a crash program was initiated to develop a very high altitude long-range photoreconnaissance aircraft equipped with the most advanced state-of-the-art photographic equipment. Its ability to fly above Soviet interceptor or missile defenses was its only protection; it could, however, be observed and tracked by Soviet radars so that its presence was known. On the other hand, it had no capability for offensive action. This new aircraft, nicknamed the U-2, was truly a revolutionary technological achievement and became operational in 1956 just at a time when fears were being aroused over the burgeoning Russian ballistic missile program. Overflights of critical areas in the Soviet Union were carefully programmed, and for the first time the Iron Curtain was significantly lifted.

Although the Soviet leaders knew of these overflights, they refrained from public protest since they did not wish to admit to the vulnerability of their air space--a good example of a most provocative intelligence collection program which was protected by its immunity from counteraction. However, by May 1960, perhaps with the assistance of a bit of luck, the Russians finally managed to shoot down a U-2, and the international uproar that followed brought this program of overflight of the USSR to an end. However, the useful reconnaissance life of U-2 type aircraft continued, and this type plane discovered the Soviet missiles being deployed in Cuba and also provided photographic coverage in many troubled areas of the world even up to the present time.

Although the U-2 was invaluable in collecting the only information then obtainable on a wide variety of high priority intelligence targets within the Soviet Union, it still was far from an ideal reconnaissance platform. Because of the political sensitivity of overflights, the number of sorties was kept very limited, perhaps of the order of thirty during the four years that it operated in that theater. More importantly, the area that an aircraft could cover in a single flight was limited to at the most a swath approximately 100 miles across and about 300 miles long. As a consequence, only the highest priority locations could be targeted for coverage, and large areas of the Soviet Union remained completely blacked out.

When fears of a missile gap arose in 1959, every effort was made to find possible ICBM launch sites; this was the primary mission for the ill-fated flight in May of 1960. No such operational launchers were ever located by a U-2, but because of the limited area covered, the negative results were no proof of their absence and did nothing to allay fears that deployment was under way. The Soviets had a fully tested and operational, so-called SS-6, ICBM, and the logical assumption was that it was being deployed. The failure of the U-2 to find launchers could not dispel the belief that they were there. It was not until more than a year later, when satellite photography with the capability of large area coverage became available, that one could establish that the Russians never deployed more than a handful of their first generation ICBMs.

Aircraft photoreconnaissance has tremendous value in some situations since the vehicle can be easily directed on short notice to a specific location, can take a high resolution picture, and can give a planner useable information within a few hours after the return of the plane. It has the disadvantages of the need for a base within range of the target, of limited area coverage, of vulnerability to destruction and, most importantly, of being extremely provocative. It is hard to tell whether a plane is carrying a camera or a bomb. This hostile characteristic frequently destroys completely its value as an intelligence tool in peacetime. Because of their flexibility, aircraft will probably continue to have limited utility as platforms for photoreconnaissance despite these drawbacks. The United States has already available a successor to the U-2, the SR-71, and the Soviet Union also has planes for this purpose. Other nations use them as well and in times of actual armed conflict they become essential.

October 4, 1957, however, marked the beginning of a new era which culminated in the current revolutionary improvement in capabilities for photoreconnaissance.* On that day the Soviets orbited their first satellite which traversed the United States and many other countries of the world and set the precedent for making legitimate space transit of national territories without permission of the states involved. No request was ever made for permission to carry out this operation, and no complaint was ever voiced by the Soviet Union when the United States followed suit the next year. No other country has ever raised the question of legality, and thus the first steps were taken toward the establishment in customary international law of the freedom of access to outer space for peaceful and scientific purposes.

Of course, these early satellites did not contain any cameras for taking pictures of the territory over which they passed, but the precedent had been set, and it was not long thereafter that at least crude reconnaissance capabilities became available. In 1960, the United States orbited weather satellites capable of making low resolution photographs of the earth, i.d., photographs which could define large geographical features such as lakes, but not smaller manmade objects such as buildings or vehicles. In April 1961, the Soviets placed Astronaut Gagarin in orbit around the earth so that at least limited visual observation would have been possible. Still no complaints on the part of any nation. Admittedly, these early space flights were of no practical value for intelligence purposes, but they did help set the stage for international approval of satellite reconnaissance.

Already by May 1960, when the U-2 aircraft was shot down over the Soviet Union, the United States had foreseen the

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* This material on satellite reconnaissance is drawn from a chapter by the author entitled "A Leap Forward in Verification" in the book SALT - The Moscow Agreements and Beyond, Free Press, 1974.

eventual demise of aircraft reconnaissance over many foreign countries and had proceeded with a program for developing methods of obtaining similar information from satellites. But in the spring of 1960, this new camera platform was still not fully operational. As mentioned earlier, fears of widespread Soviet ICBM deployment that could not be confirmed or put to rest by the U-2 or other intelligence sources resulted in the creation of the so-called "missile gap," an important campaign issue in the presidential elections of that year. There was no disagreement even within the Eisenhower administration that the Soviets had more ballistic missiles than the United States, only on the size of the gap and its military significance. The Air Force saw the gap as very large and the significance as horrendous, while the President was less concerned since he felt the U.S. bomber deterrent was more than enough to compensate for the reasonably estimated disparity in missile force levels until the U.S. missile program could catch up. By the end of 1960, satellite photography was starting to be available and during early 1961, the missile gap began to shrink and, by the end of 1961, U.S. authorities confidently discounted the existence of any missile gap. Apparently the Russians had deployed at the most a handful of their cumbersome first-generation SS-6 missiles. The ability to carry out satellite observation of large areas of the Soviet Union with sufficient photographic resolution to spot missile silos had proven that the launchers were not hidden even in the most remote parts of the USSR.

The Soviet Union proceeded with a parallel development of observation satellites, and both nations improved the capabilities of their systems throughout the 1960's. By 1964, Secretary McNamara was regularly reporting publicly on Soviet strategic deployments and in 1967 President Johnson extolled the virtues of the U.S. space program for protecting our security. In recent years, Secretaries Laird and Schlesinger have described the Soviet strategic posture in detail, frequently announcing new construction very shortly after it began and accurately describing the size of Soviet missiles. Neither country, however, publicly admitted the method by which this information was obtained in order to avoid a political confrontation and a possible international uproar which might have raised questions as to the legality of such operations.

Instead, there was a tacit recognition of photographic satellite capabilities by both sides and perhaps an increasing realization that the availability of the information to the other nation provided a stabilizing influence.

Satellite reconnaissance has a number of major advantages over that carried out by aircraft in addition to its invulnerability and international acceptance. A satellite in an orbit of 100 to 300 miles altitude can survey very large areas in a very short time period. If a satellite were launched in a north-south polar trajectory, then the entire earth could be covered, once in daylight and once at night, every 24 hours. Thus, a satellite camera platform is ideally suited for searching large areas to determine the presence of military equipment and installations. A satellite at these altitudes would normally have an orbit period of approximately 1½ hours, thus permitting 16 orbits of the earth each day. For complete daily coverage of the earth's surface at 45^{o} latitude, the camera would have to photograph a swath 1,100 miles wide. Since most of the USSR lies north of the 45^{o} latitude, a camera that could observe 600 miles on each side could cover the entire USSR in successive passes. Since this wide a swath might unduly degrade the quality of the picture, it may be more practical to photograph a narrower strip of the earth, leaving gaps in the coverage which can then be filled in on subsequent days. This gap-filling can be accomplished by selecting an orbital period which is not an even fraction of 24 hours so that the identical path over the earth will not be covered on successive days. The satellite programming must, of course, take into account the hours of sunlight, but a complete survey should be obtainable in 3 to 4 days. Some areas will inevitably be screened by clouds, so observation of the entire country cannot be counted on in any given flight. While certain parts of the world are covered by clouds a large part of the time, they are never covered 100 percent of the time, and the entire world is thus always potentially exposed to satellite observation.

Since the wider the swath, the poorer will be the photographic resolution, a narrower band would have to be photographed in a single pass for detailed examination of an object. This can be accomplished by longer focal length cameras which can be programmed to look at small areas. Thus, a survey type system might locate a missile silo while a high resolution system could measure its dimensions and determine its characteristics. Apparently, at the present time, the United States and the USSR each have both kinds of systems, i.e., those that can photograph rapidly large areas with relatively low resolution, and other systems which can focus on specific locations deemed of interest as a result of the large area surveys. Judging by the details reported on Soviet weapons systems, the United States and probably also the USSR have a capability to resolve objects with a dimension of a few feet or even less. This would permit the observation of most items of military equipment exposed in the open, but the presence and characteristics of those under cover can only be inferred from the nature of the surroundings. The information obtained can be relayed back to earth by TV transmission, in which case the quality and resolution might be degraded, or by returning the photographic film to earth in a recoverable capsule. In the case of TV transmission, the time lag between observation and the availability of the information at a command center can be very short--hours or less, but if the film must be returned to earth, the delay can be days or even a week or more.

In the early 1960's, while the early reconnaissance satellites were being gradually improved, debate was simultaneously proceeding on the international legality of such operations. Although the principle of free access to space for peaceful purposes was universally recognized from the outset, considerable debate ensued concerning the definition of the term "peaceful." In 1962, in the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space, the Soviet Union proposed that the "use of artificial satellites for collection of intelligence information in the territory of foreign states is incompatible with the peaceful objective of mankind in its conquest of outer space." The United States, while not accepting that reconnaissance satellites were "incompatible" with the peaceful uses of space, was, nevertheless, a strong advocate of restricting the use of outer space to non-military purposes. This apparent inconsistency in position was clarified by a later U.S. statement that reconnaissance was non-aggressive and, therefore, should be considered peaceful and essentially a non-military use. The

United States argued that observation from space is consistent with international law just as is observation from the high seas.

This difference in point of view between the United States and the Soviet Union was finally resolved in the fall of 1963 when the Soviet Union suddenly dropped its insistence on including a ban on space reconnaissance and negotiated with the U.S. representatives a United Nations resolution* dealing with outer space which called upon all States to refrain from placing in orbit nuclear weapons or other weapons of mass destruction. The United States and the USSR had just previously stated their intentions not to do so without including any reference to the issue of reconnaissance satellites. This public change in Russian attitude may have resulted from their acquisition of a satellite reconnaissance capability of their own, although Khrushchev is reported to have stated earlier that satellite photography was permissible. In 1967, this U.N. resolution was broadened into a Treaty on Outer Space** which carefully omitted reconnaissance from the banned activities. However, no document during this period ever specifically endorsed the use of space for reconnaissance purposes.

The final seal of approval was placed on the use of space for photoreconnaissance by the ABM Treaty and the Interim Agreement on Offensive Weapons signed in Moscow in 1972. In these agreements the United States and the USSR agreed that national technical means should not only be used to verify the provisions of these arms control agreements, but also that these information collection methods should neither be interfered with, nor have deliberate concealment measures used against them. While satellite reconnaissance is not specifically mentioned in the treaty, the legislative history is clear that this was the key method of information collection being referred to. While these were bilateral agreements

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* General Assembly Resolution 1884, XVIII, October 17, 1963.

** Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies.

between the United States and the USSR, no other country has ever objected to such reconnaissance, and thus one can say that it now has widespread international legality. At last we have available a technological intelligence collection tool which is recognized as legal and, therefore, non-provocative. Space vehicles are not practical for launching weapons and so overflights by reconnaissance satellites cannot be considered as hostile acts. Furthermore, such reconnaissance has the capability of satisfying such a wide variety of information needs that it should reduce the justification for intelligence collection by many much more provocative methods. For example, aircraft reconnaissance could be largely phased out and the capability maintained only for extraordinary situations or potential use in wartime.

New Role of Technical Intelligence

A review of the overall field of technical intelligence collection demonstrates with little question its overwhelming importance in the entire intelligence picture. No other intelligence methodology even approaches technical intelligence in the breadth of its applications or in the quality of the information provided. It produces a wealth of hard facts much less subject to alternative interpretations than the information from other sources. No one questions its reliability as a source since it is not subject to manipulation like a human agent. Its data is invaluable for almost every aspect of military and national security planning. Even such limited arms control agreements as the partial Test Ban Treaty and the SALT treaties would have been impossible without technical intelligence data, and, more significant, disarmament will never be achieved without it. Even in the political arena, technical intelligence provides the factual background to assess the estimates of intentions derived from political analyses. It is similarly useful in the economic field where it provides data on industrial and agricultural programs without which too often one would be dependent on suspect published reports.

Technology has not only improved the intelligence data base, but it has done so with increasingly less provocation and fewer political risks. The use of satellite platforms are now internationally recognized as proper for the collection of what heretofore had been considered sensitive national information. Many other technical collection methods can be effectively used without intrusion across national boundaries. National technical means of verifying arms limitations have been legitimized in treaties between the United States and the Soviet Union. This is a revolutionary turnabout from the outcry which greeted President Eisenhower's "open skies" proposal.

The important question that should be asked is whether our national security planners and the intelligence community have adequately taken this new situation into account. We should not carry out politically risky agent operations when the incremental addition to data available by technical methods is not large. We should not carry out provocative peacetime aircraft missions when satellites can provide the same data even if the latter method is more expensive. We should not be negotiating arrangements with governments inimical to our democratic principles just to obtain a base for redundant information available from other sources. Aircraft and naval missions which run the risk of armed conflict should be carefully re-examined to determine their real priority in light of the new situation. Some of these new looks are undoubtedly taking place and may be behind the reported cutbacks and reorganizations in the intelligence community, but in light of the revolutionary changes wrought by improvements in the technology of intelligence collection, it is hard to believe that even more cannot be done.