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Eye Spy: The Utility of Strategic Satellite Reconnaissance

A Monograph
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The future direction of satellite technology will then be reviewed. This discussion will provide insight into what strategic intelligence collection capabilities will be available on future battlefields.

The monograph concludes that reconnaissance satellites can satisfy many but not all of our intelligence needs. Its use must be balanced with other intelligence collection resources.

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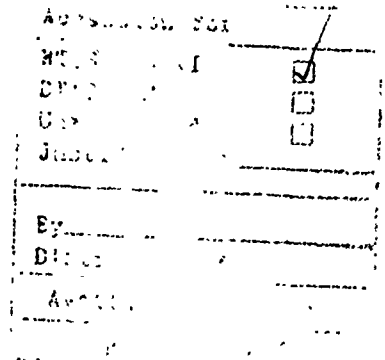

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Table of Contents Page

I. Introduction

> Now the reason the enlightened prince and the wise general conquer the enemy whenever they move and their achievements surpass those of ordinary men is foreknowledge. 1

In the 1960's, Bill Cosby teamed up with Robert Culp for his first successful television series. It was about two American intelligence agents who traveled the world and encountered many diverse situations. One technique they used to collect information on their enemies was visual, thus the appropriate title for the show, "Eye Spy." Little did they realize that this same decade, the US and the USSR would perfect an information gathering capability that would also initially collect visual information on the enemy in a much more sophisticated manner and thus provide the foreknowledge that Sun Tzu talked about. This paper is about that capability: the eye in the sky or in other words, strategic satellite reconnaissance - eye spy.

Bill Cosby was not the first person who needed intelligence. There has always been a need. Our need has increased over time as the threat has grown and we have made great technological leaps that have increased our ability to collect vital information. Sun Tzu spoke eloquently to this need when he said: "...know the enemy and...in a hundred battles you will never be in peril." 2 Although not as eloquent, Jomini also addressed this issue:

> Nothing should be neglected to have the military geography and statistics of neighboring States, to the end of knowing their material and moral means of attack and defense, as well as the strategical chances of the two parties...3

Soviet intentions drive our need for intelligence. Even though it appears that the Soviet "will" to wage war has eroded, their capability has not and there never has been a question in my mind as to what their intentions are in Europe: the political, economic, social, and military domination of the entire continent. Colonel William H. Janes addressed how this might be accomplished when he said:

> The Soviet strategy against NATO has stressed a quick surprise attack penetrating forward defenses and rapid advance to strategic depths of the alliance. This would deny full American mobilization and bring early political and military capitulation.4

Our great need for intelligence about the Soviets is derived from a desire to prevent a surprise attack in Europe. Intelligence can only prevent surprise attacks if it is both timely and accurate.

Timely is nothing more than getting information and processing it into intelligence prior to the event. A current report circulating among Army leadership speaks directly to the importance of timely intelligence when it states that a "No warning ("Surprise attack") at or near the NATO-proposed level of parity makes a successful NATO defense much less

probable."5

Accuracy addresses the truthfulness of the intelligence. This concept was not embraced by Clausewitz who thought that "...most intelligence is false,"...and "most men would rather believe bad news than good."6 Nonetheless, it becomes very obvious to even the casual observer that our need for accurate and timely intelligence about the Soviets must be satisfied by some intelligence collection capability.

I was also driven to write this paper by personal interest and a desire to determine the relationship between CFE (Conventional Forces Europe) negotiations and satellite reconnaissance. However, I quickly realized that intelligence requirements and the collection of intelligence in any theater are independent of force levels so I have not tied this paper specifically to the CFE issue but rather to Europe in general under any force ratio.

Can our need for intelligence about the Soviets be satisfied by the reconnaissance satellite? In this monograph, I intend to analyze that question by looking at the utility of strategic satellite reconnaissance.

I have focused this paper in several ways. First, as I have alluded to earlier, this report is written in a European context but is not tied to CFE. Next, there are four basic categories of satellites: photographic, electronic, early warning, and ocean

search. This paper will deal primarily with the first two types which would play the predominant role in a conventional war in Europe. Another point is that this is an unclassified report. It deals with satellite capabilities. The monograph does not address the product that is produced by the satellite. My intent is to provide information that is not restricted by security clearance requirements. This has not adversely impacted on the paper since I found a number of well researched sources that provided excellent unclassified information. Lastly, satellite reconnaissance is only one source from which intelligence is derived. This study does not consider other sources.

The following chapters will discuss a number of topics related to the utility of strategic satellite reconnaissance. I will argue that although satellites do provide a viable surveillance capability in Western Europe, they still have certain vulnerabilities and limitations that reduce their effectiveness. First, I will establish the context out of which satellite development evolved. Historical aspects of overhead reconnaissance will be reviewed with the primary emphasis since World War II. The next chapter will address current satellite capabilities. It is important that readers have a basic understanding in this area as we project to the future. I will then

conduct an analysis of these capabilities framed in terms of vulnerabilities and limitations to determine the utility of the reconnaissance satellite in a European setting today. The next chapter will discuss the future direction that satellite technology is following so that the reader will have a basic understanding of what support will be available on the next battlefield. The final chapter will state the conclusions that I have arrived at based on my research and analysis of this subject.

II. History

The major historical technological developments that led to our current satellite capability were the use of a balloon as an observation platform, the invention of the camera, and in the 1940's, the demonstrated practicality of rocket flight.[7] These events have contributed significantly to contemporary historical and scientific developments.

At the end of World War II, both the United States and the Soviet Union emerged as world powers. The U.S. already possessed the atomic bomb and was on the verge of developing the hydrogen bomb. Russia was not far behind and would close the gap much faster than was estimated at the time. Thus began the Cold War and an ever increasing need on the part of the United

States for intelligence on the USSR.

Under Stalin, the Soviet Union was a closed society where every means of disseminating information was controlled by the state. The USSR was a denied area for the purpose of intelligence collection and our means of obtaining information were limited. As our technology and the perceived threat increased, we quickly looked to aerial means as an effective way to collect needed information. It was certainly faster than using agents, generally more reliable, and lessened the danger that agents were exposed to, thus minimizing the possibility of international incidents when something went wrong with the aerial mission. The latter, of course, was true only as long as border routes were flown. As soon as penetration missions were flown, the possibility of international incident rose significantly as we learned from the Francis Gary Powers' incident.8 Planes could also collect information 24 hours per day in almost any type of weather. This was a cost effective technique.

Our first concerted aerial collection effort began immediately after World War II when we began to collect electronic intelligence (ELINT) by flying planes along the Soviet border. At this time, ELINT involved primarily the collection of radio and radar signals. This was a cost effective technique since these signals do not stop at the border and are an easy

way to obtain information.9 Because of the effectiveness of aerial platforms, they became targeted by the Soviets who began shooting down our planes even though they were flying over other countries or in international air space. They could not fly high enough or fast enough.10 By the late 1940's, 40 aircraft had been lost on reconnaissance missions.11

About the same time that we began using planes to collect information on the Soviets, we also began to look at the future use of space. As early as May 1946, the RAND Corporation issued the first in a series of reports and studies on the feasibility of satellites.12 This effort would eventually lead to extraordinary results as we shall see.

Another early effort in the aerial arena was the use of high altitude balloons. Beginning in 1947, we sent many balloons wandering across the Soviet countryside but the results were poor.13 The fact that we even tried this indicates how desperate we were to obtain information from the Soviet interior. Incidentally, this was not the first time that this technique had been tried. France was the first Western country to experiment with balloons as an intelligence collection platform in 1794. Napoleon quickly discarded this idea and we did the same.14 Balloons were totally dependent on unpredictable air currents to establish flight direction.15

The lack of a capable aerial photographic collection capability continued until the late 1950's when the U2 came into being as an operational aircraft. Although it did not fly very fast, it could fly at altitudes beyond the reach of existing weapons systems. It was our first effective means of overflying the USSR and it quickly began to produce 90 percent of our intelligence information on this denied area. 16 Probably more importantly, it pointed out how valuable satellite reconnaissance could be. The importance of the U2 reached its zenith at about the same time that we entered the satellite era.

Rocket development was obviously a requirement for satellite employment. The German V2 used in World War II demonstrated that large rockets were feasible. The invention of the transistor and solar cell reduced the size and weight of the vehicle and thus allowed for a larger payload. This also enhanced reliability and gave impetus to rocket and satellite development. 17 In 1955, the Air Force issued General Operational Requirement Number 80 which initiated the development of a reconnaissance satellite. The contract was eventually awarded to Lockheed in 1956 for the development of an Advanced Reconnaissance System which was initially known as the Pied Piper. It was to have both a photographic and electronic capability and the photos were to be either radioed to earth or deorbited

by the use of a capsule.18 Vandenburg Air Force Base was chosen as the launch site.19 Eastman Kodak would develop the camera.20

Our satellite reconnaissance development program was well under way by 1957 when the USSR launched Sputnik. Since the Soviets were first into space they gained considerable world prestige. This single event caused Pied Piper to receive top priority.

From 1957 to 1961, a phenomenon took place that was called the missile gap. It was essentially a disagreement between the CIA and the Air Force over how many intercontinental ballistic missiles (ICBM's) the Soviets had, compared to how many we would have. At this time, we had no operational ICBM's. They were being tested. It was estimated that the Soviets could hit targets in the US 30 minutes after launch; yet, it would take us two hours to launch only 134 bombers in retaliation. In other words, if true, we had no nuclear deterrent and could be subjected to nuclear blackmail. We also did not have the ability at this point in time to detect Soviet missile launch.21 This situation was eventually resolved by the U2, which brought back pictures of the Soviet Union showing that they essentially had no missile capability at this time. U2 accomplishments, such as this, added impetus to satellite development because the pictures it took were timely and the quality was excellent. It clearly

demonstrated the intelligence collection potential of a high flying collection platform. It also marked the beginning of a bitter rivalry between the CIA and the Air Force for control of the satellite reconnaissance program.

Our satellite development efforts finally yielded results. Discoverer I was launched on 28 February 1959 and signaled the beginning of operational testing of our first generation satellite. By 1962, the initial phase of the program had been completed and it had been demonstrated that satellite photography and capsule recovery were feasible.[22] The radio transmission of signals to earth had been previously abandoned.

The first high resolution satellite was launched in March 1962 and by 1963 we were into the second generation of satellites.[23] This involved the launch of two separate satellites: an area surveillance system known as the KH-5 and a close look capability known as KH-6.[24] The use of an area surveillance satellite in conjunction with a close look (point) satellite capability would continue.

By 1966, we phased into the third generation satellite which saw the launch of the KH-7 (area) and the KH-8 (close look).[25] This generation was distinguished by an improved high resolution camera. It also could use a multispectral camera (discussed later) or a mapping camera.[26]

The KH-9, better known as Big Bird, went into orbit in 1971 and represented the fourth generation reconnaissance satellite. It carried both an area surveillance and a high resolution camera and could see people on the ground for the first time.27 In addition to its photographic capabilities it could carry infrared and multispectral scanners.28

It was during the same decade that Big Bird became operational that we expanded satellite surveillance areas. The 1970's marked the first time that a country other than Russia or China had been covered by one of our satellites. Evaluation of technical data suggests that the mid-east was the target during the 1973 war.29

But Big Bird quickly faded into the background. The fifth generation, KH-11, went into orbit in 1976. This series did not use the traditional film to record pictures, but it used digital imaging and the signals were transmitted to ground stations. Because it was not inhibited by having to carry retrievable canisters, its orbit time was increased. It was an area coverage satellite and had a six foot resolution. With digital imagery, computers on the ground could now electronically manipulate the picture.30 Signals were sent to ground stations at either Fort Meade or Fort Belvoir in near real time.31

Prior to 1978, the U.S. had made a great effort

to keep everything relating to reconnaissance satellites classified. The reconnaissance satellite program was concealed in the overall satellite program. We had not officially stated that we had spy satellites. In October of that year, President Carter acknowledged for the first time that we did in fact have reconnaissance satellites.32

The KH-12 was launched in 1986 and it too incorporates digital imagery.33 It has both an area surveillance capability and a high resolution camera with a capability of six inch resolution. Photos are relayed to earth in real time and the satellite can be serviced by the Space Shuttle.34

The launch of the KH-12 represents another evolutionary step in the accelerated development of overhead reconnaissance. From its feeble steps in 1794 when the first Western observation balloon was flown, to the development of the camera in the 1820's, to the first heavy rocket flights in the 1940's, to the first operational satellite in the 1950's, the pace of technological development has blurred.

Because of these leaps in technology, our current generation of reconnaissance satellites gives us a number of excellent capabilities to collect information on the Soviets. We need to be aware of these capabilities as we analyze the utility of satellite reconnaissance. This will be discussed in the

following chapter.

III. Capabilities

Reconnaissance satellites have certain capabilities, which are broken down into two primary categories: photographic and electronic. Photographic satellites enable us to use electro-optical cameras to produce digital imagery. This allows us to image targets during clear weather, daylight hours. Images are obtained in a pixel format - similar to a television picture - which can be quickly transmitted to the ground. Satellites also have an infrared photographic capability that can image targets at night by detecting heat and a radar camera that can "see" through clouds.[35] Satellites can also be equipped with a multispectral camera.

The second category is electronic intelligence satellites. Electronic intelligence or ELINT satellites capture signals. This system is normally employed in conjunction with a photographic satellite and may be part of the same satellite or it may be a separate satellite. ELINT includes the collection of communication signals (telephone, radio, and microwave), early warning radars, air defense and missile defense radars, and telemetry.[36] Telemetry is a signal that is emitted by a missile starting prior to

launch and continuing during flight. This signal can give us information on missile design, the level of technological development related to missiles, missile accuracy, number of warheads and throw weight.37 ELINT is a valuable source of intelligence.

Our current ELINT satellite capability is known as Aquacade and was launched by the Space Shuttle in 1985. It remains in a geosynchronous orbit which provides continuous coverage of the target area. A geosynchronous orbit maintains the satellite over the same ground location at all times.38

It is important at this point to develop a basic understanding of these two capabilities. Beginning with the KH-8 satellite, it is estimated that we were able to achieve a six inch photographic resolution. This is sufficient to allow technical intelligence analysts to evaluate equipment characteristics. These satellites are also launched into a sun-synchronous orbit which means that each daylight orbit of an area is at the same sun angle. This allows the analyst to make evaluations of ground activity and equipment without being influenced by changing shadows. Using this employment method, the satellite makes one daytime and one nighttime pass of the target area each 24 hour period.39

By comparison with previous satellites, the KH-12 satellite carries a large amount of on-board fuel so

that it can maneuver down to a 100 mile high orbit which greatly enhances resolution. This in-orbit maneuver capability is important because the satellite can not maintain this height for very long before the orbit would begin to decay.40 Maneuvering up and down in orbit appears to be state of the art. Maneuvering from one geographical target area to another is also possible, but does not appear to be very common.

> Maneuvering in orbit was not, and still is not done routinely, however, since such changes risk malfunction. Maneuvering a KH-11 to increase coverage of the Iran-Iraq war in 1980 reportedly caused partial point failure.41

(In this instance, a point failure refers to the fact that the satellite did not work correctly after it arrived over the target area.) The camera carried on the KH- 2 can also counter various atmospheric distortions by using what is called adaptive optics which minutely vary the surface of the camera's mirror thus compensating for distortions and improving resolution.42 This data is relayed to a ground station located at White Sands Missile Range in real time by using a communications relay satellite known as the Tracking and Data Relay Satellite System (TDRSS). The TDRSS satellite has two high capacity channels which can handle 300 megabites of collected data per second.43

Imagery can be enhanced in several ways. One is by the use of a multispectral scanner which uses

several different lenses to take pictures simultaneously in different light ranges to include ultraviolet and infrared.[44] This allows for stereoscopic viewing of the target which leads to more precise measurement.[45] It also reveals things such as camouflage which would not normally be seen.[46]

As mentioned previously, another technique to enhance imagery is to manipulate the imagery using a computer. One specific technique is known as optical subtraction. The computer deletes everything on the picture that has been imaged previously leaving only that which has changed.[47] The satellite also has the capability to take slant angle photos as opposed to vertical shots which adds a dimension of detail to the picture.[48]

It would appear from the preceding discussion that reconnaissance satellites have extraordinary capabilities. They can collect both photographic and electronic intelligence, during day or night, and in all types of weather. Photographic resolution has been increased by several techniques to the point where we can see the proverbial needle in the haystack. Collected data is then forwarded by high speed data relay systems in real-time to ground stations. We have also developed several techniques to further enhance this collected imagery. It would appear that the reconnaissance satellite can satisfy all of our

intelligence collection requirements. But can it? The following chapter will analyze these capabilities to further determine the utility of the reconnaissance satellite.

IV. Analysis

Making proper use of good intelligence has made our country great and the leader of the free world. 49 This is not to say that there have not been intelligence failures, but to emphasize the growing importance of intelligence in today's world. Today, the need for intelligence in a European context has never been greater. If the intent of the US is to contribute to freedom and peace in Europe, then we will need intelligence so that we can mobilize and send troops at the appropriate time.

In this section, I intend to analyze our ability to generate intelligence in Europe using reconnaissance satellites. The purpose of this analysis is to determine the utility of reconnaissance satellites. In order for a satellite intelligence collector to be successful, it must be able to collect information, transmit it to the ground station where pertinent knowledge can be extracted from the data in a timely manner and subsequently forward this product to the consumer.

This analysis will address satellite limitations and vulnerabilities framed in terms of (1) usefulness of the information, (2) timeliness of the information, (3) the amount of coverage time that we can achieve, (4) and our ability to effectively retrieve information from the raw data.

We have recognized the USSR as our primary adversary since at least the end of World War II. While our current relationship changes, the dynamics of change and potential for conflict will increase our reliance on efficient intelligence in the European theater.

The first issue to be considered is the usefulness of the information that satellites collect on our primary adversary, the USSR. While there are critics of reconnaissance satellites, we have many people who will argue that there is very little question that the information obtained from them is highly useful. We have the capability to collect a number of different types of both photographic and electronic intelligence as discussed previously. There are numerous examples of satellites providing very useful data, but one of the more dramatic ones took place during 1970 - 1971. It was during this time period that we were conducting SALT (Strategic Arms Limitation Talks) discussions with the Soviets. It was important to have a precise count of their rocket

launchers and to prevent the introduction of new systems by concluding the treaty as quickly as possible. Consequently, there was great concern in the US when in late 1970, satellite photography revealed the construction of additional rocket silos in the USSR. Not only was this new construction but it appeared that the silos would hold larger rockets than were known to exist in this area. If true, the implication for the US was serious. We would be concluding a treaty with the USSR just as they had achieved an additional advantage in large rocket launch capability. The longer the talks continued, the greater our disadvantage would be. We complained to the Soviets about this apparent violation that was taking place at a critical time in the discussions.

The Soviets, in turn, assured us that new and larger missiles were not being introduced in this area, but that only hardened facilities were being constructed for existing missiles. Amazingly, in spring 1971, the Soviets lined up a complete set of silo liners beside one of the new silos. The liners were arranged in order of emplacement and were facing up so that we could evaluate their diameter in relation to the silo size. The Soviets also displayed a missile canister beside the silo. Once our reconnaissance satellite had imaged this target, we were able to

verify the Soviet story and reduce tensions over this issue. This is a good example of how satellites can provide useful data.[50]

Useful information may not be available if it is obtained from a deception operation and the resulting intelligence is inaccurate and misleading. We know historically that the Soviets extensively practiced deception and became adept at employing it during World War II. We also know that they are concerned about our ability to image targets in their country. Consequently, they initiated a concerted effort in the early 1960's to camouflage these targets which they hoped would provide us with useless information. They have emplaced dummy SAM sites and submarines, hidden missile silos (after they were built), erected false radar sites, and built mock aircraft.[51] This begs the question of how many targets they have successfully concealed from us. Additionally:

> ...the U.S. is particularly vulnerable to Soviet deception, due to: ineffective U.S. intelligence; preconceptions concerning the signals indicating the beginning of hostilities; an exaggerated view of Soviet inflexibility; assumed western superiority on a fluid and fast paced battlefield; Soviet knowledge of U.S./NATO doctrine, and force structure and wartime dispositions; overreliance upon technology and the lack of appreciation for the importance of operational deception.[52]

It is possible that we may obtain what appears to be useful information that we must react to quickly.

Consequently, we may be required to respond before the information can be verified using other sources. The usefulness of this information must always be questioned. There is great potential in this situation to incorrectly analyze the preliminary data and execute the wrong action at the wrong time. Clausewitz's lack of faith in intelligence again manifests itself in this area when he says:

> ...one report tallies with another, confirms it, magnifies it, lends it color, till he has to make a quick decision - which is soon recognized to be mistaken, just as the reports turn out to be lies, exaggerations, errors, and so on.[53]

Even with useful data from the satellite, it must still be correctly analyzed before it becomes intelligence. This is not always done well. Although this limitation applies to all intelligence systems, it remains a significant consideration in the context of reconnaissance satellites because of the value of the source. Additionally, the analysis must be accomplished in a timely manner, and then the data must be made available to the decision maker before the decision is required. Major Joe Bolick in his monograph tells us that there is great potential in this area for serious mistakes.[54]

Another area to be analyzed when evaluating the utility of satellite reconnaissance is timeliness. Timeliness of the information is critical. When information is received prior to an event, it is called

intelligence. When we receive it after the event, it is history. In other words, timeliness of information is directly related to usefulness. Whether or not the information will be received in a timely manner in the future is problematic, in part because the information must be transmitted to a ground station.

One hurdle that we may have to get over which could degrade timeliness is the disruption of ground stations of which there are only a few. These ground stations receive the data that is collected and transmitted by the reconnaissance satellite. We have to be able to receive the information before anything else can be accomplished in the intelligence process. These ground stations are fixed installations and because of the security classification of the satellite data and its sensitivity, the number of ground stations has been kept to a minimum. It would appear that the ground receiving stations could be disrupted either by direct or indirect Soviet action thus depriving us of necessary information at a critical juncture. This may be easier to accomplish than we are willing to admit. Satellites are of no value if we can not receive the data. Although it could be argued that the disabling of a ground station could be an indicator of hostilities or some other activity, I would be concerned that we may not read the indicator correctly or in time.[55]

Additionally, the satellites themselves could be attacked and disabled by either missiles, lasers, or killer satellites which would adversely affect timeliness. We know that the Soviets have conducted testing in these areas. In 1975, the IR source on a satellite over Russia was 'blinded'. This happened five times during October - November of that year. Eventually, the open press claimed that it had been disabled by a large fire caused by a ruptured gas line. As recently as 1982, a KH-11 over the USSR malfunctioned and again there was concern that it had been hit by a Soviet laser. Although we do not know for sure what caused these incidents, it is an area of continued concern and interest. If we are unable to collect the information, the result is the same as if we are unable to receive it after collection. It may also take us a considerable amount of time to determine if in fact the satellite was attacked or if it malfunctioned. Time is of the essence.

Time is critical when important decisions must be made. Although the probability of these situations happening today may appear to be remote, it would be foolish to discount them in the future. This area requires our concern and vigilance.[56]

In addition to the problems associated with the usefulness and timeliness of information, another potential limitation to be analyzed is the time on

target of the satellite. Coverage time varies by satellite type. Generally we have ELINT coverage 24 hours per day. This satellite is in a geosynchronous orbit over the USSR and is not greatly affected by weather. Photographic satellites on the other hand generally make only two passes per 24 hour period - one in daylight and one at night - and are affected more by weather, specifically cloud cover. While cloud cover is not the problem it once was, clarity and resolution are still degraded. This is being overcome somewhat by the introduction of radar imaging which looks through clouds but weather still poses a problem. Parts of Eastern Europe and Russia are covered by clouds as much as 60 - 70 percent of the time. Since area surveillance satellites can't look through clouds, in some cases it could take as long as 2 years, because of prevailing weather conditions, to get a photo of the target. We may not "see" an activity or we may "see" it too late to take appropriate action. For example:

> ...it is possible for the U.S. to be surprised by the sudden discovery of a facility well under construction, such as the Abalakova radar.[57]

Our ability tc get satellites into orbit and consequently maintain coverage time was also degraded when the Space Shuttle, which had become our primary means to launch satellites, exploded. Prior to this, we had come to rely on the shuttle as the primary means

of launching satellites. Our success up to this point had been so good that we considered a launch as a routine matter. Television provided little live coverage of launches and it had become only a minor footnote on the evening news. We were so confident that we even had civilians on the shuttle flight crew. A backup satellite launch capability was disregarded. We had to scramble to activate a backup launch capability when the shuttle was destroyed. Several of these rockets also malfunctioned when launched. This resulted in a degraded coverage capability. The thing to remember is that we must always maintain a second launch capability.

The last area to be analyzed is information retrieval. Our ability to retrieve critical information from available information and in turn produce intelligence is being overwhelmed by the sheer volume of data that the satellite is generating. The new capability to collect radar imagery from space creates more digital data than the TDRSS, our current communication relay satellite, was designed to handle.[58] This slows down our receipt of the information and appears at this point in time to be more of a limiting factor than the collector. Once we do receive this large volume of data, we do not have an automated method of sorting it, interpreting it, and subsequently producing intelligence. The early human

interface in the intelligence production cycle is still significant and we produce intelligence only as fast as the slowest analyst. Consequently, a lot of data is stored and not used simply because we can not manually sort through all of it. In this instance, too much information is almost as bad as not enough. A viable automated method to extract key data will not be in place for five years.[59]

Another limitation related to information retrieval is the demand placed on the system. We have grown accustomed to depending on the satellite for information. It has the capability to provide data on almost anything we desire. This has resulted in more and more governmental agencies asking for information than the satellite can provide even when other sources are available that could satisfy the requirement. Consequently, the system has more requests for information than the limited number of satellites available can provide and the demand is increasing. Consequently, requests must be prioritized and only the most critical of these get answered in a timely manner. There is great potential that we will not answer the most important question at the right time.[60]

So now as we look closer at the mantle of invincibility and extraordinary capabilities that shroud the reconnaissance satellite, we begin to see cracks. Yes, it can provide valuable information but

it also has limitations and vulnerabilities that must be taken into account. Let's consider for a moment a hypothetical situation where the Soviets and Warsaw Pact initiated a surprise attack westward. The intent of this excursion is not to portray a realistic World War III scenario - a number of books have already been written on this - but rather, to present a context that questions satellite utility as it has been developed.

First of all, some people would argue that from a political and world opinion point of view, this is an ideal time to conduct a surprise attack. The Soviets have many of us convinced that they are not the same threat that they were several years ago. They want the West to believe that their intentions are honorable and they are going to significantly modify over 70 years of communist ideology. However, a lot of this talk appears to be rhetoric. Their military capability has not been diminished. It is as strong today as it was in the past. In fact, military action would probably relieve some of the pressure being exerted in Eastern Europe and on the Soviet Union for rapid change. Furthermore, our attention is currently more focused on Central and South American drug issues and not so much in Europe. It is conceivable that any number of other international situations such as the invasion of Panama could take place at a given time that would further divert our attention.[61]

Two scenarios are plausible: a period of mobilization followed by a conventional war or a no-notice attack. In the first instance, it is assumed that it would take 14 days for the Warsaw Pact to mobilize while in the latter case, the Soviets could conduct a standing start attack and our satellites would provide no useful warning information.62 We will look at the former scenario. Let's suppose that the Soviets and Warsaw Pact have been conducting combined training exercises along the International German Border which they claim are at a force level that does not require observers. None have been invited. However, this is a deception. The size of the maneuvers are bigger than authorized. Additionally, large Soviet forces are rapidly moving forward under radio silence to reinforce exercise forces and Warsaw Pact reserve forces are being mobilized. In the mean time, Eastern Europe has been under cloud cover for a week with more bad weather forecast to roll in from the North Atlantic within the next 48 hours. Our only KH-12 satellite over Russia at the moment has malfunctioned for some unknown reason. We are diligently working to determine what the problem is and fix it if possible. It will be a period of time before we can launch a replacement or attempt to fix this one using the Space Shuttle. We are not alarmed.

It is imperative to the Soviet plan that our

satellites be ineffective at this point. Consequently, the Soviets are prepared to have a group of "narco-terrorists" attack our ground stations if it appears we will be able to repair the satellite prior to hostilities. They will claim that the attack was in retaliation for the killing of Jose Gonzalo Rodriguez Gacha, the Colombian drug dealer. The FBI will then begin looking for terrorists which would further divert national attention. Buried in a mountain of unevaluated data at Langley are several indicators of what the Soviets are really doing but this data will not be reviewed again and integrated with other data in time to develop the needed intelligence.

Our window in which to make a decision to send forces to Europe in hopes that we can either conventionally blunt the attack or deter it is between the 10 days of assumed NATO warning of an attack and the 14 days it is estimated to take the Warsaw Pact to mobilize.63 If we do in fact get 10 days warning, this is still probably not a sufficient amount of time to deploy enough forces to effectively influence the course of the attack. Reinforcement also assumes that the political decision to take this course is quickly made by the President.

The satellite is a valuable collector of intelligence that can provide warning information of a Soviet attack, but it has inherent defects. As we

decide the most effective way to employ its capabilities, we must also plan effective measures to counter its deficiencies. Over reliance on a system that is degraded by weather, over utilized, vulnerable to attack and deception leaves us exposed to a surprise attack.

V. Future Direction

We have made a large resource investment in satellite technology and operational employment. We also have a large stake in maintaining our lead in this area. The security of the free world may depend on what we are able to accomplish in this field. In this chapter, I will discuss what is on the horizon in terms of new satellite technology and innovation. I plan to point the direction in which we are headed.

In the future, satellite intelligence will become available to almost anyone who desires the information. A country will not have to have its own satellite capability in order to have access to the information that can be provided by the satellite. All you will need is money to buy satellite pictures. It could almost be like "rent-a-satellite." This is being facilitated today by the availability of commercial satellites. The US has the Landsat satellite, the French have their SPOT satellite and even the Russians

have an operating commercial satellite. Admittedly, the resolution of these satellites is not as good as existing military satellites, but the capability is there and we should anticipate that it will be improved over time. We know that the Soviets are already using their commercial satellite to overfly military targets. You can purchase pictures from the American and French agencies that control their commercial satellites. This means that the information the satellite obtains will be readily available to essentially anyone who wants to purchase it. It is very easy then to use these commercial photos to make military applications. In other words, every country will be able to obtain information on friend and foe alike. Secrets will become fewer and hopefully, international tensions will be reduced through political channels because of advanced knowledge of impending hostilities. 64

A somewhat parallel initiative is already under way, but has received little support or publicity to this point. It could have future implications. That effort is the creation of an international agency that would perform satellite reconnaissance during troubled times. The idea is to reduce tensions through political channels by providing intelligence data to the world on the potential belligerents. It is thought that this would bring world pressure to bear on the countries involved and that they would back down since

what they were planning to do would already be known to everyone. This agency would come under the United Nations, but has not received any support from those countries that have the existing technology. The obvious reason for this is that these countries do not want to share their technology at this time nor is there much support to provide the funds to do this.65

Another future application is the use of astronauts in a more direct role with the production of intelligence from space. The USAF currently has a test program underway called the Spaceborne Direct View System. The purpose of this is to use the military astronaut to perform direct observation of the earth which would support battle management tasks, surveillance and provide weather observations. They could also provide tactical support, missile launch detection, and target detection.66

Our current reconnaissance satellite employment strategy is to launch a large satellite that has many very sophisticated capabilities. Because of the enormous cost, we can only afford to have a few of these in space at any one time. The future may see a reverse to this trend and we may go to "cheap sats." These satellites would have reduced capabilities but because they would cost less, we could have more of them in space at any given time and we could also have more of them in reserve waiting to be put into orbit.

This makes the problem a little different from the Soviet perspective since it would be more difficult to shoot all of them down if they decided to do this.[67] We will also achieve cost reductions in this area by using multi-year procurement which would be applied to all procurement actions.[68]

Closely related to satellite employment is the critical issue of survivability which will be increased by implementing the following procedures. One technique will be to launch the new and replacement satellites more quickly which will reduce their ground exposure time which is that highly vulnerable time period that the satellite is at or near the launch pad. Once orbit is achieved, operational status will also be more quickly achieved. Replacement satellites will be orbited before the bird they are to replace becomes inoperative thus insuring that there is not a gap in coverage. The use of "cheap sats" will facilitate this since we will be able to afford more of these.

"Cheap sats" will also aid the tactical commander. In the future, there will be a real-time down link to the tactical commander so that he can view his battlefield. This will include the ability to control where the satellite looks. The satellite will also be able to film a cross FLOT penetration route which can be viewed by Apache pilots prior to these types of missions. The tactical commander's

intelligence operations will be further enhanced by more data being processed on-board the satellite prior to transmission, which will reduce the amount of analysis that needs to be accomplished after receipt.69

The number of ground launch facilities will also be increased and more replacements will be readily available which will aid survivability. DOD will have their own launch capability and will not have to rely on the Space Shuttle to deliver military satellites.70

Ground stations that receive data and are currently in fixed locations will become mobile and they will be redundant. This will further increase survivability.71

Another improvement will be realized with the deployment of the $500,000,000 Lacrosse satellite. It represents our first all weather, day-night capability. It will also be able to penetrate foliage which in the past has created some problems of detecting activity. It will enhance the employment of the KH-11 which has a better photographic resolution.72

Another ongoing Air Force satellite project is Teal Ruby which tracks flying aircraft. It will reinforce our AWACs and will give us the capability to know the Soviet air order of battle at any given time. We can then collate this intelligence with world events to determine what Soviet intentions might be.73

We are also developing a laser intelligence

satellite (LASINT). This is in the early developmental stage and consequently not much is known but it will be used to collect data on Soviet laser developments which are dynamic.[74]

The future of the reconnaissance satellite holds great promise for continued technological forward leaps. Information derived from satellites will be available to more countries. The application of this technology to peaceful purposes will grow, which will be especially important in today's world as our relationship with the Soviet Union evolves. The cost of employing this capability will be reduced as new employment and developmental procedures are implemented. This is especially significant as pressures increase to make cost reductions in the military-industrial complex. Survivability of the system will be enhanced by the application of various techniques and capabilities will continue to gallop forward as we continue to develop new technologies.

VI. Conclusion

The need by the United States for intelligence on the Soviet Union grew out of the Cold War during the 1940's. It was fueled by the perceived threat posed by this adversary and aided by great technological advances. The technological seed that would eventually

grow to satisfy this need had its beginnings in Napoleon's day when it became apparent to some that overhead observation had the potential to provide timely and accurate information on the enemy. The subsequent development of the photographic camera and the demonstrated feasibility of rocket flight pointed the direction for technology to grow. By the 1960's, what had previously been a dream had become a reality. Satellite reconnaissance was here to stay and for the most part would satisfy our need. Over the coming decades, it would be improved, enhanced, and perfected until today it is the centerpiece of our intelligence collection effort on the Soviets.

But this technological wonder has blemishes that we tend to overlook as we cast it in the light of the ultimate answer to our intelligence needs. It can be deceived, degraded, and neutralized by the Soviets. It also generates a high volume of data which can overwhelm both the communications system and the analyst. We must always insure that the correct priorities have been established. It answers many, but not all questions.

Certain trends related to satellite reconnaissance become obvious as this area is studied. From the earliest days, rocket reliability has been improved. Periodically, failures are noted but these are the exception rather than the rule. Successful

launches are the norm and rarely do they merit an entry in the media. Camera resolution has been improved. From early pictures that showed land masses, we can now see objects on the ground with a 6 inch resolution. This is sufficient not only to recognize the object but a trained analyst can determine its capabilities. Time in orbit has been improved. Initially, reconnaissance satellites were limited to time in orbit by the number of retrievable capsules that were carried. Once these were gone, the satellite was useless for all practical purposes. We now talk of orbit times in terms of years. The size of payloads has been greatly increased. Initial payloads were less than 100 pounds. Today, the Space Shuttle can carry in excess of 60,000 pounds into space. The number of reconnaissance capabilities that are in space at any given time has increased from a single camera to multiple capacities.

The future for satellites is impressive. The information that can be derived from this source will be available to more countries and if used correctly could reduce international tensions and promote peace. Their survivability will be increased and enhanced and new capabilities will be introduced as technology continues at a gallop.

The amount of time we have satellite surveillance of Russia appears to be sufficient. It can be increased by the launch of additional reconnaissance

satellites when required or it can be supplemented by the use of astronauts who are deployed on Space Shuttle missions.

Retrieving information from the satellite involves transmitting it to ground stations. This is currently not a major problem but has the potential to become more significant if we do not react to it in the near future. The ability to collect data on the Soviets is growing rapidly but our ability to transmit it to ground stations is not keeping pace.

Reconnaissance satellites therefore do appear to constitute a viable early warning capability in Western Europe but we should never forget that they constitute only one collection source. They are not the end in and of themselves.

One of the major shortfalls, yet to be overcome is that a satisfactory automated analytic capability does not currently exist and analysts are being overwhelmed by the amount of data to be evaluated. Evaluating data on a known target may be relatively easier than trying to find and develop new targets. It amounts to trying to find the proverbial needle in a haystack.

Satellites are also vulnerable and susceptible to Soviet countermeasures. Tom Clancy's Red Storm Rising gives one realistic scenario of how this might happen. In the early stages of a conventional war in Europe, a

Soviet killer satellite is able to intercept and destroy our primary photographic satellite thus denying us of valuable information at a very critical time.75 More satellites (cheap sats) may ameliorate this vulnerability.

The old intelligence principles of multiplicity, suitability, and balance still apply. Use more than one collection capability against a target, make sure that the collector can obtain the desired types of information, and do not task a single collector with more missions than it can handle.

If we carefully balance the current and projected capabilities of the reconnaissance satellite with its shortcomings, we will have an intelligence collection capability that will continue to make major contributions to European and world peace. We must compensate for its short comings and continue to pursue technological innovations. The reconnaissance satellite does have utility and can provide needed intelligence on the Soviets.

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