Col. Charles P. Wilson

Strategic and Tactical Aerial Reconnaissance in the Near East

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Strategic Reconnaissance in the Near East

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Cover design by Monica Neal Hertzman. Cover photograph: U-2 and SR-71 aircrews must wear a full pressure-suit to endure the hazardous physiological environment of high-altitude flight. (Photograph courtesy of Lockheed-Martin).

About the Author

Colonel Charles P. "Chuck" Wilson is the deputy director for Airborne Intelligence, Surveillance, and Reconnaissance (ISR) Systems, ISR Directorate, in the Office of the Assistant Secretary of Defense (C3I). In this position, he manages policy and oversight issues involving airborne ISR programs, manned and unmanned, for the Department of Defense. Colonel Wilson was formerly the director of the Manned Reconnaissance Division, Defense Airborne Reconnaissance Office (DARO), in the Office of the Undersecretary of Defense for Acquisition and Technology at the Pentagon.

Colonel Wilson has commanded two U-2 squadrons: the 5th Reconnaissance Squadron at Osan Air Base, Korea; and the 4402nd Reconnaissance Squadron (Provisional) at Taif, Saudi Arabia. He also was commander of the headquarters squadron at Edwards Air Force Base in California and has directed or served on many U-2 operational deployments to Europe, the Pacific, and Southwest Asia.

A graduate of Indiana University, Colonel Wilson previously served on the Pentagon's Joint Staff Operations Directorate (J-3), where he handled reconnaissance issues for the Chairman of the Joint Chiefs of Staff (CJCS). In that capacity, he was the monthly reconnaissance briefer for Joint Chiefs of Staff (JCS) "tank" sessions and briefings at the White House. He is rated a Command Pilot with more than 2,800 hours of flying time in the U-2, TR-1, KC-135Q, and T-38 aircraft.

Colonel Wilson was a 1996-1997 National Defense Fellow at the Washington Institute for Near East Policy.

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Author's Note

This document was written in 1996-1997. Since that time:

(1) The Defense Airborne Reconnaissance Office (DARO) has been dissolved and the programmatic management of future reconnaissance systems—such as unmanned aerial vehicles (UAVs)—transferred to the various armed services. As a result of that reassignment, the U.S. Air Force is taking a careful and deliberate approach in UAV development, reflected in the modified Air Force Long Range Plan.

(2) The operational SR-71 program was terminated as a result of a presidential line-item veto. One SR-71B trainer and one SR-71 A will continue to be flown by the National Aeronautics and Space Administration (NASA) for high altitude testing.

(3) The government has declassified signals intelligence operations performed by the U-2.

(4) Significant success has been made with the High Altitude Endurance (HAE) UAVs. At the time of printing, however, the DarkStar UAV program had been terminated.

(5) Iraq continues to defy United Nations (UN) resolutions and has been a continuing source of conflict in Southwest Asia.

(6) UN Special Commission (UNSCOM) operations have been suspended.

This text has been updated to reflect many of these changes. The reader is encouraged to review the glossary to become familiar with some of the terms.

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Preface

America's reconnaissance capability was a key component of Washington's intelligence edge during the Cold War, and it remains a central element of the U.S. national intelligence effort in the post-Cold War world. Manned reconnaissance aircraft (such as the U-2), reconnaissance satellites, and more recently unmanned aerial vehicles (UAVs) possess unique capabilities: They can collect large quantities of information concerning areas that might otherwise be inaccessible to American personnel and afford both battlefield commanders and policymakers a "bird's eye view" of the world.

During the Cold War, the United States used all three types of platforms to secure its interests in the Middle East. Reconnaissance aircraft and satellites played a crucial role in assessing the conduct and outcome of various Arab-Israeli wars, the Iran-Iraq War, and Operation Desert Storm, and UAVs were first used by the United States on a large-scale basis during the latter conflict. Finally, U-2 aircraft played an important role in supporting United Nations weapons inspections in Iraq that followed the 1991 Persian Gulf War. These overhead reconnaissance systems will remain important assets in dealing with the challenges of the post-Cold War Middle East, whether for observing terrorist training camps or for monitoring the dangerous trend toward proliferation of missile andnonconventional weapons programs in the region.

Each platform possesses certain advantages and disadvantages, and thus each type of platform plays a unique and complementary role. Manned reconnaissance aircraft are highly flexible and responsive and can carry sensors that neither satellites nor UAVs can operate. Satellites are nonintrusive and can operate over denied areas without putting pilots at risk or causing an international incident. And UAVs are not only inexpensive—meaning they can be purchased in large numbers—but they also do not put pilots at risk. For this reason, it is important that the United States retain the full mix of platform types in its force structure. Yet, owing to budgetary pressures and enthusiasm over the prospect of a "cheap fix" offered by UAVs, the future of manned aerial reconnaissance capability is unclear.

Against this background, The Washington Institute is pleased to publish Col. Chuck Wilson's study on the role aerial reconnaissance plays in advancing U.S. interests in the Near East. A U-2 pilot who commanded a U-2 squadron in Saudi Arabia, Colonel Wilson brings both extensive personal experience and detached analytical expertise to this research, offering what we hope will be a substantial contribution to the debate over the future of manned aerial reconnaissance in the U.S. armed forces.

We are especially pleased to present Colonel Wilson's study as the inaugural publication in The Washington Institute's Military Research Papers series. Since 1995, the Institute has had the honor of hosting active duty military officers from the U.S. Air Force and the armed forces of key allies Turkey, Jordan, and Israel. The Institute's program is designed to provide officers with the opportunity to learn about—and contribute to—the Washington policymaking process through interaction with Institute fellows and professional colleagues. With their varied backgrounds, and the unique professional perspective they bring to their work, these officers have already made a major contribution to the life of the Institute. We valued the presence of Colonel Wilson when he was a National Defense Fellow at the Institute in 1996-1997. We therefore present this and future research papers in the hope that they contribute further to policy debates on critical issues.

Mike Stein	Barbi Weinberg
President	*Chairman*

Executive Summary

The United States has vital interests in the Middle East, and particularly in the Persian Gulf; these areas continue to be among the most politically and militarily sensitive in the world. Decisions about U.S. policy and military activities in the region depend on timely and accurate intelligence, such as from human sources and from satellites and aerial reconnaissance. This book considers methods of intelligence gathering currently in use and under development.

Intelligence collection, analysis, and production must be related to the needs of policymakers. The five phases of the "intelligence cycle" include planning and direction, collection, processing, production, and dissemination. Collection is accomplished by various means, each defined by their sources: human intelligence (HUMINT), imagery intelligence (IMINT), signals intelligence (SIGINT), electronic intelligence (ELINT), communications intelligence (COMINT), and technical intelligence (TECHINT). Policymakers' decisions often result from accurate intelligence, much of which comes from precise reconnaissance. People frequently confuse reconnaissance and surveillance, but whereas reconnaissance necessarily involves a mission focused on specific targets, surveillance is simply a systematic and generally passive observation of an area and its people.

The military undertakes reconnaissance missions to support one, two, or all three decision-making levels of war: strategic, operational, and tactical. The strategic level involves issues of national interest; the operational level, issues of interest to a regional command; and the tactical level, issues important to forces engaged on the battlefield.

Sensitive reconnaissance missions must be managed carefully, for they can have great political fallout if they fail. A prime example was the 1960 "U-2 affair" when American pilot Francis Gary Powers was shot down over the Soviet Union. To manage subsequent missions, President Dwight Eisenhower established an office—the Joint Reconnaissance Center, later named the Reconnaissance Operations Division (ROD)—to oversee reconnaissance activities. The ROD acts as the clearinghouse for requests by theater commanders or executive departments to conduct aerial reconnaissance missions.

Despite the political failure of the Powers U-2 mission, U-2 reconnaissance missions over the Soviet Union were quite successful. Eisenhower and his staff had been concerned by intelligence reports that a gap was developing between the superpowers' production of nuclear-capable bombers. Powers's was one of several U-2 flights from Adana, Turkey, but the only one that was shot down. Until then, Eisenhower had denied that U.S. aircraft were overflying the USSR; Powers's capture revealed that the United States had flown a U-2 in the sovereign airspace of the USSR. Nevertheless, based on the imagery of previous flights, Washington determined that the Soviets had erected a facade; there was no bomber gap or accelerated missile program, and Moscow was not planning a surprise attack. The U-2 missions enabled Eisenhower to resist congressional and public pressure to escalate the arms race.

Photographic reconnaissance to support any of the three levels of war can be accomplished through the use of several platforms: satellites, high-altitude manned aircraft like the U-2, and unmanned aerial vehicles.

The use of reconnaissance satellites began in 1960 with the CORONA program, and until recently their use was a closely guarded secret. These early systems ejected film canisters that had to be retrieved from the Pacific Ocean for processing and exploitation; sometimes they were lost at sea. The imagery could take two days to travel to Washington and several more days for processing. In 1969, the director of Central Intelligence's Committee on Imagery Requirements and Exploitation (COMIREX) studied the advantages of space-based, near-real-time systems and developed one that would permit "instantaneous transmission" of images through digital signals sent to a ground station. Civilian and commercial satellites are also used for intelligence gathering. U.S. LANDSAT satellites were used for terrain analysis, imagery maps, and mission planning during the Gulf War.

The great advantage of space-based systems is the large expanse of ground observed without violating any nation's airspace. As prisoners of their orbits, however, satellites are limited; they can be vulnerable to deceptive practices such as emission control and camouflage, and their view is limited by cloud coverage. They are also difficult to "dynamically retask" for new assignments, and their costs are considerable. Satellites can cost $800 million each, plus more than $300 million to launch.

Aircraft that support the three levels of war are a great complement to satellite reconnaissance systems. The U-2 is a single-engine, single-seat, high-altitude reconnaissance aircraft first designed in the mid-1950s to observe activity in areas of Europe, the Soviet Union, and other places where the United States was denied access. The U-2 production line has reopened twice since then, in 1967 and in the 1980s. Considered a national rather than a tactical asset, the U-2 flies at altitudes above 70,000 feet for more than nine hours at speeds in excess of 475 statute miles per hour. U-2 camera systems can include a high-resolution camera, an optical bar camera, or the Intelligence Reconnaissance Imagery System III (IRIS III); each of these uses wet film. The U-2 can also carry a near-real-time optical sensor system called the Senior Year Electro-optical Reconnaissance System (SYERS), though not in conjunction with the other cameras. Another imagery option, the Advanced Synthetic Aperture Radar System II (ASARS II), has the advantage of being able to "look" through clouds or smoke, and it can also make night images.

Another aircraft, the SR-71, was first flown more than thirty years ago, but it has since been retired. Designed, like the U-2, by Lockheed Martin, the SR-71 flies at more than three times the speed of sound, travels above 80,000 feet, and can image more than 100,000 square miles in less than an hour. Its crew consists of a pilot and a reconnaissance systems operator. Its wide range of sensors include synthetic aperture radar (SAR), as well as technical objective cameras (TEOCs) and the capability to use an electromagnetic reconnaissance system to determine the precise source of electronic signals.

According to joint doctrine, manned aircraft such as these are the most mobile and responsive reconnaissance assets available; unlike satellites, they can be dynamically retasked to a new mission within seconds. Yet, unlike satellites, they put skilled manpower at risk, because of the inherent dangers of the physiological environment and high-altitude flight. It is also difficult to find bases suitable for their operations and located in a safe place far enough away from the area of interest. The SR-71 costs $38,000 per flight hour to operate; in comparison, the U-2 costs $6,000 per flight hour.

Because of the costs and risks of using manned reconnaissance aircraft, therefore, the idea of using unmanned aerial vehicles (UAVs) is becoming more attractive. UAVs are intended to provide a broad range of collection capabilities, including imagery intelligence with synthetic aperture radar, infrared, and multispectral cameras. Many UAVs are under development. The Predator UAV is designed to cruise at 70 knots carrying 450-500 pounds at an elevation of 25,000 feet for longer than twenty hours; its action radius is 500 miles. It has been deployed three times to Bosnia. The Global Hawk is a high-altitude endurance (HAE) UAV, designed to cruise at 345 knots at altitudes up to 65,000 feet for nearly forty hours; its radius of action is planned at 3,000 miles. As of December 1998, Global Hawk had flown nine test flights, and a production force mix decision is planned for sometime in fiscal year 2000. DarkStar, a stealthy UAV, was designed to penetrate and acquire imagery in high-threat areas. Two aircraft were built, but in its second test flight, in 1996, it crashed upon takeoff, causing a year's setback to the program schedule and a $22 million cost to the budget. In late January 1999, funding constraints forced the termination of the DarkStar program.

UAVs nevertheless offer two significant advantages when compared to manned reconnaissance. They are "threat insensitive" because they do not pose a risk to pilots, and they are relatively inexpensive, at less than $15 million per plane. A prime drawback is their availability and maturity. They have thus far been designed only for imagery intelligence, whereas U-2s also carry signals intelligence sensors. They are also unable to be dynamically retasked, as their flight paths are preprogrammed.

The Near East's volatile history of instability and conflict has made it a central focus of overhead reconnaissance and surveillance for more than forty years. U-2s were used in the 1956 Suez Crisis to reassure President Eisenhower that the Soviet Union was not reinforcing the Syrian or Egyptian militaries for war against Israel, Britain, and France. Satellite imagery during the June 1967 War proved useful in estimating the relative military strengths of both sides, as well as the extensive damaged caused by Israeli air strikes on Syrian, Egyptian, and Jordanian forces. Several reports claim that SR-71 and U-2 aircraft were used to photograph actual fighting, but these reports are not likely to be accurate.

Satellite imagery was again used to monitor the Egyptian-Israeli "War of Attrition" in 1969 and 1970, and satellite images also showed Egyptian forces were massing along the Suez Canal in autumn 1973, but this bit of intelligence was misinterpreted by the Israelis and Americans as an exercise. During the October War, President Richard Nixon approved the use of SR-71 aircraft to assist the Israelis, and the images provided helped the Israelis to verify a crucial gap between Egypt's Second and Third Armies. Israel was able to exploit this gap to turn the tables on the Egyptians and force a cease-fire.

The SR-71 was again used to overfly Lebanese airspace after the 1983 bombing of the U.S. Marine Corps barracks in Beirut. Use of SR-71 images of Iran in 1987 also proved the Iranians possessed Soviet Silkworm antiship missiles. The SR-71 was retired in January 1990, however, so it was not available during the Gulf War the following year.

During the Gulf War, U-2s penetrated Iraq and conducted battle-damage assessments, but aerial reconnaissance at the tactical level was lacking. Satellites were put on a wartime footing for the first time ever, to support decision makers at the strategic, operational, and tactical levels. UAVs were also utilized to support the tactical level of war. They did not have the range for large-scale reconnaissance, but they could be sent on short, high-threat missions without risking pilots. Pioneer UAV units monitored Iraqi shipping and mine laying; hunted for mines; and searched for Iraqi Silkworm sites, command-and-control bunkers, and anti-aircraft artillery sites. These UAVs, operating day and night, flew approximately 300 reconnaissance missions during Operation Desert Storm. The combination and complementarity of satellites, U-2s, and UAVs led to the war's intelligence successes.

But almost a decade later, Iraqi president Saddam Husayn remains in power and a threat to U.S. interests. In light of his past actions, Saddam can be expected to continue his threatening stance; aerial reconnaissance can therefore be expected to remain important in the Gulf, and elsewhere in the Near East, for the foreseeable future. U-2 surveillance planes have been used to assist United Nations Special Commission inspectors in rooting out Iraqi weapons facilities, and space-based imaging systems as well as manned aerial reconnaissance have been used to assist in Operations Northern Watch and Southern Watch, enforcing the no-fly zones in the northern and southern parts of Iraq.

U-2s continue to perform strategic reconnaissance by periodically monitoring the demilitarized zones in the Sinai and the Golan, between Israel and Egypt, and between Israel and Syria. These three countries each receive the U-2s' aerial photographs, thus helping to build confidence between and among them.

The U.S. Air Force is considering replacing the U-2 with an HAE UAV, but neither of the UAVs under development are capable of carrying both IMINT and SIGINT packages. Moreover, a feverish push toward investing in UAVs for the future could shift funds away from present-day needs, thus compromising current intelligence-gathering missions.

If history is any indication, the United States will need to remain involved in the Near East, and it will need increasing amounts of intelligence on the region. Space-based systems are the ultimate high-ground, but they cannot satisfy all the intelligence requirements. Therefore, aerial reconnaissance missions (including the use of UAVs) are needed.

Currently, the HAE UAV program is experiencing developmental and funding problems. In light of the UAVs' developmental challenges, the air force may need to consider building additional U-2s to assist in filling the widening gap in intelligence collection requirements. Investments should also be made to develop future systems, like HAE UAVs, but not if they cause a reduction in current operational readiness and capability.

Chapter 1

INTRODUCTION

The United States has vital interests in the Middle East and Persian Gulf arena—namely, the free flow of oil, the freedom of maritime navigation with resultant access to regional markets, the security of close allies, the protection of U.S. citizens abroad, the promotion of democratic and free-market values, and the support of human rights. This area contains a volatile mixture that includes 70 percent of the world's proven oil reserves, a proliferation of weapons of mass destruction (WMD), terrorist groups hostile to U.S. interests, and significant maritime choke points between Europe and Africa and Asia.[1] The importance of security and stability in this region cannot be overemphasized.

The Middle East and Persian Gulf area continues to be one of the most politically and militarily sensitive in the world. The Persian Gulf War highlighted the vulnerabilities of regional nations to Iraqi aggression. Without the U.S. commitment to protect these nations and their vital interests, the stability of the region would diminish along with control of the world's oil reserves. Additionally, elimination of WMD, as well as a successful Arab-Israeli peace process, are among Washington's concerns.

Decisions regarding U.S. policy in the Near East—and ongoing military operations in the region supporting that policy—depend on timely and accurate intelligence. Much of the information collected for this intelligence may be produced from national technical means, such as satellites, or from manned strategic aerial reconnaissance performed at altitudes above 70,000 feet.[2] Inadequate investment in human resources has made human collection of information difficult, however.[3] During the Gulf War, the tactical use of small, unmanned aerial vehicles (UAVs) for reconnaissance was successful,[4] and future strategic use of UAVs in this region does show promise. A strategic or high-altitude endurance UAV, however, has yet to be operationally proven and fielded.

What is strategic aerial reconnaissance, and what role does the imagery it collects play in the Near East? What are the collectors? How are they used and what contributions to decision making and/or policymaking have these technical collectors made in past regional conflicts? With the availability of space-based imaging systems and the great strides of the U.S. Department of Defense toward the use of UAVs for this type of reconnaissance,[5] are manned high-altitude strategic reconnaissance missions essential to U.S. interests in the Middle East and Persian Gulf arena for the indefinite future? This monograph will show that manned high-altitude aerial reconnaissance will indeed be needed in this explosive part of the world, well into the next century.

NOTES

1 *United States Security Strategy for the Middle East* (Washington, D.C.: Department of Defense, February 1995), p. 1.

2 Jeffrey T. Richelson, *The U.S. Intelligence Community* (Boulder, Colo.: Westview, 1995), pp. 158-159.

3 Perhaps an imprudent reliance on technical collectors resulted in inadequate investment in human intelligence for

this region. See ibid., pp. 469-470; Anthony Cordesman and Abraham Wagner, *The Gulf War,* vol. 4 of *The Lessons of Modern War* (Boulder, Colo.: Westview, 1996), p. 46; Martin Sieff, "Libya Says Executions Snuffed Out CIA Plot," *Washington Times,* January 3, 1997, pp. Al, A12.

4 Richelson, *The U.S. Intelligence Community,* pp. 160-161.

5 The U.S. Air Force is committed to an "aggressive program" for the advancement of unmanned aerial vehicles. U.S. Air Force, *1997 Air Force Long Range Plan: Summary,* http://www.xp.hq.af.mil/xpx/xpxc/m-p. 10.

Chapter 2

INTELLIGENCE AND RECONNAISSANCE

". . . good policy rests on good analysis,
which in turn rests on good intelligence."[1]
—*Daniel Kurtzer*

Intelligence is defined as "the product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas."[2] In other words, intelligence is the result of carefully analyzed information. Policymaking and decision making require accurate and timely intelligence, which becomes significant because of the far-reaching effects that policies or decisions can have. It is highly unlikely that policymakers would be able to make meaningful decisions or implement meaningful policy without correct intelligence on the state of the world.

THE INTELLIGENCE CYCLE

It is important to relate intelligence collection, analysis, and production with the needs of decision makers. This "intelligence cycle" is the process by which information is acquired, exploited, processed into intelligence, and provided to policymakers and decision makers. The process has five phases: planning and direction, collection, processing, production, and dissemination.[3] Although this monograph focuses on collection (of imagery), the other phases of the intelligence cycle are described below to provide perspective.

Planning and direction involves the management of the entire process, from the identification of the information required to the delivery of the product to the user. This phase is usually started by a request for intelligence by the president; executive departments such as Defense, State, or Treasury; theater commanders; or other users. During this phase the intelligence gathering agencies identify the intelligence requirements, form a collection plan, and issue orders, along with the requests of collection agencies for information.

Collection is the acquisition of raw data from which the finished intelligence will be derived. The process of collection can involve open sources, human sources, and technical systems. *Processing* transforms the vast amount of data collected and translates it into a useful intelligence product. Deciphering, decrypting, translating communication or electrical signals, and analyzing photographic or radar imagery are part of the processing phase.

In the *production* phase, raw information is transformed into finished intelligence through integration, analysis, interpretation, and evaluation. Simply put, the raw data is converted into a useful intelligence product based on the known or anticipated needs of the decision maker.

The last phase, *dissemination,* moves the intelligence product to the "consumer"—the decision maker, policymaker, executive department, or commander whose needs drove the requirement from the start.

THE COLLECTION DISCIPLINES

The methods used to collect intelligence are best described by the discipline supported: human intelligence, imagery intelligence, signals intelligence, electrical intelligence, communications intelligence, and technical intelligence.[4]

Human intelligence (HUMINT) is information collected by a human source. Human beings are able to gather information from open sources in the public domain or clandestinely, out of the public view. Human sources are also employed to gather occasionally sensitive political, military, or economic information in a particular area. HUMINT may potentially produce information that provides a level of understanding unattainable from technical collection, such as an adversary's intentions or thought processes or an analysis of a particular program relative to its people, facilities, suppliers, and progress. Additionally, human sources are able to report on what they see or hear inside a facility.

Imagery intelligence (IMINT) is derived from the exploitation of photography, electro-optics, infrared sensors, or synthetic aperture radar (SAR). Images of objects are reproduced optically or electronically through a medium such as film or an electronic display such as television. Photography is perhaps the oldest mechanical means of conducting surveillance and reconnaissance, dating back to the box camera and the balloon. The imagery production systems currently in use are technological marvels and considered by many decision makers to provide that ultimate intelligence product—the picture. Although worth "a thousand words" and used as hard evidence by decision makers, the picture is not completely infallible. In almost every conflict, camouflage, phony equipment, disabled vehicles, or visually deceptive aircraft, among other devices, have all been used to deceive or distort the view seen by prying eyes.

Signals intelligence (SIGINT) is a broad category of intelligence that includes communications intelligence (COMINT) and electronic intelligence (ELINT), along with intelligence from telemetry signals used for guidance and control of a missile. COMINT is "technical and intelligence information taken from foreign communications by someone other than the intended recipient"[5] and is very useful. For example, directions given to enemy forces that are intercepted by the opposition can be used for counteractions to overturn enemy intentions. Similar to IMINT and HUMINT, however, COMINT is not immune to deception. Information transmitted by radio or phone line is occasionally misleading.

Electronic intelligence (ELINT) is technical information taken from electromagnetic radiation sources. For example, search and acquisition radar emits electrical energy or signals. When collected, these signals can reveal not only the location of an enemy air defense system, but also characteristics of the radar electronic systems that are used for identification and determining the electronic order of battle. ELINT is not taken from regular communications or from nuclear detonations.

RECONNAISSANCE AND SURVEILLANCE

The collection of information supporting an intelligence discipline is widely known as reconnaissance and is often associated with surveillance. Reconnaissance is "a mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy," whereas surveillance is "the systematic observation of aerospace, surface, or subsurface areas, places, persons, or things by visual, aural, electronic, photographic, or other means."[6] Reconnaissance and surveillance appear similar in purpose, but they differ in specification and duration. Reconnaissance missions focus on localized or specific targets (active) while surveillance systems collect information continuously (passive). Reconnaissance and surveillance missions are often concurrent, so the term "reconnaissance missions" will subsequently be used to refer to both types of missions.

Reconnaissance missions are undertaken to support one or more (decision making) levels of war: strategic, operational, and/or tactical.[7] Reconnaissance at the *strategic* level rises to a matter of national interest and can have a direct effect on national policy. Information derived from strategic reconnaissance is necessary for foreign policy, diplomacy, and even anticipation of a potential adversary's reactions to an economic, political, or military crisis. A nation whose intelligence architecture is superior can dominate the balance of power in a region or affect the outcome of a war. Reconnaissance that directly supports treaty monitoring and verification[8] or United. Nations resolutions is also considered strategic and can affect national policy. At the strategic level, the president could ask the following questions: "Given that imagery reveals that Saddam Husayn's Republican Guard is positioned near Kuwait, what are his intentions? If Saddam were removed from power, who are the leading contenders to replace him and what are their views? Has the UN Special Commission uncovered any more Iraqi weapons of mass destruction?"

The *operational* level involves employing military forces within a theater of operations to attain strategic goals through the design, organization, and conduct of campaigns and major operations. Identification of an enemy's "center of gravity" (source of strength) is a prime operational task. At this level, a theater commander such as Gen. Norman Schwarzkopf would ask, "What is the location of Iraq's Republican Guard and what are its assigned (or likely) missions?"

The *tactical,* or lowest, level is concerned with forces engaged on the battlefield. To win in battle, a nation should have information on the enemy's terrain, roads, airfields, ports, waterways, and bridges along with the capabilities and intentions of the opposing force. Commanders at this level would ask, "Can that bridge support a tank?" or "Is that runway long enough for a C-130?"

Whereas the different levels of warmaking and decision making are fairly well defined, the relationship between them is occasionally blurred. It is the function supported—who uses the information collected and how—which determines whether the level is strategic, operational, or tactical. The confusion often occurs when multiple decision makers at various levels of the chain of command rely on the same information.

MANAGING SENSITIVE RECONNAISSANCE MISSIONS

When aerial reconnaissance flights occur close to another nation's borders, the potential for an international incident is great. The resulting political fallout can sometimes be disastrous, not to mention hazardous to the aircrew performing the mission, when the hostile reactions from affected nations are taken into account. For example, in the 1960 "U-2 affair" when American U-2 pilot Francis Gary Powers was shot down by the Soviet Union over Sverdlovsk, the international attention and the resulting collapse of the Paris summit was particularly embarrassing to President Dwight Eisenhower and damaging to ongoing U.S. policy initiatives. The pilot was used by the Soviet Union as a propaganda pawn for twenty-one months.

After this mission and a subsequent RB-47 reconnaissance flight over the Barents Sea, Eisenhower directed the establishment of an office to oversee reconnaissance activities in order to avoid these serious international incidents. Approval by the National Command Authorities (the president and secretary of defense) would be needed for aerial reconnaissance missions unless specifically delegated to the concerned unified command. As a result, in October 1960, that focal point became known as the Joint Reconnaissance Center (JRC), now called the Reconnaissance Operations Division (ROD), within the Office of the Joint Chiefs of Staff at the Pentagon.[9]

The ROD acts as the clearinghouse for requests by the unified (theater) commands or executive departments to conduct aerial reconnaissance missions. These requests are thoroughly scrutinized by the armed services, executive departments, and intelligence agencies. They are then presented at briefings at the highest levels[10] within the Department of Defense and finally to the National Security Council (NSC). The result is a NSC memorandum from the president's national security advisor approving, disapproving, or tailoring these sensitive missions. Because sovereign nations are very sensitive to these missions and their potential impact on their borders, this process is as important today as it was during the Cold War.

Powers and the "U-2 Affair"

The most famous high-altitude reconnaissance mission in history began in Pakistan, on May 1, 1960. Known later as the "U-2 Affair," the Soviets shot down and captured U-2 pilot Francis Gary Powers during a secret mission over the Soviet Union.[11] This incident occurred at a time when Cold War tensions between Washington and Moscow were high. During 1956 and 1957, U.S. intelligence reported that as many as forty Bison bombers were rolling off Soviet production lines. Also, in late 1957, after four attempts, the Soviets successfully launched the R-7 intercontinental ballistic missile for a 3,500-mile flight.[12] Soviet premier Nikita Khrushchev had made public statements such as "We will bury you" and that the USSR was building long-range missiles "like sausages." Eisenhower and his staff were concerned by the intelligence reports and Khrushchev's public statements, fearing that a gap was developing between the two superpowers' production of nuclear-capable bombers and, later, missiles. With enough bombers, it was feared, the Soviet Union might be able to launch a surprise attack upon the United States. The U-2 aircraft was specifically designed to penetrate Soviet airspace at high altitude (for optimum viewing and greater invulnerability to Soviet air defenses) to determine if the intelligence reports and Khrushchev's claims were true.

Few realized the Near East connection to the U-2 affair. For four years prior to the incident, U-2s based in Adana, Turkey, overflew the Soviet Union with relative impunity. The flights were so politically sensitive that presidential approval was required for each mission. The Soviets fired surface-to-air missiles (SAMs) at the U-2s and tried to intercept them with jet fighters to no avail. That continuing failure changed on May 1, 1960—coincidentally the Soviet national holiday May Day. Certain targets further east necessitated that some U-2 missions be flown from a base in Pakistan. Heading north, the missile test range at Tyuratam was Powers' first target, after which he was to proceed to Chelyabinsk, Sverdlovsk, Kirov, Yur'ya, Plesetsk, Severodvinsk, northwest to Kandalaksha, and north to Murmansk, then landing at an undisclosed base in northwestern Europe.[13] The journey would have been nearly 4,000 miles. A few miles south of Sverdlovsk, however, the U-2's autopilot malfunctioned, requiring Powers to fly the aircraft "by hand." This development would normally have been cause to cancel the mission and return to base, but being almost halfway to his destination, Powers decided to proceed to Sverdlovsk. According to his account, he had switched on the plane's cameras and turned 90 degrees toward Sverdlovsk's southern edge when the Soviets fired a barrage of new SA-2 "Guideline" missiles at his plane, one of which even hit a Soviet fighter attempting to intercept the U-2. As Powers was marking his map, he heard a thump, saw an orange colored light, and felt the aircraft going out of control. Apparently Shockwaves from the exploding missiles blew the tail off of his U-2, and Powers was forced to manually eject at an altitude of about 25,000 feet.

Until this incident, the Eisenhower administration had denied that U.S. aircraft were overflying the Soviet Union. When Khrushchev produced a U.S. pilot, Eisenhower was humiliated and forced to admit his duplicity, announcing he would end the flights. At a Paris summit shortly thereafter, Eisenhower refused Khrushchev's demand for an apology, prompting Khrushchev's walkout and the summit's collapse. Even so, the U-2 flights did bring a measure of stability to the strained U.S.-Soviet relations. Based on the imagery they produced, Washington determined that there was no bomber gap or accelerated missile program and that Moscow was not planning a surprise attack. These realizations in turn allowed Eisenhower to resist pressure from Congress and the public to escalate the arms race and instead allocate U.S. armed forces more effectively.

NOTES

1 Daniel Kurtzer, Ellen Laipson, and John L. Moore, *Intelligence and the Middle East: What Do We Need to Know?* (Washington, D.C.: Washington Institute for Near East Policy, 1995), p. 20. Kurtzer is the principal deputy assistant secretary of state for intelligence and research.

2 Joint Chiefs of Staff, *Dictionary of Military and Associated Terms*, Joint Publication 1-2 (Washington, D.C.: Department of Defense, March 23, 1994), p. 223.

3 Ibid., p. 206; Lock K. Johnson, *Secret Agencies: U.S. Intel-*

ligence in a Hostile World (New York: Vail-Ballou, 1996), pp. 4-5; Jeffrey T. Richelson, *The U.S. Intelligence Community* (Boulder, Colo.: Westview, 1995), pp. 3-4.

4 Joint Chiefs of Staff, *Dictionary of Military and Associated Terms*, pp. 86, 141, 190, 194, 379.

5 Ibid., p. 86.

6 Ibid., pp. 347, 404.

7 United States Air Force, *Basic Doctrine of the United States Air Force*, AFM 1-1, vol. 2 (March 1992), pp. 43-45.

8 Treaty monitoring and verification are distinct concepts. Monitoring involves the detection, identification, observation, measurement, and recording of significant treaty-related developments in a specific area. Verification is use of the intelligence gained from monitoring to make a subjective decision directly related to arms control issues specified in a treaty.

9 Richelson, *The U.S. Intelligence Community*, p. 426.

10 John Hughes, "Cuban Missile Crisis: The San Cristobal Trapezoid," *CIA—Studies in Intelligence* 36, no. 5 (annual unclassified edition, 1992), p. 63.

11 Michael Beschloss, *Mayday: Eisenhower, Khrushchev, and the U-2 Affair* (London: Faber and Faber, 1986), pp. 149-156; see also Ben Rich and Leo Janos, *Skunk Works* (Boston: Little, Brown, 1994), pp. 122-160.

12 Curtis Peebles, *Dark Eagles: A History of Top Secret U.S. Aircraft Programs* (Novato, Calif.: Presidio, 1995), p. 40.

13 Gregory W. Pedlow and Donald E. Welzenbach, *The CIA and the U-2 Program, 1954-1974* (Washington, D.C.: Central Intelligence Agency, 1998), p. 176 (declassified version).

Chapter 3

THE COLLECTORS

Photographic reconnaissance involving the imaging (or taking the picture of) an object or area can be produced by several types of collection platforms, technical systems that include satellites, manned aircraft, and unmanned aerial vehicles (UAVs). When viewing the systems that can support the three levels of war (strategic, operational, and tactical), however, the field of useful collection systems narrows considerably. These collectors include spaced-based systems, high-altitude reconnaissance aircraft, and, potentially, UAVs.

SPACE-BASED SYSTEMS

Perhaps the most technologically advanced method of imagery production comes from satellite systems. A large multistage rocket places a reconnaissance satellite into a low-Earth, sun-synchronous orbit. The orbit an imaging satellite follows is generally elliptical. The best image is achieved when the satellite is closest to earth and, as a result, the best time for a satellite to view the targeted area is at the lowest part (perigee) of its orbit. The drag exerted by the Earth's upper atmosphere tends to reduce satellite momentum during the perigee phase. Yet, to maintain its orbit, a satellite's forward momentum must overcome the force of gravity because as a satellite's velocity decreases, the influence of gravity increases. Therefore, a satellite's orbit steadily decays, resulting in the satellite's disintegration as it reenters the Earth's atmosphere. By placing a satellite into an elliptical orbit, kinetic energy can be saved by arranging for the satellite to pass over the target area at perigee and to spend most of its time at a greater distance from Earth, going to and from the highest orbital points (apogee) where the drag is much lower. Early satellites had a lifespan of a few days to a few weeks. A modern-day satellite, equipped with small rockets and fuel and following an elliptical orbit, can last several years.

Until recently, satellite reconnaissance programs were a closely guarded secret.[1] America's first satellite program, CORONA, made its initial successful flight in August 1960. The earliest four versions of CORONA were designated Keyhole 1 through 4 (KH-l-KH-4). The KH-1 camera had a nominal ground resolution[2] of forty feet. Improvements incorporated in KH-2 and KH-3 allowed them to achieve a resolution often feet.[3] A technological breakthrough allowed KH-4 to provide stereoscopic imagery using a MURAL camera system, which comprised two cameras that would take a photograph of a target from different angles. The stereoscopic KH-4 imagery would appear three-dimensional to photo interpreters, allowing them to exploit and analyze the imagery fully. KH-4 underwent two improvements, KH-4A and KH-4B, with each version having more advanced resolution. KH-4B entered service in 1967 with a ground resolution of five feet. The KH-5 ARGON and the KH-6 LANYARD systems both performed poorly, however, and were abandoned in the early 1960s.[4]

These early systems ejected film canisters that had to be retrieved for processing and exploitation. The canister, or bucket, would be "catapulted from space toward earth" and, hanging from the parachute over the Pacific Ocean, would be caught by a specially equipped C-119 or C-130 transport aircraft (occasionally, the canisters were missed).[5] Once recovered, the film would be transported back to Washington for exploitation. These early systems were not able to provide policymakers and decision makers with imagery in near-real-time. Between retrieval over the Pacific Ocean and arrival in Washington, D.C., one to two days might elapse. Processing and exploitation of the film could take several more days.

In 1969, the director of Central Intelligence's Committee on Imagery Requirements and Exploitation (COMIREX)[6] studied the advantages of a space-based, near-real-time system. In this study, COMIREX examined how this type of system could have been used during the Soviet invasion of Czechoslovakia, the June 1967 Arab-Israeli War, and the Cuban missile crisis. The results were obvious: A near-real-time system would have provided invaluable information on these historical events to the National Command Authorities. The study prompted President Richard Nixon to authorize the development of a new satellite system that could provide images in near-real-time along with images of a region and specific targets. The system that emerged permitted "instantaneous transmission" of imagery through digital signals transmitted to a ground station. The imagery could be processed and put into the hands of a policymaker or decision maker in approximately one hour.[7]

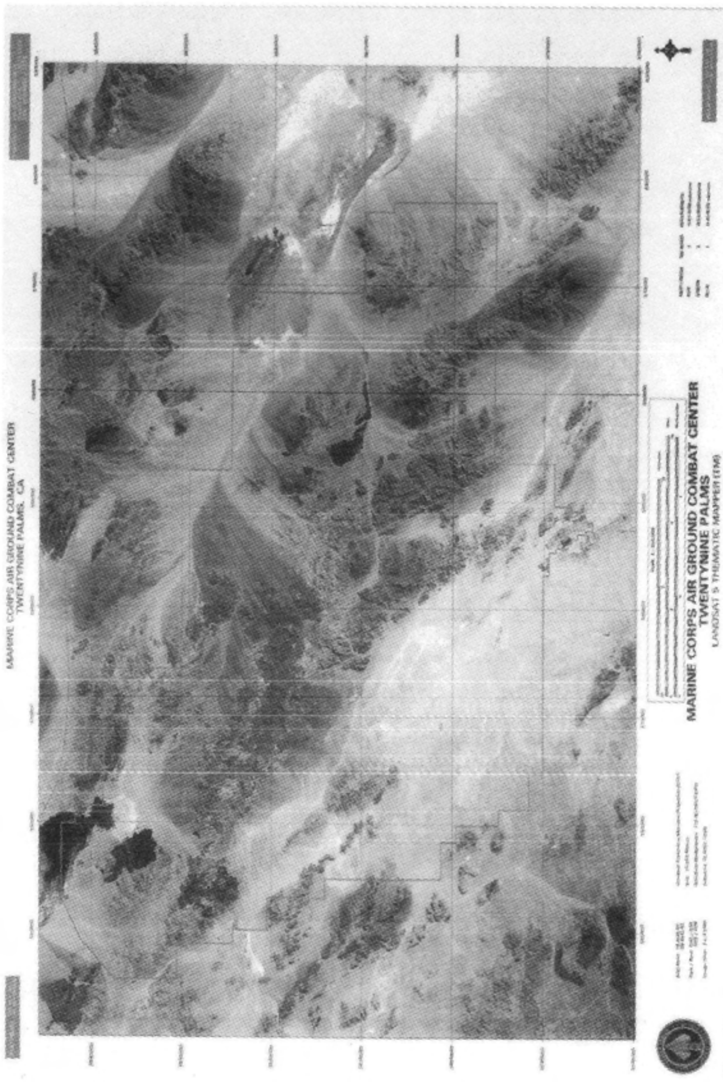
Civilian and commercial satellites are another source of imagery that can be used for intelligence purposes. Two systems used during Desert Shield and Desert Storm were the U.S. LANDS AT and the French *Satellite Pour I 'Observation de la Terre,* or SPOT. Designed for civilian and commercial uses, LANDSAT provides multi-spectral imaging of the Earth's surface for ecological mapping and detection of changes (see photo, next page). The LANDS AT system also has military applications with the remote sensing capability of the multispectral imagery it produces.[8] The imagery, purchased by the Department of Defense (DOD), was used for terrain analysis, map substitutes, and mission planning. Two LANDSATs circle the Earth every ninety-nine minutes in a near-polar orbit (98.2° inclination) at 438 miles altitude. The instruments of LANDS AT can "see" in visible and infrared light. The resolution of the imagery is about 36 yards over a path (swath) 115 miles wide.[9] The European Space Agency's SPOT was developed by France with support from Sweden and Belgium and provides multispectral imagery from an orbit of 517 miles. The area covered is about 38 miles on either side of SPOT'S ground track.[10]

Advantages and Disadvantages of Space-Based Systems

Products from space systems have been used in recent times to support all three levels of war in varying degrees. Unfortunately, open-source accounts on the role of military intelligence satellites is limited to unclassified material. Descriptions of these intelligence satellites, beyond those which have been released, are fairly speculative, although they may provide a general "feel" for the satellites' use.

The great advantage to space-based systems is the large expanse of ground covered, allowing for a worldwide view from a single location. They complete an Earth orbit in slightly more than 1.5 hours[11] and provide information where none can be obtained from conventional methods. Further, all intelligence is gathered without violating the airspace of sovereign nations, alerting other parties about which specific areas are viewed, engendering political fallout from the affected nation, or risking a human pilot.

As with all systems, space-based systems have some limitations. First, imaging satellite systems are prisoners of or-



Example of a Landsat image. Courtesy of the [illegible] [illegible] Reconnaissance Office.

bits that cannot be significantly altered. Their flight paths and times are predictable and are "therefore vulnerable to deception practices and signature control activities such as emission control, camouflage, etc.,"[12] which allowed a rogue state such as Iraq to take countermeasures to hide certain activities during Desert Storm.[13] Second, continuous coverage of a specific area is not possible from a satellite in an elliptical orbit. The satellite must revisit the target area on subsequent orbits, creating a gap in coverage. An imaging satellite could be put in a geosynchronous, or stationary, orbit, but it would be limited to looking at only one area from a distance of 22,300 miles.

Satellite systems are difficult to "dynamically retask," that is, it is hard to change the type of coverage on short notice, such as to follow an unexpected and rapidly unfolding event by a potential adversary. Maneuvering is possible but costly. With a finite amount of fuel on board, satellite life is reduced when the fuel is spent for orbital maneuvering.[14]

The cost of space-based systems is considerable, as much as $40,000 per pound to develop, not including launch costs.[15] By implication, these systems can cost as much as $800 million each, in addition to more than $300 million in launch costs.[16] This high cost causes intelligence requirements to be prioritized and, as a result, some space-based missions are not carried out.[17]

Cloud cover and adverse weather can make the imaging of certain areas difficult. During the winter months in the Near East, clouds obscure many areas of interest, such as Iraq, the Golan Heights, and the Sinai peninsula. Ostensibly, Iraq took advantage of cloud cover in hiding mobile missile launchers from imaging satellites during the Persian Gulf War.[18] A system with synthetic aperture radar (SAR), if available and in position, however, can look through weather and take images. Despite the drawbacks, space-based systems are prime collectors because they do things other collection platforms cannot.

AERIAL PHOTO-RECONNAISSANCE SYSTEMS

Aircraft are a great complement to satellite reconnaissance systems. Although there are many types of these systems, only those that have the capability or the potential to support the three levels of war with imagery are discussed below. These platforms include the U-2, the SR-71 (recently retired), and a series of UAVs. Other platforms will be mentioned in order to clarify their strategic or tactical use.

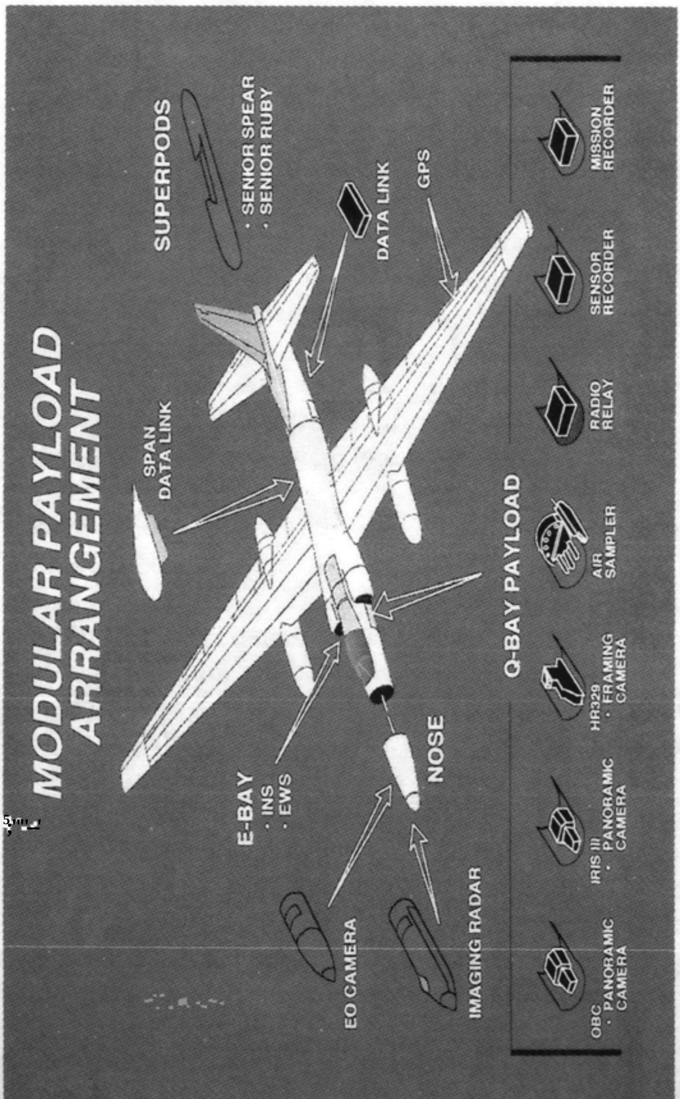
The U-2 Dragon Lady

The U-2 is a single-seat, single-engine, high-altitude reconnaissance aircraft first designed and flown in the mid-1950s by Kelly Johnson of Lockheed's "Skunk Works" (see photo and illustration, next pages). The U-2 was designed to fly at altitudes above 70,000 feet and to observe activity in areas of Europe, the Soviet Union, and other places where the United States was denied access.[19] Its high-altitude capability provided for optimum viewing and made the U-2 difficult to shoot down.

Over time, intelligence requirements increased, requiring the U-2 to carry additional sensors and raising the plane's weight significantly, which degraded aircraft performance. In response, Lockheed developed a new variation, the U-2R, a completely new aircraft with a 23-foot increase in wingspan and 13-foot increase in fuselage.[20] Overall, the U-2R was 40 percent larger than its predecessor and first flew in 1967.

In the late 1970s, the U.S. Air Force (USAF) began to build the TR-1, using the U-2R design. The TR-1 performed

U-2 Dragon Lady


MODULAR PAYLOAD ARRANGEMENT
SUPERPODS
· SENIOR SPEAR
· SENIOR RUBY
SPAN DATA LINK
DATA LINK
GPS
E-BAY
· INS
· EWS
NOSE
EO CAMERA
IMAGING RADAR
Q-BAY PAYLOAD
OBC
· PANORAMIC CAMERA
IRIS III
· PANORAMIC CAMERA
HR329
· FRAMING CAMERA
AIR SAMPLER
RADIO RELAY
SENSOR RECORDER
MISSION RECORDER

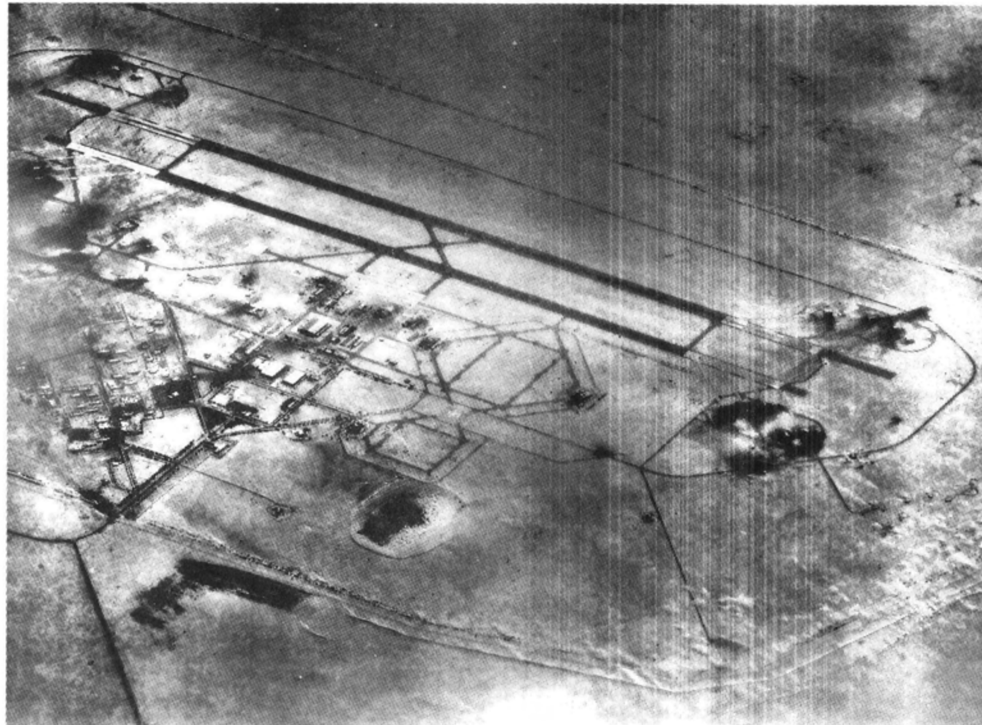
some "tactical" work while the U-2R did strategic work. During the Cold War, the TR-1 flew tactical collection missions supporting the North Atlantic Treaty Organization (NATO) in central Europe against the Eastern Bloc countries and sent the images in near-real-time to the U.S. Army V Corps in Germany.[21] In 1992, the USAF dropped the TR-1 designation and called both versions U-2Rs. Today's U-2 fleet is relatively young. Built mostly in the 1980s, they have been re-engined with the General Electric F-l 18-101 engine, which is lighter, burns less fuel, and increases power. This version is called the U-2S.[22] The service life of the U-2 could go past the year 2025. In fact, Lockheed technical representatives have stated that the U-2 fleet is as structurally sound now as when they were built, primarily because of the quality care and programmed depot maintenance cycle each U-2 undergoes. Nevertheless, attrition causes the U-2 fleet to grow smaller. From 1992 to 1996, five U-2 aircraft were lost in mishaps resulting from either pilot error, inclement weather, or equipment malfunction.[23]

Considered a "national rather than tactical asset,"[24] the U-2 flies at altitudes above 70,000 feet for more than nine hours at speeds that exceed 475 statute miles per hour. Operated by a lone pilot, the aircraft can provide continuous day or night, all-weather surveillance of an area in direct support of U.S. and allied ground and air forces. The U-2 can carry a wide variety of reconnaissance sensors that enable it to collect multisensor photo, electro-optic, infrared, and radar imagery, as well as electronic intelligence, air sampling, and certain classified intelligence.[25] It can also be used for communication relays and pinpointing the location of emitters (i.e., radar). It can track the movements of vehicles and troops, observe and verify international treaty compliance, or monitor nuclear facilities of unfriendly nations. "You can put [the U-2] where you want to; you can't do that with satellites," observed former Senator Sam Nunn, then-senior Democrat on the Armed Services Committee.[26]

U-2 camera systems include a high-resolution HR 329 camera (H-cam), an Optical Bar Camera (OBC), or the Intelligence Reconnaissance Imagery System III (IRIS III), each of which carries wet film. The H-cam uses a gyro-stabilized framing system designed to shoot pictures or image from an angle. The pilot controls camera positioning based on a preplanned angle. The angle is determined by the distance to the targets from the aircraft's flight path. Desert Storm planners experimented with the H-cam by using the nadir position. Nadir involves pointing the camera straight down. Policymakers, decision makers, and commanders were impressed by the nadir images (see photo, next page), but they were disappointed that the camera could not achieve the same detail at a greater lateral range, when it was pointed to the side of the aircraft. Even so, H-cam imagery is especially useful for targeting, determining the order of battle, and assessing damages.[27]

The IRIS III is a high-resolution panoramic camera with a twenty-four-inch focal length. This optical imagery system is mounted on a rotating optical bar assembly that can scan laterally through 140 degrees of view. The swath exceeds thirty-two miles on either side of the aircraft. Although the IRIS III gives a broader synoptic, or comprehensive, view than the H-cam, the resolution of the image is lower. Imagery from this camera also provides for excellent targeting, order of battle, and battle-damage assessment.[28] The OBC is a later version of the IRIS III. Like the H-cam's, the OBC's film must be processed after the aircraft lands, a difficult feat given that the rolls of film from these cameras can be miles long and take time to process and exploit.

In addition to the three cameras described above, the U-2 can carry a near-real-time optical sensor called the Se-

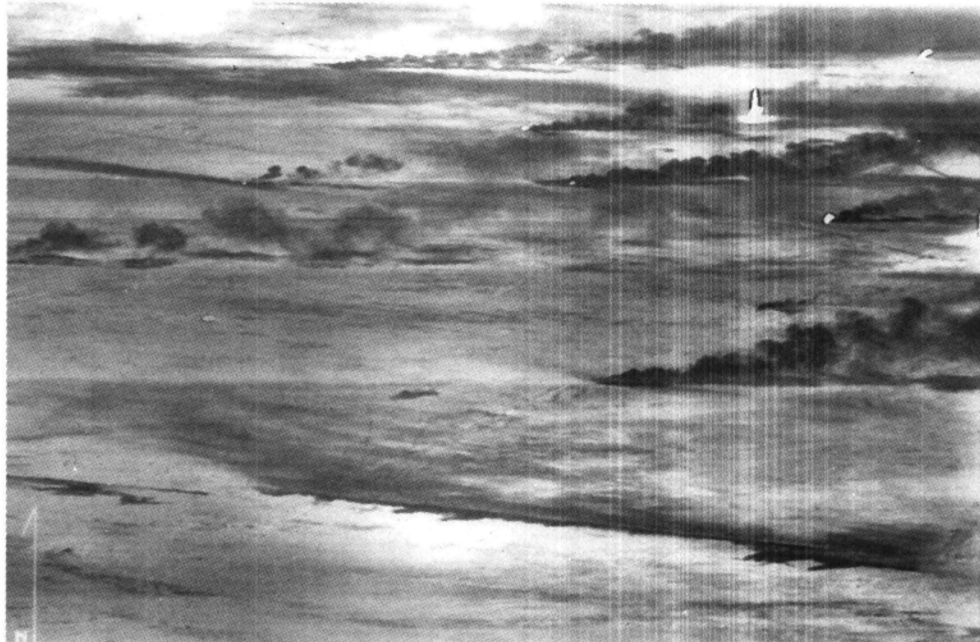


U-2 H-camera image, taken during Desert Storm, of Tallil airfield in Iraq. The blackened areas represent bomb damage.
From Coy Cross, *Dragon Lady Meets the Challenge: The U-2 in Desert Storm* (Beale Air Force Base, Calif.: 9RW History Office, 1996), pp. 58-60. Declassified by SAF/PAS security review 95-1070.

nior Year Electro-optical Reconnaissance System (SYERS), although not simultaneously with other cameras. SYERS is mounted in the nose of the aircraft and can rotate side to side. The images SYERS collects (see photo, next page) can be transmitted to a ground station in near-real-time as long as the sensor is within the station's line of sight, a distance of more than 220 miles. When the aircraft is in position to make this transmission, it is considered "on tether."[29] The ground station can control the electro-optical sensor and then process and exploit the imagery it receives. The SYERS on board the U-2 sends a digital picture to a computer screen in the ground station in near-real-time. The imagery and intelligence gathered can then be reported to theater commanders and the national intelligence community. When the U-2 is out of range of the ground station, or "untethered," it can record and store the imagery, then transmit it to the ground when it is within range. Hard copy images from SYERS can be made, but not rapidly.[30] Generally, it takes several minutes to make a hard copy SYERS image at the ground station. Instead of waiting for the aircraft to land with a film-based camera, SYERS can get the imagery to the ground station during the flight, but SYERS does not provide the broad-area view as the panoramic cameras do.

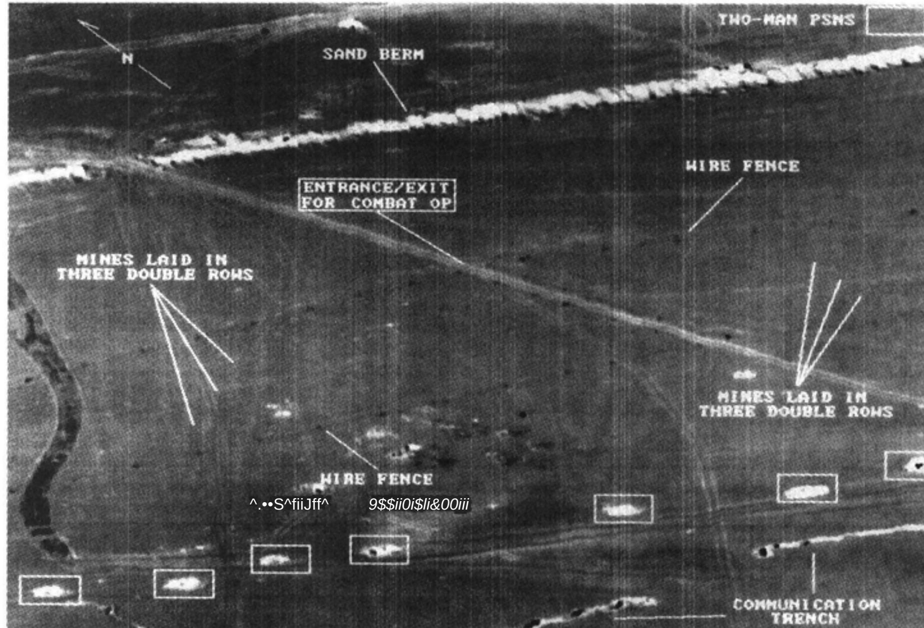
The other electronic imagery system the U-2 can carry is the Advanced Synthetic Aperture Radar System (ASARS) II (see photo, page 29). Like SYERS, ASARS II sends imagery to a ground station in near-real-time while the U-2 is on tether. ASARS II, unlike SYERS or cameras, can look through clouds or smoke and also make night images. Some ASARS II sensors have an enhanced moving target indicator (EMTI) to detect and accurately locate stationary and moving ground targets, such as tanks or other vehicles, on either side of the aircraft.[31] The EMTI feature of the U-2 is somewhat similar to that of the tactical Joint Surveillance

U-2 SYERS image of the burning oilfields in Kuwait during Desert Storm. From the image, one can see that the black smoke was moving from left to right. The image was sent in near-real-time to a ground station.



From Cross, *Dragon Lady Meets the Challenge,* pp. 58-60.

This Desert Storm image, taken from the U-2 using the Advanced Synthetic Radar System II (ASARS II), reveals buried minefields, armored vehicles, communications lines, and Iraqi fortifications at night. This image was sent in near-real-time to a ground station.



From Cross, *Dragon Lady Meets the Challenge,* pp. 58-60.

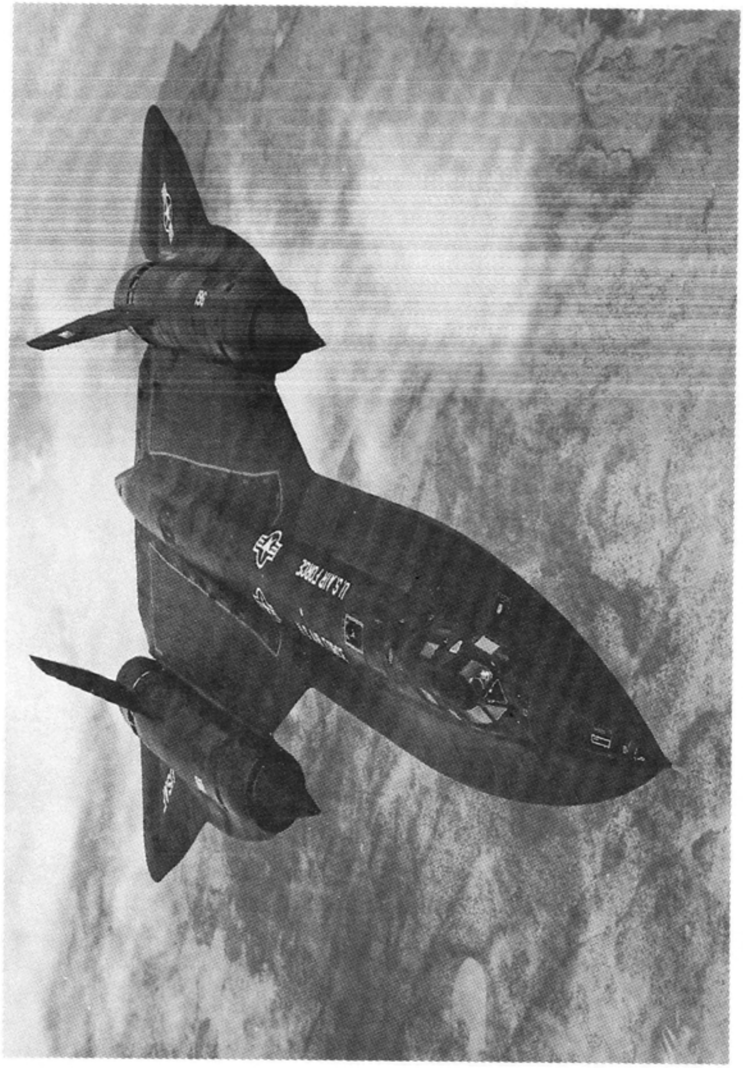
and Target Attack Radar System (JSTARS), intended for battlefield management.[32] The U-2 also has the capability to operate in an "extended tether" mode. In this mode, the U-2 can transmit SYERS or ASARS data to a remote ground station via satellite.

The SR-71 Blackbird

The SR-71 was perhaps the most exotic aircraft ever built (see photo, next page). This national asset was first officially retired in January 1990 because of budgetary constraints, but, concerned by the need for a highly survivable, manned reconnaissance aircraft, Congress ordered the DOD—and subsequently the USAF—to bring the SR-71 out of retirement in 1994. It returned to operational duty on January 1, 1997,[33] and until recently was operated by the two mission ready aircrews and operational aircraft assigned to the 9th Reconnaissance Wing at Beale Air Force Base (AFB), Calif., from Detachment II at Edwards AFB, Calif.[34]

Since its first flight more than thirty years ago, the SR-71's records have yet to be surpassed. Designed—like the U-2—by Kelly Johnson of Lockheed's Skunk Works, the SR-71 flies at more than three times the speed of sound, above 80,000 feet, and can image more than 100,000 square miles—about the size of the state of Florida—in less than an hour.[35] Powered by two Pratt & Whitney J58 jet engines with afterburners, the SR-71 literally flies faster than a speeding bullet. Its speed and altitude make it even more difficult to shoot down than the U-2.

The SR-71's crew consists of a pilot and a reconnaissance systems operator (RSO) who assists the pilot with navigation and nonautomatic sensor operations and defensive system operations.[36] Like the U-2, the SR-71 can carry a wide range of sensors, including an OBC for high resolution panoramic imagery, two Technical Objective Cameras



SR-71 Blackbird. Photo courtesy of Lockheed Martin.

(TEOC) for very high resolution of designated areas, or the ASARSI which can provide all-weather, day or night imagery. Plus, the SR-71 can carry an electromagnetic reconnaissance system for precise characteristics and locations of electronic intelligence (ELINT) (emitter) signals (see illustration, next page; and photos, pp. 35-36). The SR-71 was upgraded with a data link system that allows recorded ASARS I and ELINT to be downloaded to a ground station. This download can be in near-real-time if the flight path permits it. Otherwise, the data is recorded for download at a more convenient time.[37] The SR-71 can also provide broad-area synoptic imagery. President Bill Clinton line-item vetoed the USAF operational SR-71 program was line-item vetoed by President Clinton on October 14, 1997. The next day, the USAF ordered a stand down of the SR-71 program. Secretary of Defense Bill Cohen later approved the USAF plan to retire the SR-71 permanently and dispose of the aircraft along with associated program assets. Final disposition is planned sometime in early 1999.[38]

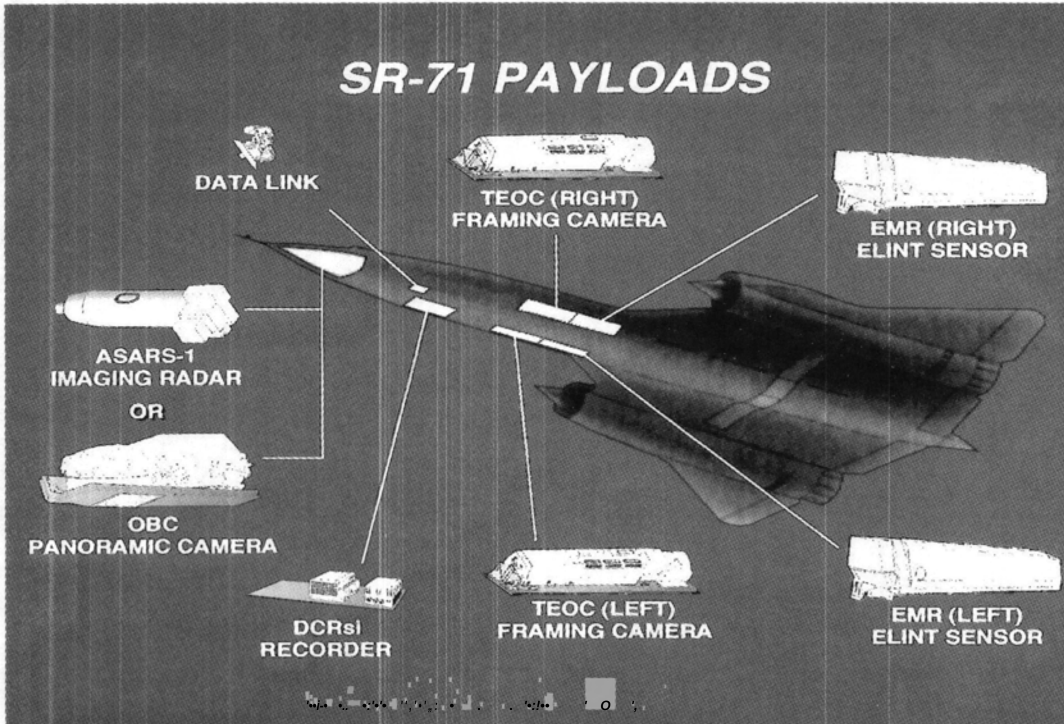
Advantages and Disadvantages of Manned Aircraft

According to the Joint Chiefs of Staff, for a variety of reasons

> [m]anned aerial [reconnaissance] systems are the most mobile and responsive reconnaissance, surveillance, targeting, and acquisition (RSTA) assets available, capable of carrying out critical missions and gathering vital information in near-real-time.[39]

When conditions significantly change during a reconnaissance mission, the pilot of a manned aircraft system can make modifications as necessary.[40] During Desert Storm, the piloted U-2 demonstrated that a mission could be dy-

Illustration courtesy of Lockheed Martin.

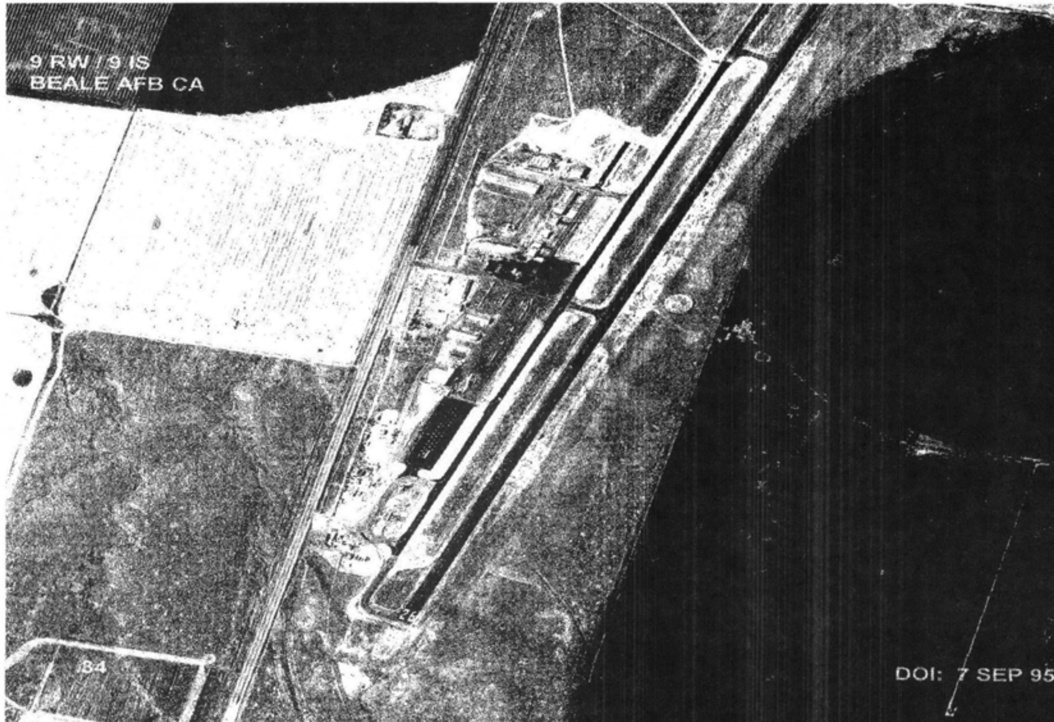


namically retasked or adjusted by the pilot in response to a target of opportunity or having to fly the aircraft home manually because of an equipment malfunction. On many documented occasions, the actions of the pilot saved the mission, aircraft, or both.[41] Aircraft systems such as the U-2 or SR-71 have a good payload-carrying capability and transport a variety of sensors—from SAR, electro-optical, infrared, and wet film—to a wide range of electronic and classified sensors (see illustrations, pp. 38-39).[42] Other platforms cannot carry nearly as many.

A significant drawback to manned aircraft systems is the risk to the pilot because of the inherent dangers of the physiological environment in high-altitude flight[43] and the surface-to-air and air-to-air missile threats of enemy air defenses. Additionally, a navigational mistake by the pilot, or a plotting error by the mission planner, could cause a serious international incident with potentially severe political and diplomatic consequences.

Training and outfitting the pilot is also a factor in terms of cost and time. High-flying aircraft like the U-2 or SR-71 require that the pilot wear a full pressure-suit like that worn by astronauts. A human pilot also needs continuation training, such as refresher academic courses and recurring flying proficiency training.

A challenge lies in finding a base suitable for operations located a safe and reasonable distance from the area of interest. It must have sufficient runway size in length and width for safe takeoffs and landings. Further, the arrangement must be approved by the host nation, and gaining cooperation from other nations for forward basing and flight routing is not easy. Sovereign nations are generally sensitive to U.S. reconnaissance collectors based on their soil. Additionally, if the route of a reconnaissance aircraft takes it through a nation's airspace, approval for overflight rights has to be



Example image of an airfield in California from the SR-71 technical objective camera (TEOC). Courtesy of Lockheed Martin.

Ex[illegible]e of [illegible]r image of McCarran Airport in Las Vegas from the SR-71 ASARS. Courtesy [illegible] acquired. In both cases the affected nation will be concerned with whether information is collected within its sovereign boundaries, or its allies', and whether the information gathered would be shared.

Aircraft are certainly not inexpensive. With its two supersonic jet engines requiring frequent in-flight refueling, the SR-71's price for relative invulnerability can cost as much as $38,000 per flight hour to operate. The U-2, by contrast, runs at a cost of $6,000 per flight hour.[44]

Platform and sensor availability is another challenge. Worldwide demand for imagery from high-altitude reconnaissance aircraft is immense. "We're at the highest tasking level ever," said officials of the 9th Reconnaissance Wing, responsible for the worldwide deployment of U-2 aircraft,. in 1996. The "workloads are high."[45] The U-2 is flying at several times the Cold War sortie rate in this new multipolar world. Freshly trained U-2 pilots can spend as many as 200 days per year overseas flying high-altitude reconnaissance missions. With finite numbers of aircraft and even fewer sensors, intelligence requirements for manned reconnaissance, like those for space-based systems, must be prioritized, inevitably resulting in a reduction of missions completed. The USAF is examining the feasibility of replacing the U-2 with a high-altitude endurance (HAE) UAV.[46]

Unmanned Aerial Vehicles (UAVs)

A type of aerial system whose use is expanding rapidly in the aerospace sector is the UAV. Formerly known as remotely piloted vehicles (RPVs), UAVs have been used for more than three decades. The United States used Teledyne Ryan-built UAVs during the Vietnam War.[47] The Israelis used UAVs in the 1973 October War and the 1982 Lebanon War.[48] During the Gulf War, the United States used the Pioneer UAV as mine hunters, for reconnaissance for SEAL

ABIT—Airborne Information Transmission
BGPHES-Battle Group Passive Horizon Extension System
CDL—Common Data Link
CARS—Contingency Airborne Reconnaissance System
CONUS—Continental United States
ETRAC—Enhanced Tactical Radar
JSIPS—Joint Service Imagery Processing System
TEG—Tactical Exploitation Group
FEBA-Forward Edge of the Battle Area
MOBSTR-Mobile Stretch Relay

Illustration courtesy of Lockheed Martin.

BGPHES-Battle Group Passive Horizon Extension System

CDL—Common Data Link

CARS—Contingency Airborne Reconnaissance System

ETRAC-Enhanced Tactical Radar

TEG—Tactical Exploitation Group

MOBSTR-Mobile Stretch Relay

Illustration courtesy of Lockheed Martin.

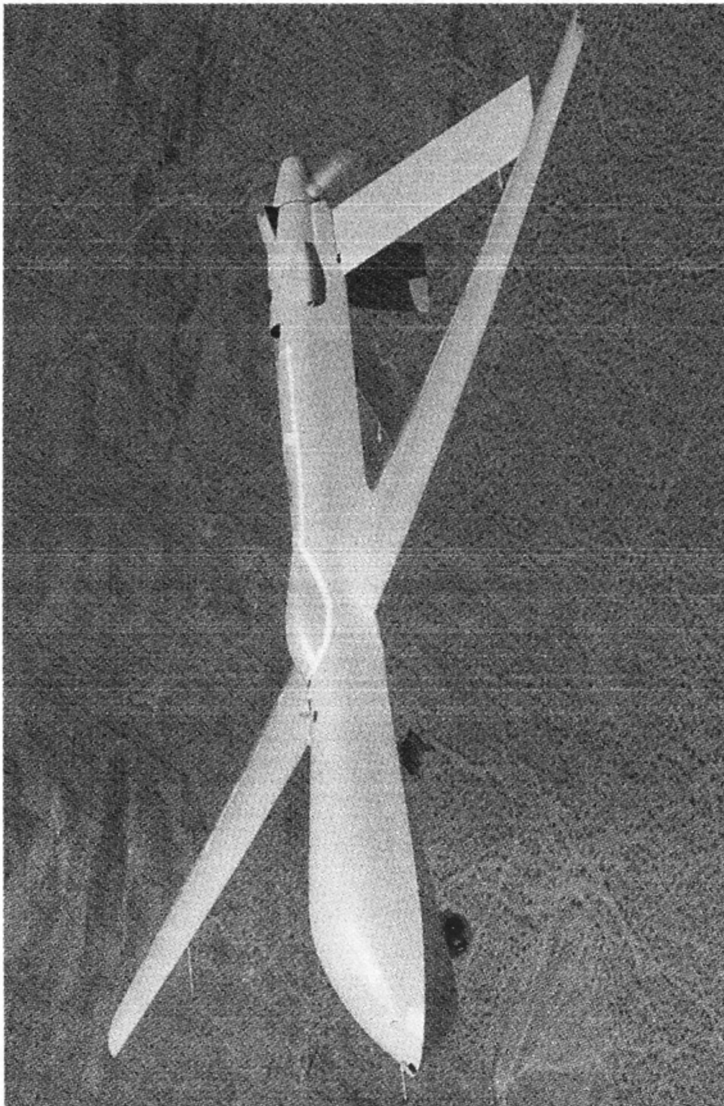
teams, and as command-and-control nodes for the navy. Pioneer UAVs were also used for near-real-time targeting for Marine attack aircraft.[49]

UAVs are intended to provide a broad range of collection capabilities, including SAR, infrared, and multispectral imagery intelligence (IMINT). UAVs can also be used as a line-of-sight communications relay. Future systems may include laser designators to highlight targets for attacking weapons systems. It should be noted that although UAVs have been around for more than three decades, the Pioneer and Predator UAVs are the only ones operating in the field at present.[50]

Many UAVs are, however, under development. The DOD, along with other agencies, is pursuing a series of pilotless vehicles in a multitiered UAV development program. Several promising ones include Tier II, Tier 11+, and Tier III-, differentiated in payload carrying capability, range, altitude, and endurance.

Tier II is a UAV known as the Predator (see photo, next page). Manufactured by General Atomics Aeronautical Systems, Inc. of San Diego, Calif., for tactical use, the Predator is a medium-altitude endurance (MAE) UAV. It is designed to cruise at 70 knots carrying 450-500 pounds at 25,000 feet in excess of twenty hours. Its action radius is 500 miles. The Predator can carry an SAR or an electro-optical (EO) and infrared (IR) sensor. On June 30, 1996, Predator completed its thirty-month Advanced Concept Technology Demonstration program. In August 1997 it transitioned to a production program in the acquisition arena. Additionally, by the end of 1998, Predator finished its third deployment to Bosnia.[51]

Tier 11+, more commonly known as Global Hawk (see photo, page 42), is made by Teledyne Ryan. It is also known as the conventional HAE UAV. This revolutionary vehicle is



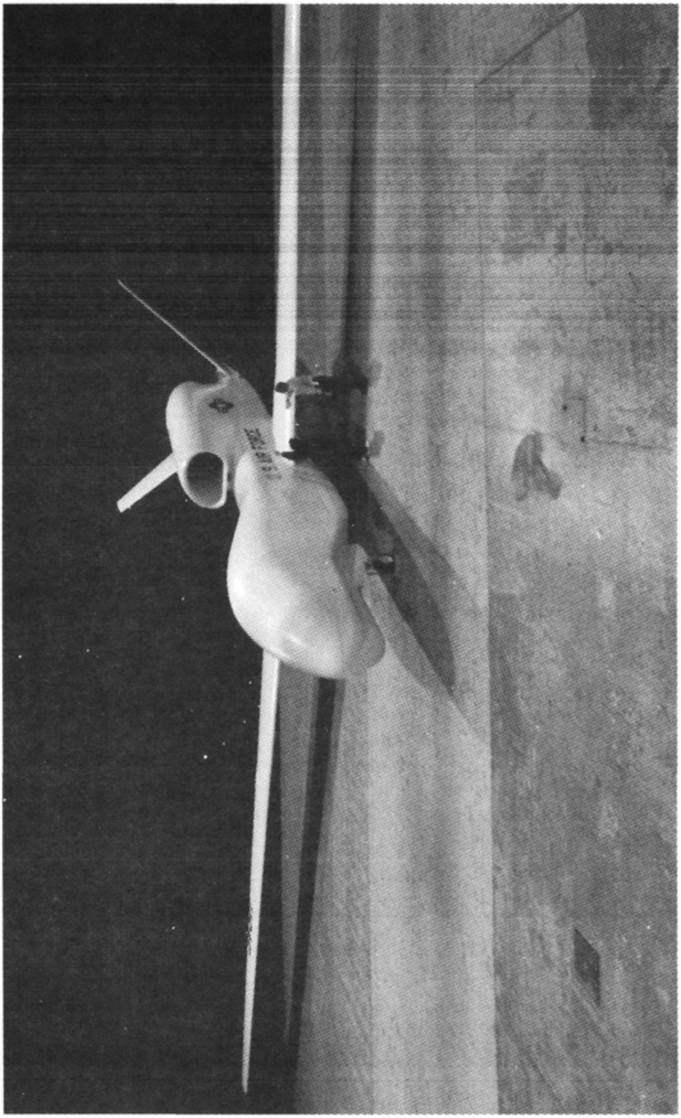


Photo of the Tier II+ UAV, Gl[illegible]l Hawk. Courtesy [illegible] RO.

designed to cruise at 345 knots at altitudes up to 65,000 feet for as long as thirty-eight hours. It is intended to fly with complete autonomy—without a pilot at the controls in the air or on the ground—and operate in "low threat" areas that are relatively free of enemy air defenses. The Global Hawk's radius of action is planned at 3,000 miles. It can carry EO/IR and SAR sensors. Payload carrying capability is about 1,960 pounds. Because of its high-altitude capability, Global Hawk could be used for imaging large areas and is intended for use in a stand-off role to avoid penetrating enemy air defenses. Although the first test flight was scheduled for spring 1997, software problems delayed the first flight until February 1998. Two demonstration vehicles have been built so far, and, as of December 19, 1998, nine test flights have been flown. The first air-worthiness flight lasted for fifty-seven minutes, during which the UAV climbed to 32,000 feet. The December 19 flight carried a payload to a height of 58,300 feet for almost seven and one-half hours. Engineering, fabrication, and user demonstrations will occur in the fiscal year 1999-2000 timeframe. A production and force mix decision is planned sometime in fiscal year 2000.[52]

Tier III- was more commonly known as DarkStar (see photo, next page). Lockheed Martin's Skunk Works, with Boeing as a partner, were contracted to develop this low-observable (stealth), high-altitude endurance (LO HAE) UAV. DarkStar was designed to penetrate and acquire imagery of heavily defended (high-threat) areas. Like Global Hawk, DarkStar is revolutionary because of its autonomous flight capability. Performance and payload capacity were trade-offs for a design that utilizes stealth technology and survivability features to counter air defenses. With a speed greater than 250 knots it was planned to cruise at altitudes above 45,000 feet for more than eight hours with an action radius of 500 nautical miles. Its 1,000-pound payload could

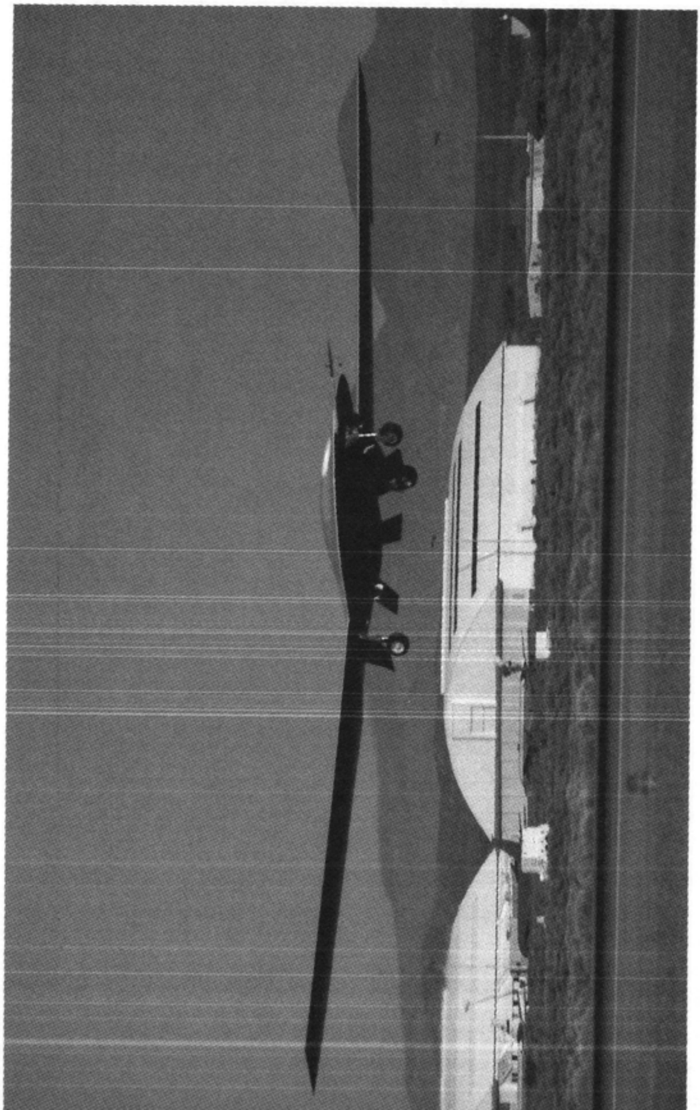


Photo of the Tier III- UAV, DarkStar. Courtesy of Lockheed Martin.

consist of either SAR or EO and could be used to acquire images of well-protected, high-value targets. Two vehicles were built. DarkStar's second test flight was in April 1996; unfortunately, it crashed upon takeoff as a result of "inaccurate prediction of air vehicle/ground interaction," setting the program schedule back by more than a year and costing $22 million. As of October 27, 1998, the one remaining DarkStar has had four successful flights to a height of 5,000 feet with flight times lasting from 44 to 72 minutes. In late January 1999, the DarkStar program was terminated because of funding constraints.[53]

Advantages and Disadvantages of UAVs

UAVs offer some significant advantages when compared to manned reconnaissance. They generally are "threat insensitive" because they do not put a human pilot in harm's way. In addition, political sensitivities may be minimized in the absence of a human pilot and, because of a relatively small radar cross section and the inclusion of stealthy characteristics, the penetration of high-threat areas such as Iraq may go undetected.[54] According to predictions, UAVs are potentially inexpensive, relatively speaking. The DOD's design goal for both Global Hawk and DarkStar was $10 million each (1994 dollars), based on the estimated price per flight hour of $1,000 in the postdevelopment stage.[55] For fiscal year 1999, estimates run higher, about $13.7 million for DarkStar and $14.8 million for Global Hawk.[56]

A prime drawback with HAE UAVs is their availability and maturity. No UAV currently operational can perform large-scale reconnaissance and support all three levels of warmaking and decision making. Production and force mix decisions on an HAE UAV, which may have the potential to be strategic, will not occur until the year 2000 or later when the engineering, fabrication, and user demonstration phase is over, assuming no unforeseen problems arise.

The DOD $10 million design goal limited the sensor development for the HAE UAVs. The planned payload of sensors is less than present manned aircraft systems. HAE UAVs are intended to carry only IMINT sensors, whereas operational systems like the U-2 carry both IMINT and signals intelligence (SIGINT) packages. Broad-area synoptic imagery will not be available from them, although they will have digital imagery. Unfortunately, the technology does not yet exist to digitally capture and store the panoramic view similar to the wet film cameras on the U-2 or the recently retired SR-71.

Without a pilot on board, these UAV imaging sensors are preprogrammed or controlled by a person on the ground and within a line of sight.[57] Dynamic retasking of sensors, or unplanned mission changes, if needed, would be difficult. It is anticipated that these UAVs will be able to be controlled via satellite, but the technology does not yet exist to replace a cognitive human being who can react to enemy threats, turbulent weather, or equipment malfunctions. Pilotless vehicles also challenge mission preparation. Accounting for every contingency, or decision point, that a human pilot would encounter results in very labor-intensive mission planning for Global Hawk or DarkStar.

Similar to the dangers of piloted aircraft, a navigational mistake from a faulty inertial navigation system, or a plotting error by a mission planner, could cause a serious international incident with significant political and military consequences. The challenges of forward-basing and overflight rights would be the same as for piloted aircraft.

Whereas there are significant advantages and disadvantages to all of these reconnaissance platforms, history has shown they have been used most effectively when employed in collective and complementary ways (see chart, next page).

	U-2	SR-71*	Predator	Global Hawk**	DarkStar***
Altitude					
—Maximum	70,000 feet	>80,000feet	25,000 feet	65,000 feet	45,000 feet
—Operating	>70,000feet	>80,000feet	15,000 feet	50,000-65,000 feet	45,000 feet
Endurance	9+hours	Limited by crew endurance	>20 hours	>38 hours	>8 hours
Action Radius	7,000 nm	Refuelled: no limit	500 nm	3,000 nm	500 nm
(in nautical mi)		Unrefuelled: 2,000 nm			
Cruising Speed	410 knots	Mach 3 (1,825 knots)	65-70 knots	345 knots	>250 knots
Engines					
—Manufacturer	General Electric Fl 18	Two Pratt Whitney J58s	Rotax	Allison	Williams
—Rating	17,000 lbs thrust	two @ 34,000 lbs. thrust	105hp	7,050 lbs thrust	1,900 lbs thrust
—Fuel Type	JPTS	JP7	Avgas(100 octane)	JP8	JP8
—Fuel Capacity	2,000 gallons	>15,000 gallons	108 gallons	2,160 gallons	416 gallons
Weight					
—Empty	variable («10,000 lbs)	60,000 lbs	1 200 lbs	8,940 lbs	4,360 lbs
—Payload	4,300 lbs	8,000 lbs.	450 lbs	1,960 lbs	1,000 lbs
—Max (at take-off)	40,000 lbs	variable	2,300 lbs	25,600 lbs	8,600 lbs
Dimensions					
—Wingspan	104 feet	55 6 feet	48 7 feet	116,2 feet	69 feet
—Length	63 feet	107 4 feet	26 7 feet	44 4 feet	15 feet
—Height	16 feet	18 5 feet	7,3 feet	15 2 feet	5 feet
Runway Required	5,000 feet	9,200 feet	2,500 feet	5,000 feet	<4,000 feet
Sensors	SYERS, IR, ASARS, OBC,	ASARS, OBC, TEOC, I-UM	**EO.IR.SAR**	**EO, IR, SAR**	**E0,SAR**
	IRIS III, Air Sampling,	*recently retired		**in development	***development
	SIGINT Suite				**terminated**

NOTES

1 Acknowledgment of the use of satellite systems for intelligence was revealed in 1967 by President Lyndon Johnson. See Evert Clark, "Satellite Spying Cited by Johnson," *New York Times,* March 17, 1967, p. 13. Satellite systems were revealed again in 1978 when President Jimmy Carter said the United States used satellites for arms control treaty verification. In February 1995, President Bill Clinton signed Executive Order 12951, which declassified historical intelligence imagery from early satellite systems known as CORONA, ARGON, and LANYARD. Consequently, the security system codeword TALENT-KEYHOLE and the associated satellite systems known as KEYHOLE (KH) 1, 2, 3, 4, 4A, 4B, 5, and 6 were declassified. Subsequent military systems remain classified. See Kevin C. Ruffner, *CORON A: Americas First Satellite Program* (Washington, D.C.: Central Intelligence Agency, 1995), pp. xi-xv; Kevin C. Ruffner, "CORONA and the Intelligence Community," *CIA—Studies in Intelligence* 39, no. 5 (annual unclassified edition, 1996), pp. 62-63.

2 Ground resolution is the measurement of the smallest detail distinguishable by a sensor system under specific conditions—the ground size equivalent of the smallest visible object and its associated space. See Joint Chiefs of Staff, *Dictionary of Military and Associated Terms,* Joint Publication 1-2 (Washington, D.C.: Department of Defense, March 23, 1994), p. 356.

3 Ruffner, *CORONA: America's First Satellite Program,* pp. xiv-xv.

4 Ibid., p. xv.

5 Ibid., p. 12.

6 The Committee on Imagery Requirements and Exploitation (COMIREX) was established by Director of Central Intelligence Directive 1/13 on April 1, 1967. COMIREX was responsible for processing the requests and assigning priorities

for satellite reconnaissance photography. It also managed the imagery produced. See Jeffrey T. Richelson, "The Keyhole Satellite Program," *Journal of Strategic Studies* 7, no. 2 (June 1984), p. 146.

7 Jeffrey T. Richelson, *The U.S. Intelligence Community* (Boulder, Colo.: Westview, 1995), p. 152; Jeffrey T. Richelson, *America's Secret Eyes in Space: The U.S. Keyhole Spy Satellite Program* (New York: Harper and Row, 1990), p. 126.

8 Department of Defense, *Conduct of the Persian Gulf War: Final Report to Congress* (Washington, D.C.: U.S. Government Printing Office [GPO], April 1992), p. 808.

9 Valerie Neal, *Spaceflight: A Smithsonian Guide* (New York: Macmillan, 1995), p. 193.

10 Ibid.

11 Ibid.

12 Joint Chiefs of Staff, *Doctrine for Reconnaissance, Surveillance, and Target Acquisition Support for Joint Operations (RSTA),* Joint Publication 3-55 (Washington, D.C.: Department of Defense, April 14, 1993), p. II-7.

13 Richelson, *The U.S. Intelligence Community,* pp. 157-158.

14 Ibid., p. 158.

15 U.S. Air Force (USAF), *New World Vistas,* Space Technology Volume (Washington, D.C.: USAF Scientific Advisory Board, 1996), p. 72.

16 Bill Sweetman, "Spy Satellites: The Next Leap Forward: Exploiting Commercial Satellite Technology," *International Defense Review* (January 1997), p. 27.

17 Richelson, *The U.S. Intelligence Community,* p. 158.

18 Ibid., p.157; "Iraqis Using Clouds to Cover Scud Firings, Meteorologists Say," *New York Times,* January 25, 1991.

19 Coy Cross, *The Dragon Lady Meets the Challenge: The U-2*

in Desert Storm (Beale Air Force Base, Calif.: 9RW History Office, 1996), p. 14.

20 Jay Miller, *Lockheed U-2* (Austin, Texas: Aerofax, Inc., 1983), pp. 45, 46, 77-87.

21 Ibid., pp. 51-53 ; Richelson, *The U.S. Intelligence Community,* pp. 159-160.

22 USAF Public Affairs, "U-2R/U-2S," Fact Sheet 96-21; Frank Oliveri, "The U-2 Comes In from the Cold," *AIR FORCE Magazine,* September 1994, pp. 46-47; Chris Pocock, "U-2: The Second Generation," *World Air Power Journal* 28 (spring 1997), p. 92.

23 John Stone, "U-2 Timeline of Events, *\99Ws,*" *John Stone's Lockheed Blackbird Page,* http://www.thepoint.net/~jstone/u2tl90.html.

24 Eliot Cohen, ed., *Planning and Control,* vol. 1 of *Gulf War Air Power Survey* (Washington, D.C.: GPO, 1993), p. 284 (unclassified). Tactical users view the U-2 as a tactical asset. Strategic users view the U-2 as a national asset. Because many U-2 missions are of national interest, and all U-2 missions must be nationally approved, the U-2 can be considered a national asset that can support the three levels of war.

25 Hundreds of targets can be captured on film. These targets must be selected before the mission, with the film processed sometime after the aircraft lands. USAF Public Affairs, "U-2R/U-2S"; Oliveri, "The U-2 Comes In from the Cold," pp. 46-47.

26 Donna Cassata, "A Venerable Cold Warrior Finds New Missions," *Congressional Quarterly Weekly Report,* September 2, 1995, p. 2666.

27 Cross, *The Dragon Lady Meets the Challenge,* p. 16.

28 Ibid., p. 17.

29 Ibid., p. 15.

30 Ibid.

31 Hughes Aircraft Company Reconnaissance System Division Marketing Brochure #RSG 1M5K 4-91; Cross, *The Dragon Lady Meets the Challenge,* p. 16.

32 The USAF/U.S. Army Joint Surveillance and Target Attack Radar System (JSTARS) was developed to undertake ground surveillance, targeting, and battle-management missions. JSTARS has a side-looking radar antenna that is integrated with the Global Positioning System. It operates in synthetic aperture radar mode to detect and locate stationary objects, such as a parked tank. It also alternates between synthetic aperture radar and a Doppler-type mode to find and follow slow moving targets. JSTARS can furnish this information to tactical aircraft, standoff missiles, or army artillery. Slow-moving targets can also include aircraft such as a helicopter. Since new Boeing 707 airframes are not available, the USAF is purchasing and modifying used 707s into the JSTARS. The converted 707s are designated E-8C and will carry a crew of army and USAF specialists to sit at eighteen operations and control consoles. These consoles display terrain data received from an Airborne Warning and Control System (AWACS) of vehicles moving anywhere within range. The primary contractor is the Northrop Grumman Corporation. JSTARS is primarily a tactical system used for battlefield management and is shown here to eliminate any confusion that may occur between JSTARS and ASARS II. The U-2 ASARS II is primarily synthetic aperture radar with a moving target indicator capability. JSTARS is primarily a moving target indicator radar with synthetic radar capability. See Susan H.H. Young, "Gallery of USAF Weapons," *AIR FORCE Magazine/United* States Air Force Almanac, May 1996, p. 137; Albert Hochevar et al., "Deep Strike: The Evolving Face of War," *Joint Force Quarterly* (autumn 1995), p. 84.

33 The SR-71 also achieved operational status in September 1995 but was grounded that same year because of lack of funding.

34 USAF, "SR-71 Blackbird Back in Business," *Air Force News Service,* January 30,1997, online at http://www.af mil/news/ Janl997/nl9970129_970105.html.

35 Ben Rich and Leo Janos, *Skunk Works* (Boston: Little, Brown, 1994), pp. 238-239; Dick van der Aart, *Aerial Espionage* (New York: Arco/Prentice Hall, 1985), pp. 65-66.

36 Van der Aart, *Aerial Espionage,* pp. 65-66; Rich and Janos, *Skunk Works,* p. 239.

37 Bill Majors, *SR-71 Reconnaissance System Executive Handbook* (Palmdale, Calif.: Lockheed-Martin Skunk Works, 1997), p. 19. The SR-71 can carry either the ASARS I, or the Optical Bar Camera (OBC) and two Technical Objective Cameras (TEOC) cameras plus the electrical intelligence (ELINT) package and a full compliment of defensive systems.

3 8 See US AF, "Air Force Retiring SR-71 Blackbirds," *Air Force News,* April 27, 1998, online at http://www.af.mil/news/ aprl998/nl9980427_980558 html.

39 Joint Chiefs of Staff, *Doctrine for Reconnaissance, Surveillance, and Target Acquisition Support for Joint Operations,* p. II-4.

40 Ibid.

41 Cross, *The Dragon Lady Meets the Challenge,* pp. 50, 90-122, app. 2 (eighteen citations to accompany the award of the Distinguished Flying Cross).

42 Michael A. Dornheim, "U-2 Runs at Frenzied Pace in New World Order," *Aviation Week and Space Technology,* April 29, 1996, p. 55. A "wet film" camera uses film similar to Polaroid film. The term "wet" refers to the use of chemicals during processing.

43 High-altitude flight above 50,000 feet requires the use of a full pressure (space) suit. Boyle's Law holds that a given

quantity of gas varies proportionally with the amount of pressure put upon it. Human beings, living at the bottom of an ocean of air at sea level, are used to 14.7 pounds per square inch of pressure from the weight of the air. Above 50,000 feet, there is so little pressure that without adequate protection the human body would expand and burst. According to Armstrong's Line, conventional liquids boil at 98 degrees Fahrenheit above 63,000 feet pressure altitude. Exposure to these elements without protection spells disaster to the pilot of a high-altitude reconnaissance flight.

44 Maj. Gen. Kenneth Israel, "Acquisition and DARO (Defense Airborne Reconnaissance Office)," *Space: Air Force Acquisition Update* (Proceedings of the United States Air Force Association Symposium, May 26,1995), p. 92.

45 Michael Dornheim, "U-2 Runs at Frenzied Pace in New World Order," p. 55.

46 See USAF, *1997 Air Force Long Range Plan: Summary,* online at http://www.xp.hq.af.mil/xpx/xpxc/m-p. 10. The plan states, "Decisions to phase out manned platforms . . . will not occur until UAVs have been proven affordable, capable, cost-effective, and reliable." See also PamHess, "Intell Panel Proposes $400 Million Plan to Replace U-2 with HAE UAV," *Inside the Air Force,* April 18, 1997, p. 9.

47 Steven Zaloga, "Unmanned Aerial Vehicles," *Aviation Week and Space Technology,* January 8, 1996, pp. 87-93.

48 Ibid., p. 87.

49 Richelson, *The U.S. Intelligence Community,* p. 161.

50 Suzann Chapman, "Aerospace World," *AIR FORCE Magazine,* November 1996, pp. 20-21; Joint Chiefs of Staff, *Doctrine for Reconnaissance, Surveillance, and Target Acquisition Support for Joint Operations,* pp. II-3-II-4.

51 Defense Airborne Reconnaissance Office (DARO), *UA VAnnual Report FY1996* (Washington, D.C.: Department of Defense, November 1996), pp. 18, 31; DARO, *UAV Annual*

Report FY1997 (Washington, D.C.: Department of Defense, November 1997), pp. 4-5; Zaloga, "Unmanned Aerial Vehicles," p. 88.

52 DARO, *UAV Annual Report FY 1996*, pp. 20, 31; DARO, *UAV Annual Report FY 1997*, pp. 34-35.

53 Both Global Hawk and DarkStar UAVs are revolutionary because they are designed for autonomous flight: both should be able to taxi, takeoff, perform an imaging mission, and return to land without a pilot at the controls. This autonomy would exist either in the air or from the ground.

54 Joint Chiefs of Staff, *Doctrine for Reconnaissance, Surveillance, and Target Acquisition Support for Joint Operations*, pp. II-3-II-4; Michael Dorheim, "DarkStar Crashed on Second Flight," *Aviation Week and Space Technology*, April 29, 1996, p. 24.

55 Israel, "Acquisition and DARO," p. 92.

56 U.S. General Accounting Office, *Unmanned Aerial Vehicles: Progress Toward Meeting High Altitude Endurance Aircraft Price Goals* (Washington, D.C.: General Accounting Office, December 15, 1998), pp. 1-3.

57 Joint Chiefs of Staff, *Doctrine for Reconnaissance, Surveillance, and Target Acquisition Support for Joint Operations*, pp. II-3-II-4.

Chapter 4

PHOTO-RECONNAISSANCE IN THE MIDDLE EAST

The Francis Gary Powers U-2 incident was not the first time that aerial reconnaissance was associated with the Middle East. The region's volatile history of instability and conflict has made it a central focus of overhead reconnaissance and surveillance for more than forty years.

THE 1956 SUEZ CRISIS

A U.S. high-altitude reconnaissance aircraft first flew over the Near East during the 1956 Suez Crisis,[1] in which France, Great Britain, and Israel colluded to attack Egypt.[2] U.S. analysts were not able to decipher all of the radio traffic between France and Britain, so President Dwight Eisenhower ordered the U-2s to overfly the area.[3] U-2 imagery revealed that Israel was mobilizing for war and had acquired sixty French aircraft, a much larger number than reported by France and an apparent violation of the British-French-American Tripartite Pact of 1950.[4] Subsequent U-2 imagery at the end of October 1956 revealed the outbreak of the conflict: burning aircraft, hangars, and buildings in Cairo and an armada of more than 200 French and British war-ships in the Mediterranean heading toward Egypt. By November 5, British and French troops were making airborne and amphibious landings.

Eisenhower was concerned that the Soviet Union would use the Suez Crisis to split NATO. Soviet Premier Nikolai Bulganin demanded that the United States intervene to stop the attack and threatened to bomb London and Paris with nuclear weapons, which would have caused the United States to go to war. The Kremlin had apparently promised Egyptian president Gamel Abdel Nasser that the Soviet Union would "do something," and Eisenhower was concerned the Soviets would send their air force into Syria, an action that would be a prime indicator of their intentions. He ordered U-2s to fly over Syria and Israel. Fortunately, the U-2 imagery revealed no Soviet planes on Syrian fields or moving into Egypt. It was apparent that the Soviets were not fully participating and, with World War III not imminent, Eisenhower was relieved.[5]

THE JUNE 1967 ARAB-ISRAELI WAR

Strategic photo-reconnaissance also played a significant role during the June 1967 Arab-Israeli War. Satellite coverage of the Near East at this time was highly useful in estimating the relative military strengths of both sides, which may mark the first use of satellites to image a conflict. The imagery revealed the extensive damage caused by the Israeli air attacks through an actual count of the aircraft destroyed on the ground in Syria, Jordan, and Egypt.[6] In terms of the satellite imagery, things did not go perfectly. Reportedly, the orbit of one of these early satellites was altered to cover the war, but the imagery found in the returned canister was not good. Another challenge was the number of days necessary to recover the film from the satellite.[7] The short duration of the war did not make for timely receipt of some satellite imagery by policymakers and decision makers.[8] Even so, the CORONA satellite program is credited for providing evidence of the extensive damage caused by the Israeli air attacks. Without this evidence, the "Israeli [claims] might have been discounted as exaggerations."[9]

Several reports claim that the SR-71 and U-2 strategic reconnaissance aircraft were used to photograph the battle areas. It is not likely that these reports are accurate, as the SR-71 was just becoming operational in the Pacific and flying missions over Southeast Asia at the time.[10] Use of the U-2 for these purposes in the Near East was constrained by political difficulties in the United Kingdom, deployed to a base in Upper Heyford. The Italians and French refused diplomatic clearance for the U-2 to fly over their countries on its way to the Suez Canal zone, and the British were reluctant to let the plane land at the Royal Air Force Base Akrotiri in Cyprus after the mission.[11] Apparently, the British were concerned over who would be affected by the information collected and were reluctant to offend the Arabs. The war ended quickly in a cease-fire.

That cease-fire ended in April 1969 when Israel and Egypt exchanged artillery fire across the Suez Canal, beginning a "War of Attrition" that continued for more than a year. Satellite return imagery revealed the organizational arrangement of Soviet surface-to-air missiles (SAMs) a few weeks before the August 8,1970, cease-fire. This imagery, as well as imagery from the U-2, was used to monitor the events leading up to the cease-fire. It was apparent that the United States was able to confirm the Israeli charge that Egypt had moved a significant number of SAMs into an area near the Suez Canal. Proof of the cease-fire violations ostensibly came from satellite and U-2 reconnaissance overflights.[12] Since the CORONA satellite program was then secret, and not shared with other governments, it is reasonable to assume that imagery from the U-2 was used for publicity purposes.[13]

Anticipating a breach in the cease-fire, President Richard Nixon ordered on August 7, 1970, that the area be watched by reconnaissance overflights. Secretary of State Henry Kissinger arranged for periodic U-2 reconnaissance missions over the Suez Canal zone to monitor the truce between Israel and Egypt. The first mission could not be flown until August 9 because of problems in acquiring a base from which to operate. Apparently Italy, Greece, and Spain refused to allow reconnaissance flights from their soil, and the United States reportedly had to "beg" the United Kingdom to use Akrotiri.[14]

Imagery revealed that a breach did occur. The first reconnaissance flight, two days after the cease-fire, showed Egyptian construction of new missile sites near the Suez Canal, placing Israeli aircraft flying over the Sinai's east bank at risk if they were defending the Bar-Lev line from an amphibious assault. Talks to end the hostilities opened on September 8, 1970, but after ten days Israel withdrew from the talks "so long as the cease-fire standstill agreement was not observed in its entirety."[15] Although Israel returned to the talks, relations did not improve until Nasser died on September 28, 1970. His successor, Anwar Sadat, would later extend the cease-fire and ease relations.[16]

THE OCTOBER 1973 WAR

As Israel observed YomKippur in October 1973, the armed forces of Egypt and Syria attacked with massive coordinated air and ground strikes along the Suez Canal and Golan Heights. The Arab objective was to regain control of parts of the Golan Heights and Sinai Peninsula—the territory lost during the June 1967 Arab-Israeli War. Under the guise of an exercise, the Egyptians massed their forces along the Suez Canal. Their deception operation worked, and the Arab forces achieved surprise. The Israel Defense Forces (IDF) could only partially mobilize.[17]

Satellite reconnaissance is credited with providing a strategic indicator to the United States, and Israeli human intelligence indicated Egyptian intentions. It is apparent, however, that the United States and Israel failed to interpret signs that preparations for war were under way. Although large troop build-ups, SAM movements, and earth-moving operations may have been seen in the imagery, this intelligence did not reveal intentions. Intentions must be interpreted, and although the signs existed, they were not properly analyzed. Egypt's willingness to fight was grossly underestimated. Israel was largely on the defensive the first few days of the war,[18] and Kissinger asked that surveillance of the conflict be stepped up "by all possible means." Moving a satellite into the right position to monitor the fighting would not be timely. Therefore, high-altitude reconnaissance flights were necessary.[19]

When Nixon was told that the Soviet Union had repositioned its COSMOS satellite to assist the Arab side with intelligence on Israeli positions, he sent the SR-71, whose speed and altitude minimized the threats from SAMs, to image the battle areas. Days before the Israeli offensive on October 15, the SR-71 imaged the area, producing intelligence to be shared with the Israelis. Unfortunately, the British, who did not want to offend the Arabs, would not publicly agree to a staging base in England for the SR-71. Instead, SR-71 missions were flown from Griffiss Air Force Base (AFB), New York, and Seymour-Johnson AFB, North Carolina. The 12,000-mile round trip to the Near East, including the time over the target area and multiple air refuelings, took approximately ten hours.[20] The imagery provided by these missions proved invaluable to the Israelis. It helped the IDF confirm information reported by its own reconnaissance assets and contributed to the discovery of the crucial gap between Egypt's Second and Third Armies—a gap the Israelis subsequently exploited to turn the tables on the Egyptians and force Cairo to agree to a cease-fire.[21]

This conflict highlighted the use of varying kinds of technical collectors. With its stealthy characteristics, high speed, high altitude, and flexible flight time, the SR-71 was an effective complement to satellite coverage. The complementary strategic reconnaissance assets the United States employed had a positive impact on the success that the Israeli forces achieved by the end of the war.

Shortly after the war ended on October 24, 1973, the U-2 was assigned to monitor periodically the demilitarized zones in the Sinai and the Golan Heights between Israel and Egypt and Syria, respectively. Kissinger arranged this confidence-building measure, allowing each country to receive aerial photographs and reports showing the disposition of the forces of each country.[22] Providing imagery to all parties enhanced the stability of the region and was, therefore, in the strategic interests of the United States. The arrangement continues today.[23]

LEBANON AND IRAN

In 1983, terrorists bombed the U.S. Marine Corps barracks in Beirut, Lebanon. Approximately 300 Marines were killed. President Ronald Reagan sent an SR-71 to penetrate this high-threat area and image all terrorist bases in the region. These flights provided broad-area synoptic imagery of the Syrian and Israeli armies, movements of contraband supplied to the Islamic Jihad, and the movements of key terrorist leaders' aircraft as they flew from one desert airstrip to another.[24]

In 1987, the White House needed to confirm reports of Iranians possessing Chinese Silkworm antiship missiles. If the reports were true, these missiles could be fired against shipping in the Straits of Hormuz. Reagan sent the SR-71 to the Persian Gulf to image the area. Results of the Blackbird imagery revealed that the Iranians did indeed possess the missiles. Knowing their exact location, the U.S. Navy was forewarned of the threat, and some diplomatic "warnings" were given to the Iranians on what they could expect if one of those missiles were fired at any commercial shipping in the area.[25]

THE 1991 PERSIAN GULF WAR

During the last two weeks of July 1990, representatives of Iraq and Kuwait met in Jiddah, Saudi Arabia, to settle their differences. The parties could not come to an agreement, and the Iraqis walked out of the meeting on the first day of August 1990. Satellite imagery revealed the mustering of 120,000 Iraqi troops and more than 1,000 tanks along the southeastern border of Iraq prior to these negotiations.[26]

Although the imagery clearly revealed Iraq's build-up of forces near Kuwait, it could not reveal Saddam Husayn's intentions. His moves were equally consistent with an intent to intimidate Kuwait, seize the Ar-Rumaylah oilfield in northern Kuwait, or overrun the entire country. Although continued read-outs from imagery allowed a confident U.S. intelligence community to warn allies in the Near East that Iraq would invade Kuwait days before the invasion took place, friendly Arab states repeatedly assured Washington that Saddam was only bluffing. Without definitive proof of Iraqi intentions, and encumbered with conflicting assessments from U.S. intelligence and other Arab states, the United States opted to wait. In the early morning hours of August

2, 1990, more than 120,000 Iraqi troops of the Republican Guard invaded Kuwait.[27]

Events demanded that strategic decision makers determine whether to form a coalition and commit forces from the United States, then draw up operational plans for Desert Shield and Desert Storm and specify Iraqi order of battle and defensive preparations, as well as identify targets. Challenges loomed for several of these demands. With the retirement of the SR-71 in January 1990, the coalition did not have a reconnaissance aircraft that was invulnerable to Iraqi air defenses. In January 1991, however, the U-2 penetrated Iraq and conducted battle-damage assessment (BDA) imaging missions early on the second day of the war.[28]

In addition, aerial reconnaissance at the tactical level was lacking. The U.S. Air Force had retired the RF-4 tactical reconnaissance aircraft from active duty without an adequate replacement. The Advanced Tactical Airborne Reconnaissance System (ATARS) was "still in the laboratory" because of funding cuts. The U.S. Marine Corps had also retired its RF-4Bs. The U.S. Air National Guard possessed the only operational RF-4s. These RF-4s were deployed but were a late addition to the effort. Twenty-four RF-4s arrived in total, twelve just before the start of the war and six not arriving until February. Reportedly, "the lack of ramp space" contributed to the problem. This lack of space suggests that reconnaissance was given a low priority.[29] Other tactical aircraft, such as Navy F-14s equipped with Tactical Air Reconnaissance Pods (TARPs) and Saudi RF-5s, were used for tactical reconnaissance, but this was not enough to overcome the reconnaissance shortfall.

Imagery from varying reconnaissance platforms, beginning with satellite reconnaissance, was needed. The Persian Gulf War marked the first time satellites were put "on a wartime footing"[30] to support policymakers and decision makers at the strategic, operational, and tactical levels of war. The appetite for imagery intelligence was tremendous, and in response the United States employed a wide array of reconnaissance platforms including satellites, aircraft, and unmanned aerial vehicles (UAVs) to view this region.

Satellite reconnaissance[31] of the Gulf region was a prime source of intelligence. More satellite coverage was devoted to this war than to any other prior conflict. Both the national decision-making community in Washington, D.C., and U.S. Central Command benefited. The imagery enhanced President George Bush's decision-making ability and aided BDA and attack mission planning. The national intelligence community was particularly interested in images of strategic targets such as nuclear and chemical facilities. The theater intelligence community was more interested in tactical targets, such as the Iraqi order of battle, troop positions, and airfield damage.[32]

The challenge was the strategic and tactical application of a strategically designed system. Transmitting a satellite product to the operational and tactical commanders in the Persian Gulf was not the original intention of the system and thus took time. Once the information was collected, it went to Washington, D.C., for processing, exploitation, and dissemination at the strategic level. When the images were finally received in the field, they were not of the wide areas for which U.S. military commanders had hoped.

Navy Capt. Robert Brown, the Defense Intelligence Agency's deputy director for intelligence on the Joint Staff, noted in June 1991 that the "largely static defense strategy [pursued by the Iraqis] allowed us to track [Saddam's] numbers and disposition with acceptable accuracy."[33] The lack of broad, synoptic or "near-simultaneous coverage" correctly identifying the Iraqi order of battle, however, caused "overcounting of Iraqi troops and rendered the allied forces incapable of totally eliminating the mobile threats (aircraft and armor)." Brown also pointed out that clouds covered Iraq for about half of the war. Apparently, some systems had difficulty looking through the weather, and other systems were not "continuous enough" in their penetration capability to see the movement of units, according to Brown.[34] In addition, battlefield commanders did not always get information sent to them rapidly.[35] Since this was a strategic system designed to satisfy the national community with information, dissemination to tactical commanders was not as timely as they would have liked.[36] Even so, satellite systems were successfully used more often during the Gulf War than in any previous conflict.

Aircraft systems complemented the satellite systems. At the time, the U-2 was the only operational reconnaissance aircraft conducting worldwide imaging missions and could also provide support for the three levels of war (the SR-71 had been officially retired in January 1990).[37] The U-2s began arriving in Saudi Arabia on August 17,1990. Considered a "national asset" and designed for strategic reconnaissance,[38] the U-2 played not only a strategic role but a tactical one as well.[39] The U-2 provided more than "30% of the total intelligence, 50% of the imagery intelligence, and 90% of all Army targeting intelligence . . . ."[40] Most of the Desert Storm and Desert Shield U-2 reconnaissance missions supported the operational and tactical levels of war.

The U-2 deployment during the Gulf War was the largest in history, with twelve aircraft deployed to Saudi Arabia.[41] The U-2 training squadron (U-2 pilot school) at Beale AFB in California was virtually closed, with most of the aircraft deployed to Saudi Arabia, because the remaining U-2s in the inventory were still needed to fulfill their other worldwide commitments[42] to crisis areas in Korea, Central and South America, and Europe.

The dynamic nature of conflict and war affected U-2 operations significantly. When Desert Shield began, the U-2 was used to identify Iraqi troop movements and potential targets for future offensive operations. When Desert Storm began, the U-2s also flew BDA missions. With the first launch of the Iraqi SCUD missile, SCUD hunting would be added to the list of U-2 duties.[43] The U.S.-led coalition was tremendously concerned about SCUD attacks on Israel and Saudi Arabia, giving the detection and destruction of SCUDs a very high priority. Because of the finite number of collection platforms and sensors, BDA missions sometimes were displaced.

With shifting collection priorities, missions changed frequently. Normally the pilot and mission planners prepare and plan for a high-altitude reconnaissance mission the day (or night) prior to the mission. Sometimes, additional taskings caused the mission planners to replan the mission through the night, with the pilot not knowing the destination of the mission until just prior to flight time. Other times the missions would change during the flight. These in-flight tasking changes, sometimes called "dynamic retaskings," would force the pilot to reprogram the aircraft's initial navigation system and occasionally reset the sensor to accommodate different targeting arrangements over Iraq.

Shifting priorities may have caused disagreements over BDA of Iraqi forces. The varying sensor platforms, analysts, and resulting data were likely part of the cause. U.S. Air Force intelligence officers in the U.S. Central Command reportedly used videotapes from strike missions.[44] The national intelligence community was reportedly using satellite photos[45] and their reports indicated that Iraqi forces apparently had greater strength. It appeared the coalition air strikes were not as effective as the air force had estimated.[46] An accurate count could only be made by an airborne platform.

Right after the war ended, a lone U-2 flew over and imaged the battlefield[47] with an Optical Bar Camera wet-film camera. Until that time, 388 of approximately 846 tanks reportedly were destroyed.[48] In the final analysis, imagery from the U-2 revealed that only 166 Iraqi tanks were destroyed.[49]

The UAV was another complementary reconnaissance system used during this conflict. All UAV missions supported the tactical level of war. Although they did not have the range or the capabilities for large-scale reconnaissance,[50] they could be sent on short, high-threat missions without putting a pilot at risk. Three U.S. Marine Corps ground units, the U.S. Army's 7th Corps, and two battleships (the *Wisconsin* and *Missouri)* employed the Pioneer UAV. Each of these six units had about five UAVs controlled from fixed and portable ground stations. From a fixed station, Pioneer could be controlled from a distance of 100 miles; portable stations were limited to 40 miles.[51]

The Pioneer units operating from the battleships monitored Iraqi shipping and mine laying; hunted for mines; and searched for Iraqi Silkworm missile sites, command-and-control-bunkers, and anti-aircraft artillery sites. Navy Pioneer crews helped to "pinpoint" targets for naval gunfire and coordinated naval air strikes on Iraqi convoys and tanks.[52]

The Marine Corps used UAVs for near-real-time targeting. The UAV system worked closely with attack aircraft. In fact, it was a Pioneer UAV that detected the first Iraqi penetration into Saudi Arabia, near Ras al-Khafji, on January 29, 1991.[53] Additionally, Marine Corps pilots viewed Pioneer videotapes to learn how many potential targets they were missing.[54]

The Army used Pioneer UAVs for training, familiarization, and field operations. It developed a "concept of route" reconnaissance for Apache helicopters in which pilots would view Pioneer videotapes of new routes to become familiar with the changing terrain, threats, and targets along the way. In addition, the Army used Pioneer for tactical aviation and cruise missile targeting.[55]

In all, Pioneer UAVs, operating day and night, flew approximately 300 reconnaissance missions during Desert Storm.[56] Reportedly, twelve air vehicles were lost to mechanical failure, Iraqi ground fire, or operator error. Thirteen damaged UAVs were repaired and returned to service. Despite the shortfall of tactical reconnaissance, UAV use in Desert Shield and Desert Storm was a success.[57]

Perhaps in no other conflict have policymakers, decision makers, and commanders at all levels been able to call upon such a capable intelligence system. It was the combination and complementary use of all these collectors that led to the achievement of these intelligence successes.

NOTES

1 This overflight occurred one year before the world entered the space age with the Soviet launch of Sputnik in October 1957. See Michael Rip and Joseph Fontanella, "A Window on the Arab-Israeli 'Yom Kippur' War of October 1973: Military Photo-Reconnaissance from High Altitude and Space," *Intelligence and National Security* 6, no. 1 (1991), p. 16.

2 Apparently the French government suspected that Egypt was supporting rebels behind an uprising in Algeria, then a French colony. The British government was not happy with Egypt's seizure of the Suez Canal. Israel was certainly supportive of the West in any dispute with the Arabs. See Ben Rich and Leo Janos, *Skunk Works* (Boston: Little, Brown, 1994), p. 159; Rip and Fontanella, "A Window on the Arab-Israeli 'Yom Kippur' War," pp. 16-17.

3 Michael Beschloss, *Mayday: Eisenhower, Khrushchev and the U-2 Affair* (London: Faber and Faber, 1986), p. 136.

4 Ibid., p. 137.

5 Ibid., pp. 137-138.

6 Kevin C. Ruffner, *CORONA: America's First Satellite Program* (Washington, D.C.: Central Intelligence Agency, 1995), p. 37.

7 These satellites ejected film canisters that would reenter the atmosphere on a precise trajectory and deploy a parachute. During the descent, an aircraft, the C-119 or later the C-130, would fly over the top of the chute, catching it or its shrouds with a hook and winching the canister aboard. This procedure sometimes took days to get imagery into the hands of decision makers.

8 Rip and Fontanella, "A Window on the Arab-Israeli 'Yom Kippur' War," p. 19.

9 Ruffner, *CORONA: America's First Satellite Program,* p. 37.

10 Col. Ken Collins, U.S. Air Force (ret.), telephone conversation with author, April 17, 1997. Collins is the former director of operations, 9th Strategic Reconnaissance Wing, Beale Air Force Base, Calif.

11 Chris Pocock, "U-2: The Second Generation," *World Air Power Journal* 28 (spring 1997), pp. 60-61; Chris Pocock, *Dragon Lady: The History of the U-2 Spyplane* (Osceola, Wise: Motorbooks International., 1989), pp. 109-110.

12 Rip and Fontanella, "A Window on the Arab-Israeli 'Yom Kippur'War," p. 21.

13 An example of the releasability problem was revealed in former Secretary of Defense James Schlesinger's following written comments:

> . . . In April (1975), spy satellite photos landed on my desk showing that the Soviets had constructed a

> missile handling and storage facility at the Somalian port of Berbera, commanding strategic approaches to the Red Sea, which would be a depot for storing Styx missiles used by the Soviet fleet in the Indian Ocean. These were missiles fired against other ships. The pictures provided proof of a Soviet buildup in the area, but I was stymied by a blanket injunction against any public disclosure of satellite photography, extending even to [M]embers of [C]ongress. In those days we didn't admit that spy satellites existed, so I could not release the pictures, especially to make a point. Instead, I ordered the Air Force to schedule a U-2 flight over the Berbera installation and provide overhead photos that I could make available to the press. The photos taken by the U-2 were superb, and I decided to go public and announced that the Soviets had begun storing missiles in Somalia....

See Rich and Janos, *Skunk Works,* p. 189.

14 London Daily Times Insight Team, *The Yom Kippur War* (New York: Doubleday, 1974), p. 42; Rich and Janos, *Skunk Works,* p. 190; Rip and Fontanella, "A Window on the Arab-Israeli 'Yom Kippur' War," p. 52; Dick van der Aart, *Aerial Espionage* (New York: Arco/Prentice Hall, 1985), pp. 42, 43.

15 London Daily Times Insight Team, *The Yom Kippur War,* p. 43.

16 Ibid.

17 Rip and Fontanella, "A Window on the Arab-Israeli 'Yom Kippur'War," pp. 31-32.

18 Ibid., pp. 34, 52, 65.

19 London Daily Times Insight Team, *The Yom Kippur War,* p. 72.

20 Rich and Janos, *Skunk Works,* p. 256; van der Aart, *Aerial*

Espionage, pp. 66-67; Jay Miller, *Lockheed's Skunk Works: The First Fifty Years* (Fort Worth, Texas: Aerofax, 1993), p. 149; Rip and Fontanella, "A Window on the Arab-Israeli 'Yom Kippur' War," pp. 51, 53, 64.

21 The exact contribution of U.S. imagery from the SR-71 missions to Israel's victory in the 1973 October War remains a matter of debate. The key issue is whether the Israel Defense Forces (IDF) first learned of the gap between the Egyptian Second and Third Armies from their own reconnaissance elements or from the American SR-7 Is. The vast majority of Israeli officers and Western military historians agree that elements of Maj. Gen. Ariel Sharon's armored division discovered the gap as early as October 9. Maj. Gen. Avraham "Bren" Adan, *On the Banks of the Suez* (San Francisco: Presidio, 1980), pp. 187-189; Colonel Trevor Dupuy, *Elusive Victory,* paperback ed., (Dubuque, Iowa: Kendall Hunt, 1992), pp. 474-475; Chaim Herzog, *The Arab-Israeli Wars,* (New York: Random House, 1982), p. 255. After the war, however, Maj. Gen. Shumel Gonen, commander of the Israeli Southern Command, claimed that Israel had first learned of the gap not from Sharon's forces, but from remote sensing (SR-71) imagery provided by the United States. Unfortunately, Sharon and Gonen developed a ferocious animosity during the war, and afterward both attempted to discredit the achievements of the other. This feud makes it difficult to determine the accuracy of Gonen's claims.

Even if Gonen has overstated the role of the SR-71 imagery in finding the gap in the Egyptian lines, it is plausible to believe that the imagery may have played a key role in confirming the presence of the gap and assuring Israel's military leaders that it could be exploited for a major counteroffensive. Gonen and many other senior military commanders were suspicious of Sharon and did not believe his claims. Moreover, Sharon had been arguing for an immediate counteroffensive against the Egyptians from the very beginning, whereas Gonen and other Israeli generals wanted to absorb the Egyptian blow first before developing a counterattack. Consequently, Gonen may not have accepted Sharon's initial reports of a gap at Deir Suweir—believing that this information was yet another gambit by Sharon to get approval for a counterattack—and became convinced of its existence only after he received objective confirmation from the American imagery. In addition, that overview would display the disposition of Egyptian forces that the Israelis exploited with their advance. See also Michael Russell Rip, "Military Photo-Reconnaissance during the Yom Kippur War: A Research Note," *Intelligence and National Security* 7, no. 2 (1992), p. 129.

22 Pocock, "U-2: The Second Generation," pp. 60-61; Pocock, *Dragon Lady,* p. 120; Rich and Janos, *Skunk Works,* p. 190; van der Aart, *Aerial Espionage,* p. 43; Rip and Fontanella, "A Window on the Arab-Israeli 'Yom.Kippur' War," pp. 54, 55.

23 According to the Defense Intelligence Agency's John Moore,

> Monitoring the military balance between Israel and its neighbors has been an ongoing process for the past five decades in the U.S. intelligence community. [To monitor compliance with treaty commitments] U.S. reconnaissance aircraft routinely overfly the Sinai and U.S. intelligence reports the results to both parties involved (Egypt and Israel). . . . This has also been done over the Golan Heights since 1974, after Secretary of State Henry Kissinger negotiated the Israel—Syria disengagement agreement.

Comments by John Moore, February 16, 1995, during a Policy forum at the Washington Institute for Near East Policy; see also Daniel Kurtzer, Ellen Laipson, and John L. Moore, *Intelligence and the Middle East: What Do We Need to Know?* (Washington, D.C.: Washington Institute for Near East Policy, 1995), p. 20.

24 Paul F. Crickmore, *Lockheed SR- 71: The Secret Mission Exposed* (London: Osprey Aerospace, 1993), p. 169.

25 Rich and Janos, *Skunk Works,* pp. 253-255.

26 Eliot Cohen, ed., *Planning and Control,* vol. 1 of *Gulf War Air Power Survey* (Washington, D.C.: U.S. Government Printing Office [GPO], 1993), p. 59 (unclassified); Thomas Allen, F. Clifton Berry, and Norman Polmar, *CNN War in the Gulf* (Atlanta: Turner Publishing, 1991), p. 65.

27 Author's interview with Ken Pollack, Persian Gulf War expert and former senior fellow at the Washington Institute for Near East Policy, Washington, D.C., May 5, 1997. Dr. Pollack is now a senior member of the faculty at the National Defense University, Fort McNair, Washington, D.C.

28 Pocock, "U-2: The Second Generation," pp. 60-61.

29 See Thomas Keany and Eliot Cohen, ed., *Gulf War Air Power Survey/Summary Report* (Washington, D.C: GPO, 1993), p. 194 (unclassified); David Fulghum, "Desert Storm Highlights Need for Rapid Tactical Intelligence," *Aviation Week and Space Technology,* February 11, 1991, p. 18.

30 Craig Covault, "Space Recon of Iraq Taxes CIA Operations," *Aviation Week and Space Technology,* September 3, 1990, p. 30; Bruce Nardwall, "U.S. Relies on Combination of Aircraft, Satellites, UAVs for Damage Assessment," *Aviation Week and Space Technology,* February 4, 1991, p. 24.

31 According to Keany and Cohen,

> Spacecraft included a total of six meteorological satellites, [and] three Defense Support Program satellites that scanned for and reported bright infrared 'events'—the exhaust glow from Scud launches (the satellites were put in orbit to warn of a Soviet ballistic missile attack against the United States). Two civil satellites also provided imagery: the U.S. LANDSAT and the French SPOT.

Keany and Cohen, *Gulf War Air Power Survey/Summary Report,* p. 194.

32 Craig Covault, "Recon Satellites Lead Allied Intelligence Effort," *Aviation Week and Space Technology,* February 4, 1991, p. 25.

33 David Fulghum, "Key Military Officials Criticize Intelligence Handling in Gulf War," *Aviation Week and Space Technology,* June 24, 1991, p. 83.

34 Ibid. See also Jeffrey T. Richelson, *The U.S. Intelligence Community* (Boulder, Colo.: Westview, 1995), p. 157 (referring to the lack of "broad, synoptic, or near-simultaneous coverage"); House Committee on Armed Services, 103rd Congress, 1st session, #5, *Intelligence Successes and Failures in Operations Desert Shield/Storm* (Washington, D.C.: GPO, August 16, 1993), p. 10 (identifying the shortfall of "wide-area synoptic coverage").

35 Fulghum, "Key Military Officials Criticize Intelligence Handling in Gulf War," p. 83; Mark David Mandeles, *Managing 'Command and Control' in the Persian Gulf War* (Westport, Conn.: Praeger Publishers, 1996), p. 100.

36 Fulghum, "Desert Storm Highlights Need for Rapid Tactical Intelligence," p. 18.

37 Richelson, *The U.S. Intelligence Community,* p. 158. At the time of the Iraqi invasion of Kuwait, Lockheed Skunk Works president Ben Rich called Gen. Mike Loh, USAF vice-chief of staff, and offered to have three SR-71 s operational in ninety days at a cost of $100 million. The offer was subsequently made to Secretary of Defense Dick Cheney, who turned down the idea. See Rich and Janos, *Skunk Works,* pp. 259-260. As a result of congressional direction, the air force brought two SR-7 Is out of retirement and to mission-ready status in January 1997. See United States Air Force, "SR-71 Blackbird Back in Business," *Air Force News Service,* January 30, 1997, online at http://www.af.mil/news/Janl997/nl9970129_970105.html.

38 Coy Cross, *The Dragon Lady Meets the Challenge: The U-2 in Desert Storm* (Beale Air Force Base, Calif.: 9RW His-

tory Office, 1996), p. 20.

39 Tactical reconnaissance is not altogether new for the U-2. The TR-1, which appeared in 1981, was almost identical to the U-2. It was named TR-1 for "tactical reconnaissance" to avoid the "spyplane" image associated with the U-2; this made basing the aircraft in the United Kingdom easier. The TR-1 flew "tactical" reconnaissance missions in the central region of Europe supporting the North Atlantic Treaty Organization during the Cold War. Strategic contributions were made from every mission, but they are classified. With the end of the Cold War and the transfer of TR-1 to the 9th Reconnaissance Wing, all TR-ls were redesignated to U-2s. See also Cross, *The Dragon Lady Meets the Challenge,* p. 14.

40 Ibid., p. 50.

41 Ibid., p. 35.

42 Ibid., pp. 49-50.

43 The U-2 would primarily use its Advanced Synthetic Aperture Radar System to look through weather while patrolling suspected launch areas. The data would be passed to a ground station almost instantaneously. A photo-interpreter in this ground station would call in an air strike on any SCUD missile launch site that was spotted. See ibid., p. 39; Bruce Smith, "U-2/TR-ls Provided Critical Data to Theater Commanders," *Aviation Week and Space Technology*; August 19, 1991, pp. 60-61.

44 Curtis Peebles, *Dark Eagles: A History of Top Secret U.S. Aircraft Programs* (Novato, Calif.: Presidio, 1995), p. 209.

45 Ibid., pp. 209-210.

46 Ibid.

47 House Committee on Armed Services, *Intelligence Successes and Failures,* p. 20.

48 Ibid.

49 Ibid., p. 21.

50 Keany and Cohen, *Gulf War Air Power Survey/Summary Report*, p. 195.

51 Richelson, *The U.S. Intelligence Community*, pp. 160-161.

52 David Foxwell and J.R. Wilson, "UAVs Win Plaudits in the Storm," *International Defense Review*, October 1991, p. 1115; Richelson, *The U.S. Intelligence Community*, p. 160.

53 Richelson, *The U.S. Intelligence Community*, p. 161.

54 Foxwell and Wilson, "UAVs Win Plaudits in the Storm," p. 1115.

55 Ibid.

56 Keany and Cohen, *Gulf War Air Power Survey/Summary Report*, p. 195.

57 House Committee on Armed Services, *Intelligence Successes and Failures*, p. 7.

Chapter 5

IRAQ AND THE NEAR EAST TODAY

Although the outcome of the Persian Gulf War significantly reduced Iraq's military capability, restored the government of Kuwait, and returned relative stability to the area, Saddam Husayn's regime remains a strategic problem for the United States. Following the heavy losses from Desert Storm, Iraq continues to reconstitute its military forces. Iraq has organized its army into twenty-three divisions—seven of them Republican Guard[1]—with an active ground force of more than 350,000 and 650,000 in the reserves, possessing more than 2,000 tanks; 4,500 armored personnel carriers; and other types of combat vehicles. In comparison, Saudi Arabia and Kuwait combined have only 80,000 troops and about 1,000 tanks. The Iraqi air force has 316 aircraft compared to 300 aircraft for Saudi Arabia.[2]

In light of his past actions, Saddam can be expected to continue threatening peace and stability in the region as long as he holds power. In late 1992 and early 1993, Iraq attacked U.S. aircraft and harassed United Nations (UN) inspectors. On December 27, 1992, Iraqi aircraft confronted two U.S. fighters enforcing the no-fly zone. One of the Iraqi aircraft was subsequently shot down. In January 1993, Baghdad frequently sent workers into Kuwait to retrieve equipment left behind during the war. It also harassed UN inspectors by refusing to allow their transport aircraft to land (Iraq insisted that the UN charter Iraqi aircraft). Additionally, Iraq moved anti-aircraft guns south to threaten U.S. patrol planes. On January 6, 1993, President George Bush told Iraq it had forty-eight hours to disperse the guns. Baghdad complied, but it returned the anti-aircraft weapons to their southern position on January 11. By January 15, another U.S. ultimatum was issued. On January 17, in retaliation for continued Iraqi harassment of UN inspectors, the United States launched a cruise missile attack (see photos, next pages). On January 19, Iraqi planes violated the northern no-fly zone and Iraqi anti-aircraft fired on U.S. aircraft in the south. On January 21, U.S. planes were attacked in the north. The U.S. fighters then attacked and disabled Iraqi air defense radar. A short time later, February 5, Saddam appealed to newly inaugurated President Bill Clinton to improve relations.[3]

Saddam demonstrated the threatening use of his armed forces in October 1994 when he moved two Republican Guard units to within twenty kilometers of Kuwait, prompting the U.S.-led response known as Operation Vigilant Warrior (see photos, pages 82-83). In September 1996, his troops conquered Irbil, committing atrocities in the course of the attack. In November 1997, he continued to defy UN Special Commission (UNSCOM) weapons inspectors and threatened to shoot down U-2 surveillance planes.[4] Tensions grew again in 1998 because of Saddam's refusal to cooperate with UNSCOM.[5] When Ambassador Richard Butler, UNSCOM chairman, reported the defiance to the UN, President Clinton ordered a "strong sustained series of air strikes" against Iraq in December 1998.[6] Saddam continually defies the world community on weapons of mass destruction (WMD) issues by lying to UNSCOM. His continued reign jeopardizes the

This optical bar camera picture taken from a U-2 shows the destruction of the Tallil air defense headquarters in January 1993. The bomb damage was from a U.S. cruise missile attack in retaliation to Iraqi provocations and harassment of UN inspectors. Declassified by the Defense Intelligence Agency (DIA/CL-1C), January 1993, for press release.

This U-2 image, using an optical bar camera, shows the bomb damage to the As-Samawah Iraqi air defense site after the U.S. cruise missile attack on January 17, 1993. The attack was in retaliation to Iraqi provocations and harassment of UN inspectors. Declassified by the Defense Intelligence Agency (DIA/CL-1C), January 1993, for press release.

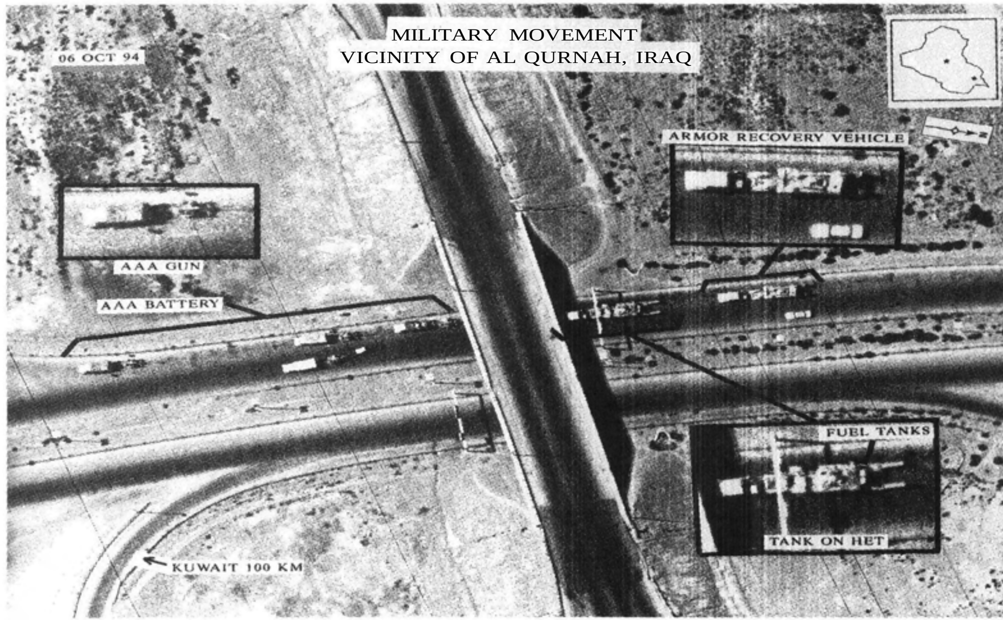
vital interests of the United States, the coalition, and the countries in the region.

The United States continues to maintain a military presence in the Near East to protect these interests. U.S. Central Command forces in the region include a naval, army, and air component. The U.S. Navy has a carrier battle group plus other assets, a maritime intercept operation, and a Marine Expeditionary Force in the region. Ashore, the U.S. Army has forward-deployed Patriot batteries, special operations teams, and enough pre-positioned equipment for five brigades. The Joint Task Force South West Asia (JTF/SWA) has the 363rd Air Expeditionary Wing (formerly the 4404th Provisional Air Wing) conducting Operation Southern Watch to enforce the no-fly zone up to the 33rd parallel in southern Iraq.[7] In northern Iraq, forces from U.S. European Command conduct Operation Northern Watch (formerly Operation Provide Comfort) which enforces the no-fly zone above the 36th parallel.[8] Space-based imaging systems and U-2 imaging systems are tasked heavily to support these operations. Even before President Clinton's line-item veto, the SR-71 was deemed too expensive to use in this capacity. As mentioned previously, the SR-71 has since been retired from operational service.

In addition to these operations, the United States strongly supports UNSCOM by providing, along with other nations,[9] personnel and equipment for its missions. UNSCOM was established in 1991 to monitor, with the International Atomic Energy Agency, Iraqi compliance with Section C of UN Security Council Resolution 687.[10] UNSCOM has had difficulty in carrying out its mandate. From the beginning, Iraq consistently misled the international community regarding Resolution 687, and its dialogue with UNSCOM has been deliberately "confusing and contradictory."[11]

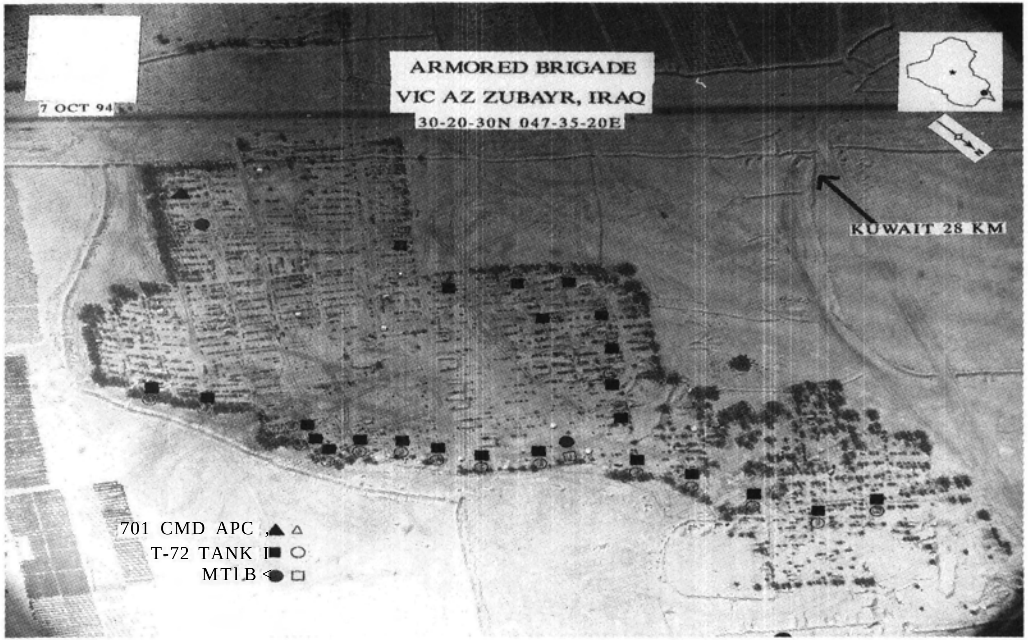
Despite these challenges, UNSCOM inspectors have been

U-2 image from an optical bar camera, which reveals the threatening movement of Iraqi forces toward Kuwait in October 1994. This image shows Iraqi forces moving south along a highway near Al-Qurnah, Iraq.



Declassified by the Defense Intelligence Agency (DIA/CL-1C), October 1994, for press release. Further use limited to DoD and The Washington Institute for Near East Policy.

Another U-2 image from an optical bar camera, which reveals an Iraqi armored brigade that has positioned itself near the Kuwaiti border in October 1994. T-72 tanks and armored personnel carriers can clearly be seen.



Declassified by the Defense Intelligence Agency (DIA/CL-1C), October 1994, for press release. Further use limited to DoD and The Washington Institute for Near East Policy.

quite successful.[12] "For years, they have struggled to discover and destroy Iraq's once extensive WMD arsenal. Although often harassed and threatened by Iraqi officials, they have made steady and at times stunning progress," said Secretary of State Madeleine Albright.[13] UNSCOM has proven "that Iraq diverted (not destroyed) missiles required by Resolution 687. We have reduced Iraq's capability to produce weapons of mass destruction," said Ambassador Rolf Ekeus, former head of the commission.[14] UNSCOM uses intrusive, on-site inspections; technical monitoring; and interviews with Iraqi military and civilian personnel to monitor the known and identify new WMD locations and WMD research facilities.[15] Central to UNSCOM's mission are the high-flying U-2 reconnaissance missions provided by the United States and, as a result, the Iraqi government vehemently objects to each U-2 mission.[16] Ekeus described UNSCOM's use of the U-2 as

> develop [ing] a library [target data base] focusing on [potential WMD] facilities plus to survey new and existing sites—in other words building and expanding a data base which we can compare over time. Additionally, since UNSCOM is made up of individuals from many nations, releasability of U-2 imagery is much easier. . . . The U-2 is the workhorse. The data it provides is fundamental to UNSCOM planning. The images also reveal the hiding of production equipment and the movement of such equipment. It can systematically cover large areas of Iraq revealing new facilities and production sites. The dynamic use of the U-2 is an insurance policy against the expansion of production facilities. Additionally, we now have a "living" library of U-2 images that are actively used by our teams on their inspections. . . . The U-2 is indispensable to UNSCOM. In fact, we need more missions, particularly night missions. We know the Iraqis engage in (illegitimate) activity when the U-2 is not flying.[17]

ISRAEL, SYRIA, AND EGYPT

In 1996, the peace negotiations between Israel and Syria were suspended.[18] In the preceding five years, according to a National Defense University *Strategic Assessment,* these two nations narrowed but did not resolve their differences on the following issues: "the nature of peace; the depth of Israel's withdrawal in or from the Golan; security arrangements including early warning stations, demilitarized zones, monitoring arrangements, and water sharing regimes; [and] the timetable for implementing an agreement."[19] Syria continues to shelter the Lebanese Hizballah and Palestinian terrorist groups, and as these groups continue to fight the Arab-Israeli peace process, tensions between the two countries continue.

Ostensibly, Egypt has slowed normalization with Israel because of domestic opinion critical of the peace treaty with Israel and criticism Egypt has received from the Arab community. Further, Egypt's efforts to build an Arab consensus on the peace process and its attempts to pressure Israel to sign the Nuclear Non-Proliferation Treaty have had negative effects. These activities have caused relations between Egypt and Israel to "cool."[20]

Given present-day tensions between Israel and both Egypt and Syria, Richard Nixon's presidential directive, issued more than two decades ago, remains valid—that a U-2 should perform strategic reconnaissance by periodically monitoring the demilitarized zones in the Sinai and Golan Heights. This arrangement continues as a confidence-building measure allowing Egypt, Israel, and Syria to receive aerial photographs (broad-area synoptic imagery) along with reports that show the disposition of forces for each country.[21]

Demand for imagery from high-flying reconnaissance missions will continue to be strong. Strategically, it is needed to assist UNSCOM with its critical mission of disarming Iraqi WMDs and to monitor the disengagement agreements for the sake of the Near East peace process. At the operational and tactical levels, these missions are needed for Operations Northern and Southern Watch.

NOTES

1 United States Central Command (CENTCOM), *1996 United States Central Command Posture Statement* (MacDill Air Force Base, Fla.: CENTCOM, 1996), p. 10.

2 National Defense University, *Strategic Assessment 1997: Flashpoints and Force Structure* (Washington, D.C.: U.S. Government Printing Office, 1997), p. 88.

3 See Ami Ayalon, ed., *Middle East Contemporary Survey* 17 (Boulder, Colo.: Westview, 1995), p. 27.

4 CNN Interactive, "Iraq Threatens to Shoot Down U.S. Surveillance Planes," November 3, 1997, online at http://cnn.com/WORLD/9711/03/iraq.130p.wrap/index.html; CNN Interactive, "Top Iraqi Leader Vows to Open Fire on U-2s," November 8, 1997, online at http://cnn.com/WORLD/9711/08/iraq/index.html; CNN Interactive, "U-2 Jet Flies Safely over Iraq," November 10, 1997, online at http://cnn.com/WORLD/9711/09/iraq.pm/index.html.

5 Barbara Crossette, "In New Challenge to the UN, Iraq Halts Arms Monitoring," *New York Times on America Online,* November 1, 1998.

6 Steven Lee Myers, "U.S. Moves Ahead With Preparations for Strikes on Iraq But Sets No Deadline," *New York Times on America Online,* November 6, 1998; Steven Erlanger, "White House Is Said to Favor Swift Action Against Iraq," *New York Times on America Online,* November 10, 1998; Barbara Crossette, "Iraq Again Hindering Inspections, UN Told," *New York Times on America Online,* December 11, 1998; Francis X. Clines and Steven Lee Myers, "U.S. and

British Forces Attack Iraq; Clinton Cites Military Need to Act," *New York Times on America Online*, December 17, 1998.

7 National Defense University, *Strategic Assessment 1997*, p. 95.

8 Office of International Security Affairs, *United States Security Strategy for Europe and NATO* (Washington, D.C.: Department of Defense, 1995), p. 28.

9 The United Nations Special Commission (UNSCOM) is organized with an executive chairman and deputy executive chairman, along with representatives of Australia, Austria, Belgium, Canada, China, Czechoslovakia (Czech Republic), Finland, France, Germany, Indonesia, Italy, Japan, the Netherlands, Nigeria, Norway, Poland, the Soviet Union (later the Russian Federation), Sweden, the United Kingdom, the United States, and Venezuela. The mission of UNSCOM is planned and managed under the direction of the executive chairman from UN headquarters in New York. An UNSCOM field office in Bahrain is used as an assembly and training area for inspection teams. This field office is also a base for UNSCOM's transport aircraft. The inspection teams work out of the Baghdad Monitoring and Verification Center. Approximately 40 people work in New York, 10 in Bahrain, and more than 100 in Baghdad.

10 UN Security Council Resolution 687 requires Iraq to dismantle its weapons of mass destruction (WMD) and provides UNSCOM with a mandate to inspect suspected WMD sites, seize WMD and/or associated material, and supervise WMD destruction. See United Nations, *The United Nations and the Iraq-Kuwait Conflict, 1990-1996,* Blue Book Series, vol. 9 (New York: UN Reproduction Section, 1996), pp. 74-75.

11 Ambassador Rolf Ekeus, remarks to a special Policy Forum at the Washington Institute for Near East Policy, January 29,1997. Ambassador Ekeus was the chairman of UNSCOM. See also "Dismantling Iraq's Weapons of Mass Destruction:

A Progress Report," *PolicyWatch* no. 235, Washington Institute for Near East Policy, February 5, 1997.

12 According to Assistant Secretary of State Robert Pelletreau,

> UNSCOM has played [a] dangerous cat-and-mouse game with the Iraqi regime since 1990 in an effort to carry out its Security Council mandate to root out Iraqi weapons of mass destruction. What UNSCOM found was that Iraq's WMD programs were far more developed than previously thought .... UNSCOM's accomplishments are even more impressive because they have come in the face of continued Iraqi attempts to obstruct its work.

Remarks by Robert Pelletreau at a special Policy Forum with the Washington Institute for Near East Policy, January 22, 1997.

13 Remarks by Secretary of State Madeline Albright at Georgetown University's School of Foreign Service, March 26, 1997.

14 Ambassador Rolf Ekeus, interview with author at the UN in New York, December 18, 1996.

15 United Nations, *The United Nations and the Iraq-Kuwait Conflict*, pp. 81, 449, 820; Jeffery Smith and John Goshko, "U.S. Lends Spy Plane to UN to View Iraq: Highflying U-2 to Search for Weapon Sites," *Washington Post*, August 13, 1991.

16 Letter from the minister of foreign affairs of Iraq to the president of the UN Security Council, November 7, 1996; see Appendix 1.

17 Ekeus interview with author, December 18, 1996.

18 National Defense University, *Strategic Assessment 1997*, pp.108-110.

19 Ibid.

20 Ibid.

21 Daniel Kurtzer, Ellen Laipson, and John L. Moore, *Intelligence and the Middle East: What Do We Need to Know?* (Washington, D.C.: Washington Institute for Near East Policy, 1995), p. 20; Chris Pocock, *Dragon Lady: The History of the U-2 Spyplane* (Osceola, Wise: Motorbooks International, 1989), p. 120; Ben Rich and Leo Janos, *Skunk Works* (Boston: Little, Brown, 1994), p. 190; Dick van der Aart, *Aerial Espionage* (New York: Arco/Prentice Hall, 1985), p. 43; Michael Rip and Joseph Fontanella, "A Window on the Arab-Israeli 'Yom Kippur' War of October 1973: Military Photo-Reconnaissance from High Altitude and Space," *Intelligence and National Security* 6, no. 1 (1991), pp. 54-55.

Chapter 6

CONCLUSIONS

"Precision guided munitions are not worth much without precise reconnaissance."
—*Maj. Gen. Ken Israel, USAF (ret.)*

For almost forty years, U.S. policy toward the Near East has relied heavily on strategic aerial and satellite reconnaissance to provide information for crucial policy decisions in peacetime, during crises, and in war. These methods have been utilized because the Middle East and Persian Gulf arena is such a challenging environment for intelligence collection, certainly for strategic human intelligence and signals intelligence.

The Suez Crisis of 1956 was a considerable concern for the United States. At the time, the Soviet Union was allied with Egypt and the United States with Israel. A change in the balance of power in the region had the potential to escalate into a third World War. It was in the strategic interest of the United States to know if the Soviet Union was adjusting its military posture to support Egypt. When imagery from the U-2 showed that the Soviets were not repositioning their forces to the region, direct action by the United States was deemed unnecessary.

Satellites were helpful during the June 1967 Arab-Israeli War in determining relative military strengths on both sides and in showing the extensive damage caused by Israeli air strikes. U-2 strategic reconnaissance proved useful in monitoring the cease-fire that followed.

With the October War of 1973, the United States used a combination of satellite and aerial reconnaissance at the strategic level. Unfortunately, satellite imagery showing the massing of Egyptian forces along the Suez Canal as part of an "exercise" was misinterpreted and not seen as threatening. Because the United States and Israel thought that an Egyptian attack was unlikely, Israel was caught completely by surprise. The strategic interests of the United States demanded that it assist an ally with imagery that would potentially affect the outcome of the entire war and whose adversary was supplied with overhead imagery by the Soviet Union.

Imaging satellites, in a predetermined orbit around the earth, could not be adequately repositioned in sufficient time to monitor the events rapidly unfolding on the Sinai in 1973. Virtually immune from attack by surface-to-air missiles (SAMs), the bullet-fast SR-71 was sent to image the battle areas. Imagery from these flights reportedly contributed to the discovery of a "zone of vulnerability" in the Egyptian lines.[1] Additionally, these aerial photographs provided the broad-area synoptic view of the entire battlefield, revealing the Egyptian order of battle. Again, U-2 strategic reconnaissance flights were needed to monitor the disengagement agreements.

The Persian Gulf War highlighted the tremendous technological advantages the U.S.-led coalition possessed in intelligence and reconnaissance. Overall, intelligence collection was good, but with the tremendous appetite for imagery at all levels of policymaking and decision making—and the finite number of platforms and resources—it was necessary to utilize collectors from satellites and high-flying reconnaissance aircraft.

These collection methods had their shortcomings. The retirement of the SR-71 in January 1990, for example, undercut U.S. intelligence-gathering capabilities before and during Desert Storm. With speeds over Mach 3, it would have been relatively invulnerable to Iraqi air defenses and could have provided broad-area synoptic coverage of enemy territory. Instead, the U-2, which is potentially vulnerable to some SAMs, initially flew its missions standing off from the more heavily defended areas of Iraq. Although its high altitude flights allowed it to look deep into Iraqi territory, a direct overflight would have provided better resolution.

Because the SR-71 was not available during the Gulf War, the U-2 was the only platform that could provide broad-area synoptic coverage of Iraq with its panoramic Intelligence Reconnaissance Imagery System HI (IRIS III) and optical bar cameras. The resolution along the margins of the panoramic image, however, were not clear enough to enable photo interpreters to view small targets. According to a U.S. House of Representatives Armed Services Oversight and Investigations Subcommittee 1993 report, "the simultaneous retirement of the SR-71 and a wide-area satellite imagery system, without follow-on systems, was shortsighted."[2]

The SR-71 was first retired in 1990 ostensibly because of its high cost and a perception that overhead systems such as satellites, along with the U-2s, could compensate for intelligence loss stemming from the SR-71's inactivity. In addition, according to Ben Rich, former president of Lockheed's Skunk Works, money from the SR-71 program was used to help fund other weapon systems programs.[3] Two SR-71s were returned to operational duty only because of a congressional mandate. Their later retirement stemmed from President Bill Clinton's line-item veto.

The retirement of the RF-4 tactical reconnaissance aircraft by the U.S. Air Force and U.S. Marine Corps from the active duty inventory by 1990 without an adequate replacement had a negative impact on U.S. tactical reconnaissance capabilities. The only RF-4s left were in the U.S. Air National Guard, but they were not quickly deployed during the Gulf War. A variety of other tactical aircraft, such as Navy F-14 TARPS and Saudi Arabian RF-5s, flew reconnaissance missions, but they were not present in sufficient numbers to meet the imagery requirements of the Gulf War coalition.[4]

Funding priorities were also responsible for the RF-4 being retired in 1996 without an adequate replacement. The Advanced Tactical Airborne Reconnaissance System (ATARS) for the F-16, which would replace the RF-4, was still in the laboratory because of funding decisions[5] to buy more modern weapons systems and precision-guided munitions.

Despite the hindrances, imagery collection in the Gulf War was good because of the collective and complementary use of available reconnaissance systems. When cloud cover, darkness, smoke, or dust obscures a target area from the view of a reconnaissance satellite, airborne reconnaissance platforms can be used to fill in the gap.[6] During Desert Storm, U-2s equipped with the Advanced Synthetic Aperture Radar System II (ASARS II) were used. The Joint Surveillance and Target Attack Radar System (JSTARS), equipped with synthetic aperture radar, also contributed to battlefield management at the tactical level.

The Air Force is considering replacing the U-2 with a high-altitude endurance unmanned aerial vehicle (HAE UAV).[7] Unfortunately, neither of the UAVs currently under development (Global Hawk and DarkStar) will be multi-intelligence, or "multi-int," capable—that is, they will not be capable of carrying both imagery intelligence (IMINT) and signals intelligence simultaneously. Moreover, the IMINT capability planned for the HAE UAVs is digital only, making them unable to provide broad-area synoptic imagery at this time.

The strategic implications are significant. Problems with

Iraq and the Arab-Israeli peace process could be resolved in the next few years, but this scenario is unlikely. More realistically, Saddam Husayn will remain in power, and friction within the peace process will continue. The premature retirement of a reconnaissance system like the U-2 without an adequate replacement would undermine UNSCOM's mission of eliminating Iraqi WMDs, because the lack of broad-area coverage provided by the panoramic cameras of the U-2 would not allow UNSCOM to prepare for and conduct inspections properly. Additionally, this U-2 coverage would not be available to support the disengagement agreements between Egypt, Syria, and Israel, negatively affecting the peace process. The operational and tactical levels of U.S. involvement in the Near East would also be affected. Operations Northern and Southern Watch in Iraq would not only lose the panoramic coverage from the U-2, but also the capability to perform the wide array of reconnaissance missions associated with all the other sensors carried on the U-2, some of which are classified.

A feverish push toward investing in the future regarding UAVs could have a negative effect on present-day operations not only by shifting funds and resources but by removing capability. This decision would deny U.S. strategic policymakers and decision makers and war fighters information they need for decisions now. Compromising present-day operations in this way will most certainly have a negative impact on future operations.

FINAL THOUGHTS

If history is any indication, the United States will need to be continually involved in the Near East—from the Arab-Israeli peace process to the Persian Gulf arena. Despite the successes of Desert Storm and the achievements of U.S.

diplomacy with the peace process, the United States faces diverse and interrelated threats, not only to its own security but to its allies' as well. Therefore, a prudent awareness of the dangers and opportunities that confront the United States can be achieved only by a painstaking collection of information on key events. Clearly, history has revealed the need for reconnaissance imagery of this volatile region that supports all levels of policymaking and decision making.

Space is the ultimate high ground. One day, as technology improves, space-based systems may be able to look at any part of the globe at any time and provide imagery with superior resolution in near-real-time. Until then, operationally proven systems will be needed to satisfy the intelligence collection requirements in this volatile region. The ability to send a collection platform such as a UAV into a high-threat area such as Iraq should be pursued, especially when it avoids placing a pilot in harm's way and at a lower cost. These systems, however, must be allowed to mature technologically into viable platforms with at least the same sensor capabilities as present systems.

In light of the developmental challenges facing UAVs, along with the potential of continuing U-2 attrition, the U.S. Air Force may need to explore the feasibility of building additional U-2 aircraft to assist in filling the widening gap in intelligence collection requirements. Realization of this proposal would not only provide some relief from high operations tempo, but also allow future systems time to develop adequately and then augment the reconnaissance force structure. Investments should also be made to develop future systems, such as the HAE UAV, to modernize our reconnaissance forces. These systems should have the same, or improved, sensor capability. These investments in force modernization, however, should be made without causing a reduction in current operational readiness and capability.

Obviously, no single type of system can satisfy all the current intelligence requirements in the Middle East and Persian Gulf arena. In fact, collectively, all of these reconnaissance systems cannot achieve this goal. Therefore Department of Defense must continue to pursue the right "mix" of collectors. With the overwhelming requirement for accurate and timely information on this region, the finite number of satellites and manned aircraft along with the immature, less capable, and unavailable UAVs strongly suggest that high-altitude manned reconnaissance will operate in this region indefinitely.

NOTES

1 Maj. Gen. Avraham "Bren" Adan, *On the Banks of the Suez* (San Francisco: Presidio, 1980), pp. 187-189; Col. Trevor Dupuy, *Elusive Victory,* paperback ed., (Dubuque, Iowa: Kendall Hunt, 1992), pp. 474-475; ChaimHerzog, *The Arab Israeli Wars* (New York: Random House, 1982), p. 255.

2 House Committee on Armed Services, 103rd Congress, 1st session, #5, *Intelligence Successes and Failures in Operations Desert Shield/Storm* (Washington, D.C.: U.S. Government Printing Office [GPO], August 16, 1993), p. 10.

3 Ben Rich and Leo Janos, *Skunk Works* (Boston: Little, Brown, 1994), p. 258; David Fulghum, "Desert Storm Highlights Need for Rapid Tactical Intelligence," *Aviation Week and Space Technology,* February 11, 1991, p. 18.

4 U.S. Department of Defense, *Conduct of the Persian Gulf War: Final Report to Congress* (Washington, D.C.: GPO, April 1992), pp. 175, 340, 346; Thomas Keany and Eliot Cohen, ed., *Gulf War Air Power Survey/Summary Report* (Washington, D.C.: GPO, 1993), pp. 194-195 (unclassified); Jeffrey T. Richelson, *The U.S. Intelligence Community* (Boulder, Colo.: Westview, 1995), p. 160.

5 Fulghum, "Desert Storm Highlights the Need for Rapid Tactical Intelligence," p. 18.

6 Chris Pocock, "U-2: The Second Generation," *World Air Power Journal* 28 (spring 1997), pp. 87-88.

7 United States Air Force, *1997 Air Force Long Range Plan: Summary,* online at http://www.xp.hq.af mil/xpx/xpxc/m-p. 10; Pam Hess, "Intell Panel Proposes $400 Million Plan to Replace U-2 with HAE UAV," *Inside the A ir Force,* April 18, 1997, p. 9.

Appendix 1

UNITED NATIONS
Security Council

S/l 996/932
12 November 1996
ENGLISH
ORIGINAL: ARABIC

LETTER DATED 11 NOVEMBER 1996 FROM THE PERMANENT REPRESENTATIVE OF IRAQ TO THE UNITED NATIONS ADDRESSED TO THE PRESIDENT OF THE SECURITY COUNCIL

On instructions from my Government, I have the honour to transmit to you herewith a letter dated 7 November 1996 addressed to you by Mr. Mohammed Said Al-Sahaf, Minister for Foreign Affairs of the Republic of Iraq, concerning violations of Iraqi airspace by the U-2 aircraft.

I should be grateful if you would have this letter and its annex, the letter from the Minister for Foreign Affairs of the Republic of Iraq, circulated as a document of the Security Council.

(Signed) Nizar HAMDOON
Ambassador
Permanent Representative

Annex

Letter dated 7 November 1996 from the Minister for Foreign Affairs of Iraq addressed to the President of the Security Council

We refer to our letter of 7 September 1996 addressed to the President of the Security Council (S/1996/727) concerning the violation of Iraq's airspace by the United States U-2 spy plane on the pretext of conducting aerial surveys for the Special Commission.

I should like to inform you that this aircraft, which takes off from Saudi territory, has continued its invasions and penetrations of Iraq's airspace in violation of the country's sovereignty and security. As of the end of October 1996 it had made 324 overflights, for a total flight time of 1,448 hours and 28 minutes, since it began such operations in August 1991.

The facts that have come to light since this aircraft was first brought into use, which are set forth in our aforementioned letter, and the ill repute the aircraft has acquired from its past espionage activities in various parts of the world, make it incumbent upon the United Nations to re-examine the question of the continued coercive use of the aircraft by the United States of America to violate Iraq's airspace in a manner totally incompatible with the purposes and principles of the Charter of the United Nations as they relate to respect for the sovereignty of all Member States.

We condemn these unjustified violations of our airspace and take this opportunity to reaffirm the request we have consistently made in the 114 letters on this matter that we have addressed to the Secretary-General of the United Nations that Iraqi aircraft be used instead of foreign aircraft in the work of the Special Commission in order to exclude any possibility of such aircraft being used for purposes prejudicial to Iraq's sovereignty and security.

1 should be grateful if you would have this letter circulated as a document of the Security Council.

(Signed) Mohammed Said AL-SAHAF
Minister for Foreign Affairs of the Republic of Iraq

Appendix 2

Future Imagery Reconnaissance Scenario

The year is 2002 and the situation in the Near East has changed little from the 1990s. The peace process has not moved forward toward its final goal. Saddam Husayn remains in power in Iraq. Several years have passed since the implementation of United Nations Security Council Resolution 986 allowing Iraq to sell several billion dollars worth of oil in exchange for food to feed the Iraqi people, but Saddam is using proceeds from the sales to continue building up Iraq's armed forces. For the last few years, Saddam has been suspiciously cooperative, and Iraq's neighbors are seemingly comfortable with this unusual state of calm.

U.S.-led Operations Northern and Southern Watch continue at a cost of $25 billion a year. It is winter, with clouds obscuring the Near East region most of the time. The UN Special Commission (UNSCOM) still conducts extensive inspections into Iraqi weapons of mass destruction (WMD). For the last several years during December and January, Iraq has been conducting large scale military exercises in the south.

Downsizing and tight budgets have caused significant funding shifts in the U.S. reconnaissance arena. The development of unmanned aerial vehicles (UAVs) has been a Department of Defense priority, and therefore funds originally allotted for sensor upgrades and improvements to the U-2 and SR-71 were shifted to fund the further development of UAVs.

Although the DarkStar and Global Hawk UAVs have just completed the demonstration phase of development, UAVs have been plagued with software problems, causing delays and development cost overruns. Both systems are scheduled to be fielded at a rate of four per year. Five Global Hawks have been built so far. These UAVs can carry imagery intelligence (IMESfT) packages, but only one at a time. UAV imagery is digital, which is very good, but the technology does not exist to enable panoramic digital imagery, a necessary quality in providing broad-area synoptic coverage.

Taking advantage of obscuring wintertime clouds, and under the guise of an exercise, Iraq moves several brigade-size units of the Republican Guard south toward Kuwait. Although the cloud cover blocked most of the movement from satellite imagery, the strategic indicator was identified by a seasoned imagery analyst in Washington, D.C., and confirmed by a reconnaissance aircraft flying at an altitude above 70,000 feet. A patrolling U-2 equipped with the Advanced Synthetic Aperture Radar System II (ASARS II) has been looking through the clouds deep into Iraqi territory and monitoring the Iraqi force movement.

The U.S. president demands that the military movements threatening Kuwait stop and that Iraq pull its Republican Guard units back. Saddam ignores the president's demands and keeps his forces within twenty kilometers of Kuwait. The president then orders additional military forces to Southwest Asia to augment those already in-theater. The Commander-in-Chief of U.S. Central Command (USCINCCENT), who is responsible for military operations in the Southwest Asian Theater, requests additional reconnaissance aircraft, both the U-2 and SR-71, for pre- and post-strike battle-damage assessment (BDA). The Joint Staff J-3 Reconnaissance Operations Division (ROD) provides staff for the reconnaissance aircraft request and acquires National Command Authorities (NCA) approval for the deployment. Operation Vigilant Warrior II has begun.

Several U-2s deploy from the United States to Saudi Arabia. Two SR-71 s are sent to a forward operating base in the United Kingdom. Combat air patrols of the coalition enforcing the no-fly zones in Iraq are intensified. ASARS-equipped U-2s continually fly missions at night or during the day looking through the darkness and the clouds at the Iraqi forces. When there is an occasional break in the weather during the day, a U-2 equipped with an Optical Bar Camera (OBC) is used for broad-area synoptic coverage to determine the Iraqi order of battle. During one U-2 reconnaissance mission, the pilot hears an alarm and sees a series of lights from the defensive system on board, indicating a surface-to-air missile (SAM) has been launched. The pilot turns his head and observes a missile, with speeds exceeding Mach 5, streak toward him from his left side. With only a second to react, the pilot rapidly and violently maneuvers the U-2 in an attempt to evade the SAM. Miraculously, the tactic works. At the same time, coalition fighter aircraft attack and destroy the SAM site. The U-2 pilot aborts the mission and brings the U-2 to a safe landing.

Shortly after this incident, the president orders an attack against Iraq with ship-launched Tomahawk cruise missiles. Target sets are determined from previous U-2 missions flown with an OBC. Shortly after the Tomahawk attack, the president and the field commanders need imagery that will show the disposition of Iraqi forces and BDA. The president needs to know whether Iraq has followed U.S. demands. The field commanders need to know what targets have been successfully neutralized and identify new targets along with the current Iraqi order of battle.

With the situation worsening and the Iraqi air defense environment more threatening, it is determined that the SR-71 equipped with an OBC for broad-area coverage will be used. The Mach 3-plus speed and the 80,000-foot cruising altitude of the SR-71 make it a very difficult target to shoot down. The SR-71 mission is planned around the next forecast break in the weather. Overflight clearances from the United Kingdom, France, Italy, Israel, and Jordan are needed to fly the SR-71 from the United Kingdom to the target area and back.[1]

For the most part, the five-hour mission with multiple air refuelings from a KC-135 tanker goes as planned. The anticipated Iraqi air defense reaction does not occur. On the return leg over the Mediterranean Sea, a momentary power surge causes an electrical generator to drop off-line, causing the astronavigational system (ANS) to lose its data and the aircraft's position. The backup inertial navigation system for emergencies such as this, only moderately accurate, could point the SR-71 in the right direction but could be miles off. The reconnaissance systems officer (RSO) will have to manually reprogram the ANS and realign it while airborne. Otherwise the crew of the SR-71 would have difficulty finding the precise location for the next aerial refueling rendezvous with the KC-135. Running out of fuel means the crew would have to bail out, but attempts to contact the KC-135 tanker fail. Fortunately, the RSO is able to bring the ANS back on-line. The SR-71 rendezvous with the KC-135 for fuel is completed over the central Mediterranean Sea, and the SR-71 successfully makes it back to its operating location in the United Kingdom.

A Second Major Regional Crisis Develops

Meanwhile, tensions grow to an all-time high between North and South Korea. Food shortages continue to plague the North; intelligence reports indicate some cannibalism is occurring. Satellite imagery reveals North Korean forces located 300 miles from the border mobilizing and moving south. A U-2, patrolling at night and equipped with the AS ARSII and moving target indicator, sees massing North Korean forces thirty-five miles from the demilitarized zone. Diplomats on both sides meet in Panmunjong to discuss their differences.

The commander-in-chief of UN forces in Korea, who is also the commander of U.S. forces in Korea, asks the U.S. NCA for assistance. With U-2 aircraft supporting Operation Provide Hope in south-central Europe, treaty verification in the Near East, and Operations Vigilant Warrior II and Northern and Southern Watch along with UNSCOM in Iraq, no U-2 aircraft from the Near East theater are immediately available to assist South Korea. Both SR-71 s are committed to Vigilant Warrior n, so a decision is made to send three Global Hawks to assist with the Korean crisis.

The reconnaissance operations tempo in Korea is high with the U-2 and the Global Hawk flying missions nearly every hour of the day. Policy/decision makers prefer to utilize the U-2 during optimum collection times because it carries more than one intelligence collection package (sensor) at a time. The Global Hawk performs very well carrying either the synthetic aperture radar (S AR) or electro-optic and infrared (EO/IR) IMINT packages.

Unfortunately, bad weather adversely affects the recovery of several reconnaissance aircraft. A U-2 pilot, returning from an imaging collection mission, reports encountering moderate turbulence while descending toward home base. Thunderstorms are reported within twenty miles of the base. As the aircraft is tossed by the turbulence, the pilot fights with the flight controls to keep the aircraft on course and in a proper approach. The U-2 safely lands at its operating base. The Global Hawk, returning from an IMINT mission later that day, is not as lucky. The moderate to severe turbulence causes Global Hawk to crash into an apartment building in a small South Korean town, killing ten South Korean citizens.

Diplomats from both sides are settling their differences in Panmunjong. The UN will assist North Korea in obtaining foodstuffs for their people while negotiations continue. Tensions ease, but the crash of the pilotless Global Hawk causes the South Korean government to demand that the U.S. fly no more UAVs over their nation. The U.S. complies.

In the Near East, Saddam broadcasts that "the magnificent Republican Guard has defied the infidels of the West and is moving back toward Baghdad." Apparently the U.S. attacks on strategic targets by the Tomahawk missiles has caused the Iraqi forces to retreat. The broad-area synoptic imagery taken by the SR-71 confirms that the Iraqi forces have pulled back. The U.S. president is relieved that direct confrontation between the two military forces has again been avoided.[2]

NOTES

1 In reality, overflight clearances for a situation like this may be difficult to acquire from those nations that may be sympathetic to Iraq, but for this scenario, they get approved.

2 This brief look at a possible orchestration of reconnaissance platforms in a fictional but hypothetical scenario was not intended to describe either the magnitude or the complexity of the overall military operations, but to give the reader a snapshot view of the possible complementary uses of reconnaissance platforms. Although the SR-71 has been retired and is currently awaiting disposition, it was included in this scenario to provide a perspective on how it might be used.

Glossary of Terms

Advanced Synthetic Aperture Radar System II (ASARS II)—Imaging system developed for the U-2 aircraft (ASARS I was developed for the SR-71). ASARS is an all-weather, day or night imaging system using radar to "look" through clouds and smoke to detect, locate, classify, and sometimes identify enemy ground targets. Some of these sensors are equipped with an enhanced moving target indicator (EMTI). ASARS data is transmitted to a ground station in near-real-time or can be recorded for download at a later time.

Advanced Tactical Airborne Reconnaissance System (ATARS)—Add-on reconnaissance pod with two sensors using electro-optical, charge-coupled devices and one infrared line scanner for night reconnaissance. ATARS also provides near-real-time datalink to ground stations within line-of-sight.

Air reconnaissance—The acquisition of intelligence information through the use of visual observation and/or sensors in air vehicles.

Air sovereignty—A nation's inherent right to exercise absolute control and authority over the airspace above its territory.

Air superiority—That degree of dominance in the air battle of one force over another which permits the conduct of operations by the former and its related land, sea, and air forces at a given time and place without prohibitive interference by the opposing force.

Air supremacy—That degree of air superiority wherein the opposing air force is incapable of effective interference.

Apogee—The point in a satellite's elliptical orbit farthest from the earth.

Battle-damage assessment (BDA)—The timely and accurate estimation of damage resulting from the application of military force, either lethal or non-lethal, against a predetermined objective. BDA can be applied to the use of all types of weapon systems (air, ground, naval, and special forces weapon systems) throughout the range of military operations. BDA is primarily an intelligence responsibility with required inputs and coordination from the operators and is composed of physical damage assessment, functional damage assessment, and target system assessment.

Broad-area synoptic—Term used frequently by photo interpreters to describe the type of imagery that allows a comprehensive look at several targets over a wide geographic area at virtually the same time (synoptic). For example, a broad-area synoptic picture might include several airbases where the type and number of aircraft are revealed. An accurate order of battle can be determined from this type of picture.

Cease-fire—A command given to air defense artillery units to refrain from firing on, but continue to track, an airborne object. Missiles already in flight will be permitted to continue to intercept their targets.

Classified information—Official information deemed to require, in the interests of national security, protection against unauthorized disclosure and which has been so designated.

Classified matter—Official information or matter in any form or of any nature that requires protection in the interests of national security.

Combatant command—A unified or specified command with a broad continuing mission under a single commander established and designated by the president, through the secretary of defense and with the advice and assistance of the chairman of the Joint Chiefs of Staff. Combatant commands typically have geographic or functional responsibilities.

Combatant commander—A commander-in-chief (CINC) of one of the unified or specified combatant commands established by the president.

Committee on Imagery Requirements and Exploitation (COMIREX)—Established by Director of Central Intelligence Directive 1/13 on April 1, 1967, and responsible for handling the requests and assigning priorities for satellite reconnaissance photography. It was assigned to manage the imagery produced.

Communications intelligence (COMINT)—Technical and intelligence information derived from foreign communications by other than the intended recipients.

Dynamically retask—To change a reconnaissance mission to cover an unexpected and rapidly unfolding event on short notice. Mission changes can include target sets, navigational changes in course, or both.

Electronic intelligence (ELINT)—Technical and intelligence information derived from foreign, noncommunications, or electromagnetic radiation emanating from sources other than nuclear detonations or radioactivity.

Electro-optics (EO)—The technology associated with those components, devices, and systems designed to interact between the electromagnetic (optical) and the electric (electronic) state.

Electro-optical intelligence—Intelligence other than signals intelligence derived from the optical monitoring of the electromagnetic spectrum from ultraviolet (0.01 micrometers) through far infrared (1,000 micrometers). Also called electro-optint.

Elliptical orbit—An orbit that mirrors the oval contour of an ellipse. The speed of a spacecraft in elliptical orbit will decrease as the craft approaches apogee because the orbital motion is going against the pull of the Earth's gravity. As the spacecraft swings back and approaches its perigee, it speeds up because its orbital motion and the planet's gravity are both exerting force on the spacecraft in the same direction.

Enhanced moving target indicator (EMTI)—Used on some U-2 aircraft. See **moving target indicator.**

Geosynchronous orbit—An orbit in which a satellite moves at the same rate of spin as the Earth. With an orbital period of 24 hours the position of the satellite is fixed over a point on the Earth's surface. A satellite in geosynchronous orbit is located about 22,300 miles (36,000 kilometers) above the equator. Communications satellites are often placed in this type of orbit, also called geostationary orbit.

High-altitude endurance (HAE)—Term associated with an unmanned aerial vehicle intended for long-range deployment and long sensor dwell over a target area.

Human intelligence (HUMINT)—A category of intelligence derived from information collected and provided by human sources.

Human resources intelligence—The intelligence information derived from the intelligence collection discipline that uses human beings as both sources and collectors, and in which the human being is the primary collection instrument.

H-camera—HR-329 high-resolution camera used on the U-2 aircraft. The H-camera uses a gyro-stabilized framing system designed to shoot pictures, or to image, from an angle. The pilot controls camera positioning.

Imagery—Collectively, the representations of objects reproduced electronically or by optical means on film, electronic display devices, or other media.

Imagery intelligence (IMINT)—Intelligence derived from the exploitation of information collected by visual photography, infrared sensors, lasers, electro-optics, and radar sensors such as synthetic aperture radar. The images of objects are reproduced optically or electronically on film, electronic display devices, or other media.

Infrared (IR)—Being, relating to, or using radiation having wavelengths longer than those of red light. Electromagnetic spectrum value is approximately 0.72 to 1,000 microns.

Infrared film—Film coated with an emulsion especially sensitive to "near-infrared." Used to photograph through haze because of the penetrating power of infrared light. Also used in camouflage detection to distinguish between living vegetation and dead vegetation or artificial green pigment.

Infrared imagery—Produced as a result of sensing electromagnetic radiation emitted or reflected from a given target surface in the infrared position of the electromagnetic spectrum.

Infrared photography—Photography employing an optical system and direct-image recording on film sensitive to near-infrared wavelength (infrared film). But see also **infrared imagery.**

Infrared radiation—Radiation emitted or reflected in the infrared portion of the electromagnetic spectrum.

Intelligence—1. The product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas. 2. Information and knowledge about an adversary obtained through observation, investigation, analysis, or understanding.

Intelligence Reconnaissance Imagery System III (IRIS III)—Panoramic imaging developed for the U-2. It is an optical imagery system mounted on a rotating optical bar assembly that can scan laterally (from side to side) through 140 degrees of view. The swath exceeds 32 miles on either side of the aircraft.

International Atomic Energy Agency (IAEA)—Multinational organization utilizing an action team that, with the assistance and cooperation of UNSCOM, plans and conducts the inspection, disposal and monitoring activities within the nuclear field. The IAEA Action Team has its own offices within the Baghdad Monitoring and Verification Center, and its inspection and monitoring teams utilize UNSCOM's transportation, communication, field office and logistic capabilities.

Joint Surveillance and Target Attack Radar System (JSTARS)—Joint U.S. Army and Air Force system, using Boeing 707 aircraft, developed to undertake ground surveillance, targeting, and battle management missions. JSTARS has a side-looking radar antenna integrated with the Global Positioning System. It operates in synthetic aperture radar (SAR) mode to detect and locate stationary objects. It also alternates between SAR and a Doppler-type radar mode to find and follow slow-moving targets. JSTARS furnishes this information to tactical aircraft, standoff missiles, or Army artillery for attacks.

Knot—A speed of one nautical mile per hour.

Low Observable High-Altitude Endurance (LO HAE)—Designation for a stealthy, high-altitude endurance unmanned aerial vehicle.

Mach number—The ratio of the velocity of a body to that of sound in the surrounding medium. At sea level, on a standard day, the speed of sound approximates 661 knots or 760 mph.

Moving target indicator (MTI)—A radar presentation that shows only targets in motion. Signals from stationary targets are subtracted out of the return signal by a memory circuit.

Multi-spectral imagery (MSI)—The image of an object obtained simultaneously in a number of discrete spectral bands. MSI can show features of the earth beyond human visual detection. Using MSI, it is possible to identify shallow areas near coastlines where equipment has traveled over the earth. Satellite MSI was used to map the Persian Gulf area precisely.

Nadir—With regard to aerial photography, that point on the ground directly below the aircraft.

National Command Authorities (NCA)—The U.S. president and secretary of defense or their duly deputized alternates or successors.

National intelligence—Integrated departmental intelligence that covers the broad aspects of national policy and national security, is important to more than one department or agency, and transcends the exclusive competence of a single department or agency.

National policy—A broad course of action or statements of guidance adopted by a government at the national level in pursuit of national objectives.

National Reconnaissance Office (NRO)—Department of Defense agency responsible for ensuring that the United States has the technology and spaceborne and airborne assets needed to acquire intelligence worldwide and provide support to such functions as monitoring of arms control agreements, indications and warnings, and the planning and conduct of military operations.

National security—A collective term encompassing both national defense and foreign relations of the United States. Specifically, the condition provided by (1) a military or defense advantage over any foreign nation or group of nations; (2) a favorable foreign relations position; or (3) a defense posture capable of successfully resisting hostile or destructive action from within or without, overt or covert.

Nautical mile (nm)—A measure of distance equal to one minute of arc on the earth's surface. The United States has adopted the international nautical mile equal to 1,852 meters or 6,076.11549 feet.

Near-real-time—Pertaining to the timeliness of data or information delayed by factors required for electronic communication and automatic data processing. This term implies that there are no significant delays. See also **real-time.**

Operational level of war—The level of war at which campaigns and major operations are planned, conducted, and sustained to accomplish strategic objectives within theaters or areas of operations. Activities at this level link tactics and strategy by establishing operational objectives needed to accomplish the strategic objectives, sequencing events to achieve the operational objectives, initiating actions, and applying resources to bring about and sustain these events. These activities imply a broader dimension of time and space than do tactics; they ensure the logistic and administrative support of tactical forces and provide the means by which tactical successes are exploited to achieve strategic objectives. See also **strategic level of war** and **tactical level of war.**

Optical Bar Camera (OBC)—A later version of the IRIS camera. The OBC is a panoramic film camera that can be carried on the U-2 aircraft; one version was developed for the SR-71.

Orbit—The path taken by one body as it circles another, such as that of the Earth around the sun, or an artificial satellite around the Earth.

Order of battle—The identification, strength, command structure, and disposition of the personnel, units, and equipment of any military force.

Perigee—The point in a satellite's elliptical orbit nearest the Earth.

Real-time—Pertaining to the timeliness of data or information delayed only by the time required for electronic communication. This term implies that there are no noticeable delays. See also **near-real-time.**

Reconnaissance—A mission to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy; or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area.

Remotely piloted vehicle (RPV)—An unmanned aerial vehicle capable of real-time controls by a person from a distant location through a communications link.

Resolution—A measurement of the smallest detail that can be distinguished by a sensor system under specific conditions.

Senior Year Electro-optical Reconnaissance System (SYERS)—A near-real-time electro-optical sensor carried by the U-2 aircraft mounted in the nose of the aircraft and able to rotate from side to side. The images SYERS collects can be transmitted to a ground station in near-real-time when the sensor is within the line of sight (about 220 miles).

Side-looking airborne radar (SLAR)—An airborne radar, viewing at right angles to the axis of the vehicle, which produces a presentation of terrain or moving targets.

Side oblique air photograph—An oblique photograph taken with the camera axis at right angles to the longitudinal axis of the aircraft.

Signal—1. As applied to electronics, any transmitted electrical impulse. 2. Operationally, a type of message, the text of which consists of one or more letters, words, characters, signal flags, visual displays, or special sounds with prearranged meaning, and conveyed or transmitted by visual, acoustical, or electrical means.

Signals intelligence (SIGINT)—1. A category of intelligence, comprising either individually or in combination, all communications intelligence, electronics intelligence, and foreign instrumentation signals intelligence, however transmitted. 2. Intelligence derived from communications, electronics, and foreign instrumentation signals.

Statute mile—A measure of distance equal to 5,280 feet.

Stereographic coverage—Photographic coverage with overlapping air photographs to provide a three-dimensional presentation of the picture; 60 percent overlap is considered normal and 53 percent is generally regarded as the minimum.

Strategic level of war—The level of war at which a nation, often as one of a group of nations, determines national or multinational (alliance or coalition) security objectives and guidance, and develops and uses national resources to accomplish these objectives. Activities at this level establish national and multinational military objectives; sequence initiatives; define limits and assess risks for the use of military and other instruments of national power; develop global plans or theater war plans to achieve these objectives; and provide military forces and other capabilities in accordance with strategic plans. See also **operational level of war** and **tactical level of war.**

Surface-to-air guided missile (SAM)—Surface-launched for use against air targets in the SAM envelope, that air space within the kill capabilities of a specific SAM system.

Surveillance—The systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means.

Swath—That area on the ground "seen" by the camera lens with aerial photography.

Synthetic aperture radar (SAR)—Used to "look" and take images through clouds, smoke, haze, or darkness at targets of interest. Analogous to "synthetic array radar" as the movement of the aircraft along a specified track creates a synthetic antenna array. The radar sets up an array length (dependent upon range to the target, desired resolution, and squint capabilities) of the "real" antenna. Simply put, as the platform moves along track, the signal processor puts the sequential radar returns into individual signal bins, the number of which is determined by the desired "array" length. The processor then sums the output of these signal bins and proceeds as if they were the output of an "antenna" (and receiver combination) to develop the "processed" imagery.

Tactical level of war—The level of war at which battles and engagements are planned and executed to accomplish military objectives assigned to tactical units or task forces. Activities at this level focus on the ordered arrangement and maneuver of combat elements in relation to each other and to the enemy to achieve combat objectives. See also **operational level of war** and **strategic level of war.**

TALENT KEYHOLE—Security system codeword declassified by Executive Order 12951. TALENT-KEYHOLE and the associated satellite systems known as KEYHOLE (KH)-l, -2, -3, -4, -4A, -4B, -5, and -6 were also declassified.

Target—1. A geographical area, complex, or installation planned for capture or destruction by military forces. 2. In intelligence usage, a country, area, installation, agency, or person against which intelligence operations are directed. 3. An area designated and numbered for future firing. 4. In gunfire support usage, an impact burst which hits the target.

Tactical air reconnaissance pod (TARP)—A reconnaissance pod carried on a number of fighters. Navy F-14Ds, among others, used TARPs in the Persian Gulf War. The system measures twelve feet long; weighs about 1,700 pounds; and contains two cameras, one framing and one panoramic, and an infrared sensor.

Technical objective camera (TEOC)—High-resolution framing camera used on the SR-71.

Theater—The geographical area outside the continental United States for which a commander of a combatant command has been assigned responsibility.

Theater of war—The area of air, land, and water that is, or may become, directly involved in the conduct of the war as defined by the National Command Authorities or the geographic combatant commander. A theater of war does not normally encompass the geographic combatant commander's entire area of responsibility and may contain more than one theater of operations.

Theater of operations—A sub-area within a theater of war defined by the geographic combatant commander required to conduct or support specific combat operations. Different theaters of operations within the same theater of war will normally be geographically separate and focus on different enemy forces. Theaters of operations are usually of significant size, allowing for operations over extended periods of time.

Unified command—A command with a broad continuing mission under a single commander and composed of significant assigned components of two or more military departments, established and designated by the president through the secretary of defense with the advice and assistance of the chairman of the Joint Chiefs of Staff. U.S. Central Command, with its area of responsibility being the Southwest Asian Theater, is one example.

United Nations Special Commission (UNSCOM)—Established in April 1991 by the UN Security Council to disarm Iraq of its weapons of mass destruction and control their future production within Iraq.

Unmanned aerial vehicle (UAV)—A powered vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, flies autonomously or is piloted remotely, is expendable or recoverable, and possibly carries a lethal or non-lethal payload. Ballistic or semi-ballistic vehicles, cruise missiles, and artillery projectiles are not considered UAVs.

Weapons of mass destruction (WMD)—In arms control usage, weapons that are capable of a high order of destruction and/or of being used in such a manner as to destroy large numbers of people. May be nuclear, chemical, biological, or radiological weapons. This term excludes the means of transporting or propelling the weapon where such means is a separable and divisible part of the weapon.

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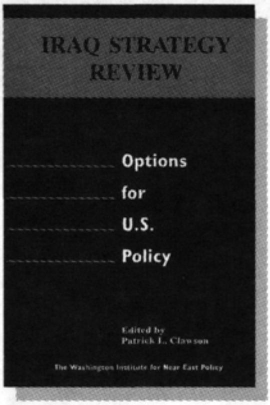

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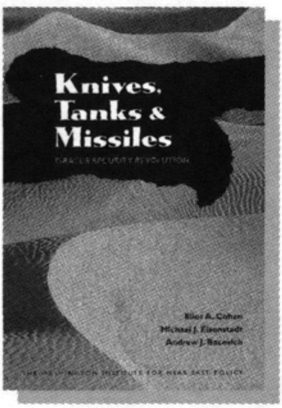

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