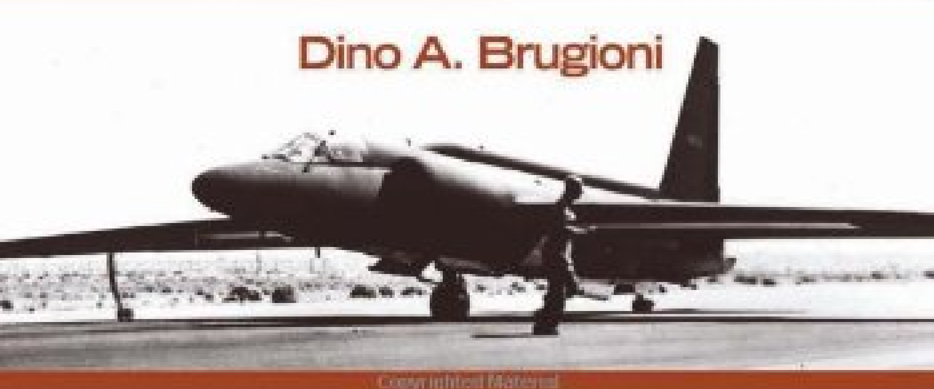
eyes in the sky

EISENHOWER, THE CIA AND COLD WAR AERIAL ESPIONAGE

Dino A. Brugioni



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Edited by Doris G. Taylor

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TO ROBERT F. McCORT
MY BEST FRIEND

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PREFACE

> For history, if it is to reflect on the past accurately, it must foremost be a record not only of the acts but of the thoughts and feelings—the source and explanation of those acts—of the living men and women who populated the world at the time the historian is describing.
>
> *Sir Arthur Bryant*

IN WRITING HIS MEMOIRS Dwight D. Eisenhower was extremely conscientious about protecting the details of national security. He avoided, for instance, explaining how intelligence information was obtained from aerial and satellite reconnaissance sources. In this book I have attempted to fill in many missing pieces of the puzzle, drawing on documents declassified since Eisenhower's time and on personal interviews with many of those involved with developing and using this critical source of military intelligence.

Before describing Eisenhower's pivotal role in advancing and using aerial reconnaissance, I briefly examine the development of aerial reconnaissance as a primary source of intelligence, not only for the United States but for our allies and enemies as well. Many key leaders of our country were far from convinced that acquiring photographs from balloons, airships, aircraft, or satellites was worth the cost in dollars and lives. Eisenhower had to deal with these attitudes as he rose through positions of leadership in the military and afterward as president, and the rather tumultuous early history that blended talent, tools, and information affected his decisions.

The importance of imagery reconnaissance grew from Eisenhower's early years as a staff officer through World War II, afterward at SHAPE, and when he was president. Deficiencies in intelligence caused him great anxiety during the Kasserine campaign in North Africa, for example, and later in the Ardennes. As supreme Allied commander in Europe, he knew, of course, the importance of intelligence in military decision making. He did not hesitate to approve new methods of gathering intelligence—even those with risks—and he pursued them with fervor.

With the advent of atomic weapons, Eisenhower recognized that global wars had become inconceivable. He understood that a nuclear war would be suicide for both the United States and the Soviet Union, and that other nations drawn into it would be destroyed as well. On November 3, 1959, at the cornerstone-laying ceremony for the new CIA building, he said, "I have issued directives to gather, in every feasible way, the information required to protect the United States and the free world from surprise attack and to enable them to make effective preparations for defense." He had full faith in his scientific advisers and focused on the results of new and radical systems. Foreign policy decisions pertaining to U.S. political and military involvements during his administration included Korea, the Formosa Strait, Lebanon, China, Tibet, Indochina, East Germany, Hungary, Guatemala, Suez, and Indonesia. He kept the nation at peace at a time when some thought military conflict with the Soviet Union was inevitable.

Probably more than anything else during his administration, Eisenhower realized the value of aircraft and satellites in acquiring intelligence, and he evinced great patience with the men and women who were exploring this frontier of science and intelligence collection. Today we take for granted the many reconnaissance assets the United States possesses, the reliance our leaders place on them, the many disarmament and peace-keeping agreements they monitor, the vital information they provide our fighting forces, and the views they provide of our environment. Their existence is the result of a farsighted quest begun early by President Eisenhower to make aerial and space reconnaissance the guardian of our national security. The reconnaissance satellites developed during his administration have revolutionized our lives in ways few realize. The development and use of these systems represented a radical departure both in technology and in intelligence-gathering techniques. The risks of being detected were great, and the potential political repercussions would be both domestic and international in scope. Eisenhower decided that the need to obtain up-to-date factual intelligence to maintain peace far outweighed the potential political repercussions. He trod an often desperate and dangerous route to seek the truth and peace through aerial and space reconnaissance achievements. Indeed, his administration's use of reconnaissance resources became the accepted avenue to achieve a better understanding between the United States and the Soviet Union, and other nations of the world.

This book attempts to chronicle those endeavors on the cutting edge of technology and their impact on national security. Within seven years, from 1954 through 1960, Genetrix reconnaissance balloons, the U-2, the SR-71, and the Corona, Samos, Lanyard, and Argon satellite reconnaissance systems were developed. The Midas missile launch detection system was inaugurated along with the GRAB ELINT and solar radiation satellites. Two antisatellite systems were developed under Project SAINT. The primitive, polar-orbiting TIROS meteorological satellite—and a secret military version launched at the same time—evolved into a worldwide weather-gathering system. The advent of the Transit navigation satellite and the deployment of SOSUS for detecting and tracking Soviet submarines were modern warfare milestones. President Harry S. Truman approved the construction of the Distant Early Warning Line (DEW), but it was Eisenhower who authorized its construction. Aerial reconnaissance was also widely used in the construction of the St. Lawrence Seaway and the transcontinental highways system, certainly two of Eisenhower's foremost domestic achievements.

The aerial and undersea undertakings were amazing accomplishments of science and engineering, and also of human persistence. Other presidents might have canceled such projects after their early failures, but Eisenhower had patience and confidence in the people dedicated to their tasks. He was a visionary who saw these efforts as challenges to be met. His foresight and imagination resulted in the reduction of military uncertainties, saved billions of dollars in weapons research, and may well have prevented a surprise nuclear attack. Establishing a new primary source of objective U.S. intelligence gave Eisenhower a strategic advantage that allowed him to define U.S. positions in world affairs with clarity and emphasis. And much of what he did occurred behind the scenes. He never asked for public recognition or accolades. R. Cargill Hall, an eminent historian, may have stated it best: "In his memoirs, except for the U-2, which had become public knowledge, Eisenhower mentioned none of the technical advances or changes in intelligence operations for which he was responsible. One would be hard-pressed to think of a contemporary politician able to resist claiming credit for such an intelligence revolution, or willing to carry the secrets with him to the grave."

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eyes in the sky

ONE
the beginning

Military commanders have always been concerned that their combat preparations and operations not be observed, either covertly or overtly; concomitantly, they have been just as eager to view the activities of their opponents. From antiquity, military tacticians have sought the "high ground," climbing nearby hills or building towers in order to look down on their enemies. The armed force with the high ground has the advantage of easier deployment of firepower and the ability to make a better estimate of the enemy's intentions and capabilities. The development of the art and science of reconnaissance from the biblical age to the modern era is an astonishing record of scientific achievement perpetually fueled by the insatiable quest for knowledge that has driven humans to seek more information about every aspect of their environment. Each increase in altitude has given an ever-widening view, until humans can now envision the ultimate prospect of achieving an unlimited perspective of the universe. The advances made from the earliest use of a balloon to lift an observer above the field of battle to the deployment of satellites capable of capturing an image of a human being from the cold darkness of space are a record of the genius and enduring accomplishments that created a new, intensely personal view of the world.

Photo intelligence is derived from the analytic process of locating, identifying, and describing objects, activities, installations, and terrain features represented on photographic film or electronic display devices. Arthur C. Lundahl, the nation's preeminent photo interpreter, likened the development and application of aerial photography to the invention of gunpowder. Just as gunpowder changed warfare, aerial photography has revolutionized and affected nearly every method we employ to observe and solve earth-science problems. "It is a powerful tool," Lundahl said, ". . . simple and comprehensible by anyone and capable of transmitting an unbelievable amount of information. It is a universal non-verbal language that transcends barriers and boundaries and it allows us to isolate events for further study."[1] As early as 1954 Lundahl recognized that

> photography is not only one of man's most important tools but it is simultaneously one of his most important languages. . . . As a tool the camera is used to obtain a record that cannot be had in any other way. The photographic emulsion, when it is used as the retina not only of cameras but of microscopes, telescopes, spectroscopes, oscilloscopes, stroboscopes, and X-Ray tubes results in instruments infinitely more versatile than the unaided eye. They operate efficiently under the widest range of conditions beyond the capabilities of the human eye—where light is too bright or dim, objects too small or far away, movements too fast, too slow, or too confused, environments hostile or inaccessible, radiation invisible or lethal. Photography as a tool not only overcomes these barriers to humans but enables measurements of incredible accuracy to be carried out rapidly and with certainty and provides a permanent and infallible memory record which is infinitely reproducible. . . . Aerial photography . . . offer[s] an almost infinitely detailed geographical and a highly suggestive geological report of the ground area imaged. However, this report is written in a graphical language which must be carefully studied and understood before it can be translated accurately and efficiently."[2]

Elsewhere Lundahl noted that "each photo interpreter looks at a photo through a window of his experience."[3] A skilled photo interpreter can provide quantitative and qualitative data on a land area's topography, drainage, soils, mineral resources, weather and climate, coastline, plant life, animal life, and inhabitants. Aerial photos reveal the historical background of settlement (migration and development, distribution of population), economic activities, agriculture, dairying and stock raising, forest industries, hunting and fishing, mineral resources, manufacturers, transportation, commerce, and military holdings and activities.

What began with air balloons in the late eighteenth century gave way to primitive airplanes and dirigibles by the early 1900s. By the time World War I erupted in Europe, all of the major nations involved had at least begun experimenting and developing methods and equipment to gather photographic intelligence. Military encouragement for these efforts, however, was lacking. Field Marshal Sir Douglas

Haig, for example, maintained that cavalry remained the best way to reconnoiter and remarked that it would be foolish to think that airplanes could be usefully employed for reconnaissance. Indeed, when the war began, the airplane's primary function in the eyes of most military commanders was merely to provide information regarding the disposition of the opponent and, when possible, to help direct artillery fire.

As is so often the case, the exigencies of war led to rapid and dramatic technological and intellectual advancements in the realms of aerial photography and photographic interpretation. The inevitable evolution of technology, tactics, and strategy gave airplanes a more direct combat role as pilots and their rear gunners dropped primitive bombs on targets and strafed men in the trenches. When World War I became a battle of trench warfare and attrition, reconnaissance aircraft were increasingly useful for artillery observation and spotting. At first, pilots themselves attempted to observe enemy activities, but a pilot also had to keep an eye on the weather, ground fire, mechanical problems, and his line of retreat if attacked. The British were the first to send an army officer to do the actual intelligence reporting in a two-seat observation aircraft. The observer "could detect with the naked eye individual men at 1,200–1,500 meters and troop columns at 2,500–3000 meters altitude."[4]

Even the observer found it difficult to take in minute details of the trenches, troop buildups, artillery positions, and rear supply units. The camera captured all of these details and also provided a supplemental source of information to confirm or deny other battlefield reporting. To obtain aerial photos, however, the Allies had to gain control of the air, because reconnaissance aircraft became prime targets. Manfred von Richthofen and his "Flying Circus" prowled the skies looking for Allied reconnaissance aircraft. In 1917 the average life of a scout pilot was about three weeks, and about six months of combat was the most a pilot could tolerate. By the spring of 1917 the RAF was losing about two hundred pilots a month.[5]

Troop commanders on the ground studied aerial photos and maps made from aerial photos of trenches and used observation planes to help coordinate assault after failed assault, but most continued to focus on a two-dimensional war fought on the ground by traditional units in traditional ways. The United States had no military intelligence branch. When President Woodrow Wilson, who knew little about military affairs, was approached to establish one, he said that if American commanders needed information, they could get it from the French or British.

After four years of stalled trench warfare, Gen. John J. Pershing began preparations for a battle to end the stalemate. Pershing and his staff recognized the importance of aerial reconnaissance and depended on it for rapid updates and comprehensive information about the upcoming battle of Saint-Mihiel. The photos taken by American aerial reconnaissance aircraft reflected a dramatic improvement in quality over previous efforts, primarily as the result of Capt. (later Lt. Col.) Edward Steichen, who had gained renown in the prewar years for his photographs of celebrities. Steichen joined the U.S. Army in 1917, and along with Maj. James Barnes was responsible for establishing an American photo reconnaissance and interpretation capability with the creation of the U.S. Army Signal Corps Photographic Division on August 2, 1917. "The consensus of expert opinion as expressed at the various inter-Allied conferences on aerial photography," Steichen later wrote, "is that two-thirds of all military information is either obtained or verified by aerial photography. The success with which aerial photographs can be exploited is measured by the natural and trained ability of those concerned with their study and interpretation. The aerial photo is itself harmless and valueless. It enters into the category 'instrument of war' when it has disclosed the information written on the surface of the print."[6] Aerial reconnaissance and its most vocal advocates still remained on the fringe of most military circles at the end of the war, in spite of the advancements that had been made in airplane and aerial reconnaissance technologies.

Although aerial photography had taken a quantum leap in World War I, research in its future military applications remained at low ebb between the wars. "No one in the Air Service gave a tin nickel for the advancement of aerial photography" during the "Long Armistice of 1919–39," lamented Gen. George Goddard. "Furthermore neither the infantry nor the cavalry understood the value of photography. The cavalry thought reconnaissance was its job and the science of photo reconnaissance was too highfalutin' and alien for the man on horseback to accept."[7] The various U.S. service branches argued over how aerial reconnaissance should be conducted and who should control the results. Factions within the Navy, for example, had planned to use large airships to conduct recon activities, while their counterparts advocated the use of newly developed dual-propose long-range bombers.

Although it ravaged the U.S. economy, the Great Depression was responsible for important developments in aerial reconnaissance. Civilian survey companies with little or no work were recruited into a massive mapmaking effort undertaken by the federal government. When Franklin Roosevelt accepted the Democratic presidential nomination on July 2, 1932, he promised a "New Deal." Roosevelt felt a deep sense of responsibility for all Americans and was determined to rescue the nation from poverty. The way to do that was to provide jobs. A number of Roosevelt's New Deal projects would require aerial surveys and maps and charts. At the same time there were increasing demands for maps to be standardized, to be more accurate and refined, to be larger in scale, to have smaller contour intervals, and to show land surface features in greater detail. Civilian survey companies had the aircraft, cameras, and trained professionals to do the job.

On April 10, 1933, during the first hundred days of his administration, Roosevelt asked Congress to create the Tennessee Valley Authority (TVA); he signed the bill establishing it on May 18, 1933. Congress created the TVA "for the especial purpose of bringing about in said Tennessee drainage basin and adjoining territories the maximum amount of flood control; the maximum development for navigation purposes; the maximum generation of electric power consistent with flood control and navigation; the proper use of marginal lands; the proper method of reforestation; and the economic and social well-being of the people living in said river basin; and to provide for the national defense."[8]

The TVA's mission involved the construction of a series of twenty dams and associated lakes along the Tennessee River and its tributaries in North Carolina, Georgia, Alabama, Kentucky, Virginia, and Tennessee. The TVA project provided the first opportunity for large-scale use of aerial photography for mapping. Maps created from aerial photography were used in constructing the dams, spillways, locks, canals, reservoirs, powerhouses, intakes, diversion canals, and levees. The dams' reservoir capacity, hydraulic head, and size were estimated from aerial photographs. Before a single dam could even be planned, however, more than 40,000 square miles of the watershed had to be photographed, profiles developed, field surveys conducted, and detailed maps created. Topographic map coverage at the scales of 1:62,000 and 1:24,000, with contour intervals of twenty feet, had to be created in minimum time, at minimum expense, and with minimum fieldwork. By 1940, twenty similar New Deal organizations were using maps produced by aerial photography. As a result of these programs, the federal government possessed a clearer picture of the nation and had access to techniques and technologies that would play a crucial role in the impending world war.

The Department of Interior led the way in the use of aerial photography for mapping in the United States during this period, but by 1937 more than 46 percent of the United States remained unmapped.[9] Secretary of the Interior Harold Ickes laid out an ambitious twenty-year National Mapping Program to remedy the situation, and Eastman Kodak would play an important role in it. The perfection of roll film and special films contributed greatly to the quality of processing and analyzing photographic prints. Bausch and Lomb Optical Company of Rochester, New York, became the principal provider of lenses.

"Photogrammetry," a new term, came into use to describe "cameras, film, laboratory procedure, photographic papers, airplanes, navigational aids, measuring devices, plotting instruments, instruments for establishing ground control, skilled personnel, drafting and reproducing materials, and labor."[10] Twelve scientists founded the American Society of Photogrammetry on July 29, 1934, for scientists, engineers, and firms engaged in aerial photography and photogrammetric measurements. The society played a leading role in gathering and disseminating information on aerial photography, photogrammetry, and mapping; and published "valuable, informative articles . . . about cameras, film, interpretation, mapping and charting instruments, film and print storage, and on existing and future applications of photogrammetry."[11]

By June 1938, 1,582,052 square miles of the United States had been photographed using a variety of cameras; most were the standard 9-inch-by-9-inch format using 8.5-inch-focal-length lenses at a scale of 1:20,000. Fairchild Model 71 and Model 82 planes conducted most of the reconnaissance. The Fairchild Corporation constructed a mobile photographic laboratory to process the film. The self-contained laboratory was sixteen feet long, seven feet wide, and eight feet high, and had its own electrical power supply, water storage tanks, refrigeration units, and heating and cooling systems as well as sleeping space for its operators. It would become the prototype of the mobile processing labs of World War II.

Despite these advances, the U.S. military services had not yet recognized the true strategic value of aerial photography. Photo intelligence gathering was championed by few and all but ignored by most. Most American officers during the 1920s and 1930s looked down on the intelligence branch as well as on logistics and training. Few officers actively pursued intelligence careers because those positions were poorly regarded and opportunities for promotion were poor. Gen. Lucius Clay, the postwar military governor of Germany, noted that the intelligence branch before World War II was a dumping ground for poor performers, malcontents, and loners whose personalities limited their utility in other branches of the services. Clay remarked that line officers usually associated poor intelligence with the poor officers in intelligence. Maj. Gen. George C. McDonald likewise referred to intelligence at the time as "an undernourished wretch, misunderstood and not encouraged."[12]

Among the most significant proponents of aerial intelligence was Dwight D. Eisenhower, a member of the West Point class of 1915, "the class the stars fell on" (of 164 graduates, a remarkable 36 percent became generals; five, including Omar Bradley, would become four-star generals). His classmate Lyman Lemnitzer recalled that Eisenhower "had a short fuse. He could blow real quick when he was exasperated with something."[13] Emmet John Hughes, a speechwriter for Eisenhower during his tenure at the White House, recalled that baseless criticism could ignite an explosion of temper almost fiercely physical. His voice would rise, his cheeks flame with rage, his arms wave threateningly. That temper would come into play on a number of later occasions when intelligence was a problem.

Eisenhower's first assignment was at Fort Sam Houston, Texas. After the United States entered World War I in April 1917 he moved from Fort Sam Houston to Fort Oglethorpe, Georgia; to Fort Leavenworth, Kansas; and then to Fort Meade, Maryland. On October 14, 1918, his twenty-eighth birthday, he received orders to take command of an overseas armored unit beginning on November 18. Eisenhower's appreciation for aerial reconnaissance can be traced to his early years as a staff officer. During the 1930s the Roosevelt administration was haunted by the specter of the United States being cut off from its sources of vital raw materials in a worldwide conflict. Military leaders devised emergency plans to forestall that possibility in the event of an outbreak of hostilities, especially with Japan. Bright young military staff officers were tasked to prepare such studies. As an assistant to the U.S. Army chief of staff, Eisenhower was called on to prepare reports on the sources and supplies of such raw materials as tin, magnesium, and rubber. Aerial photographs played a big role in his work. The Army did not have a photo interpretation course at that time, so Eisenhower had to learn it on his own. He later told Art Lundahl that through looking at aerial photos of these installations, he became intimately familiar with the aerial "signatures" of the component parts of the industrial process. He readily recognized that each building had a unique size or shape that indicated the specific process that was taking place inside. Unfortunately, the report seems not to have survived in Eisenhower's papers. Eisenhower's experience as a pilot—unknown to most people—was a definite advantage for him in photo interpretation. He told Lundahl that he took flying lessons in 1936, while he was working for Gen. Douglas MacArthur in the Philippines. The early-morning lessons, taught by two Air Corps officers in a Stearman PT-13, apparently took place without the knowledge of either MacArthur or Mamie Eisenhower. In July 1939 he passed a flight physical and was issued a private pilot's license. He enjoyed flying and logged 320 hours as a pilot and aerial observer before returning to Washington.[14]

The lack of trained intelligence specialists in the U.S. forces in the early days of World War II was a major problem. Eisenhower reflected soberly that he and other U.S. commanders were to blame for the situation because they had been responsible for shunting incompetent officers to intelligence assignments. In his book *A Soldier's Story* Omar Bradley noted:

> For too many years in the preparation of officers for command assignments, we had overlooked the need for specialization in such activities of intelligence. It is unrealistic to assume that every officer has the capacity and the inclination for field command. Many are uniquely qualified for staff intelligence duties and indeed would prefer to devote their careers to those tasks. Yet instead of grooming officers for intelligence assignments, we rotated them through conventional duty tours, making correspondingly little use of their special talents. Misfits frequently found themselves assigned to intelligence duties. And in some stations G-2 [Army Intelligence] became a dumping ground for officers ill suited to the line command. I recall how scrupulously I avoided the branding that came with an intelligence assignment in my own career. Had it not been for the uniquely qualified reservists who so capably filled so many of our intelligence jobs throughout the war, the army would have found itself badly pressed for competent intelligence personnel.[15]

Throughout the war, Eisenhower relied on aerial reconnaissance to develop his plans, coordinate attacks, and generally monitor German activities. His faith in the value of such intelligence was underscored early on during Operation Torch and the subsequent campaign in Africa during 1942–43. At Kasserine Pass, Eisenhower's first major engagement with Rommel in the desert, poor intelligence gathering and the inability to conduct aerial reconnaissance due to inclement weather were considered to be the determining factors in the tactical victory won by the Germans. Eisenhower blamed "faulty work by Intelligence agencies [whose] [s]taffs were too prone to take one isolated piece of intelligence in which they implicitly believed and to shut their eyes to any contrary possibility."[16] Historian Stephen Ambrose evaluated the battle as follows: "Kasserine was Eisenhower's first real battle; taking it all in all, his performance was miserable. Only American firepower and German shortages had saved him from a humiliating defeat."[17] Eisenhower removed Maj. Gen. Lloyd Fredendall from command and replaced him with Lt. Gen. George Patton. Under Patton's leadership the battered U.S. Army became an effective fighting force. Eisenhower would not forget his Kasserine defeat.

On the eve of the invasion of Europe, aerial reconnaissance had never been more important, but photo analysis remained in a primitive state. Allied and Axis armies, navies, and air forces were continually trying to improve their weapons' effectiveness amid fears that the enemy might deploy completely new and highly destructive weapons against them. When that happened, a blanket of security was often applied until a counterweapon could be developed. Unfortunately, the cloak of secrecy kept photo interpreters completely out of the loop. Their analysis was confined to the photo at hand and that photo alone. There was an additional impediment: Interpreters were divided into sections, and it was unusual for an air photo interpreter to view targets belonging to another section.

British intelligence began receiving reports of German rocket experiments as early as 1939. In December 1942 information reached London that long-range rockets were under development along the Baltic coast. On February 9, 1943, Military Intelligence asked Army photo interpreters at the Central Intelligence Unit (CIU) at Medmenham if they had found indications that the Germans might be developing some form of long-range projectors, perhaps "similar in form to a section of railway track," capable of firing on England from the coast of France.[18] Constance Babington-Smith, a highly skilled photo interpreter at the CIU, was told to look for "anything queer," specifically for "some sort of tube out of which a rocket could be squirted."[19] American photo interpreters at Mount Farm were told to look for any type of long-range projectile. The CIU received instructions from the Air Ministry to interpret aerial photography from future missions for any indications of a "long range gun, a rocket aircraft or rocket launched from a tube."[20]

The Germans had always had a penchant for long-range artillery that could strike enemy supply lines and manufacturing plants. The artillery pieces were mounted on railway carriages because of their size. Big Bertha had created a sensation during World War I; in World War II, Gustav, the largest rail gun ever built, created havoc on the Russian front. All of the Allied forces who fought in

Italy remembered the terror that Anzio Annie created. There was some presumption that the Germans were at it again, working on a long-range artillery piece.

On April 20, 1943, Winston Churchill charged his son-in-law, Duncan Sandys, to review the evidence for German long-range rocket development. Sandys' first move was to obtain aerial photographs of Peenemünde, the suspect rocket base, and he ordered the CIU to search all aerial photographs closely for unusual structures. The first reconnaissance mission over Peenemünde had been flown on April 15, 1942. The CIU photo interpreters were not privileged to all-source intelligence, as they would have been today, and few interpreters had scientific training. Dr. R. V. Jones, the Air Ministry's assistant director of scientific research, was an additional hindrance because he withheld substantial knowledge of German missile information that would have aided the interpreters.

The aerial photos taken on that first mission over Peenemünde revealed two vast factory halls. One that the interpreters labeled "nitration houses" was actually the V-2 manufacturing and assembly plant. A second large building (220 feet by 140 feet) would prove to be the liquid oxygen plant.[21] Three massive circular embankments not unlike empty reservoirs were V-2 firing pads, and two sludge pumps thought to be used in an offshore land-reclaiming dredging operation were the V-1 launch ramps. The power plant appeared to be inactive because there was no sign of smoke. The photo interpreters had no way of knowing that this was a very modern plant with dust and smoke removers, and that it was, in fact, in full operation. Such was the embryonic stage of scientific photo interpretation. The photo interpreter looking at the Peenemünde film briefed Duncan Sandys on his findings. Sandys concluded that the circular and elliptical constructions were probably for testing explosives, and that the lack of activity at the power station indicated that it was not in use.

Another mission flown over Peenemünde on May 14 produced different results. The photo interpreter reported high activity. He also reported two vehicles, each carrying a cylindrical object with dimensions of thirty-eight feet by eight feet. These were actually V-2s on Meillerwagen trailers. A cloud-free mission flown on May 20 produced photos with excellent interpretability.

Churchill visited the CIU on June 14 and was shown aerial photos of Peenemünde and briefed by an interpreter. The prime minister was concerned that the two objects were missiles that could be transported by road or rail and launched from just about anywhere. On June 16 the CIU issued a report on its findings. Among the objects described in it were a thick vertical column about forty feet tall and four feet wide (a V-2 standing vertically) and several thirty-five-foot-long objects that appeared to have radial fins sitting on rail cars near the large manufacturing and assembly building. A June 23 photographic mission provided exceptionally clear photos of the entire experimental site that showed the missiles and launch points. The photos left no doubt that there were rockets present, although the photo interpreter had called them "torpedo like objects." One photo showed "a large cloud of white smoke or steam . . . drifting in a northwesterly direction from the area," and another showed an object about twenty-five feet long "projecting in a north-westerly direction from the seaward end of the building." This object was not visible in a photo taken four seconds later that showed "a small puff of white smoke or steam . . . issuing from the seaward end of the building."[22] Most likely, a V-2 had been test-fired. Further review of all the Peenemünde photographs revealed that several finned objects (V-2s) had been outside the tall upright buildings, on the traverser carriage serving the ellipse and nearby ramps.

There were several theories as to how the missiles would be launched. Dr. A. Crow was certain that the rocket would have to be launched by a giant mortar if the missile was to be aerodynamically stable, and he provided a sketch of a large tube on a rail line leading to a gantry that would invert it.[23] In fact, the Germans could launch the V-2 from a small launch platform. The frequent reconnaissance flights made it clear to the Germans that Peenemünde had become a target of interest to the Allies.

Churchill called a meeting on June 29 that was probably among the most dramatic of the war. The threat of a missile attack on England was real. The missiles would have to be found and destroyed. A reconnaissance mission flown on July 26 revealed that antiaircraft defenses had been increased and smoke generators deployed. In addition, a decoy site covering more than twenty acres had been constructed nearby. On August 17, 1943, Bomber Command launched Operation Hydra: 433 Sterlings, Halifaxes, and Lancasters bombed Peenemünde. It was the first time a research establishment had been bombed. Forty-one bombers did not return; most of those were downed by fighters. Mosquito reconnaissance bombers photographed Peenemünde following the attack. The initial bombing damage report from the CIU indicated a large concentration of craters in and around the target area and that many buildings were still on fire. In the north manufacturing area (the development works), some twenty medium-size buildings had been completely destroyed and at least four were still burning.[24] A more detailed report indicated that thirty huts in the forced labor camp and the scientists' houses had been demolished. More than seven hundred people were killed, among them several prominent German scientists and engineers. The raid set back the German effort by months.

The big question now became whether the Germans would rebuild Peenemünde or establish a new location out of reach of Allied bombers. The answer was not forthcoming until August 1944, when it was learned that the assembly of V-1s and V-2s had been moved to the largest underground factory in the world, near the town of Nordhausen in the central German Harz Mountains. The installation was often referred to as the Central Works, or Mittelwerk.

Construction of the large underground complex began in the spring of 1943. Prisoners were sent from the concentration camp at Buchenwald to build it. They were housed in Dora-Maittelbau, a large camp on top of the mountain. Thousands of inmates from the Dora camp dug huge tunnels into the mountain and then helped to install the machines for the construction of missiles. Twenty of the southernmost tunnels had been allocated for the production of V-2s. The rest were for the production of V-1s and jet engines. The town of Nordhausen was bombed several times, but the bombs had little effect on what was happening inside the tunnels. Late in February 1945 American and British officials discussed saturating every tunnel, shaft, and ventilator in the underground installation with a highly inflammable petroleum-soap mixture. The problem was that the ventilator shafts were inside the Dora camp, and thousands of slave laborers would perish.

U.S. Army forces captured the installations on April 11, 1945, and found thousands of dead prisoners stacked like cordwood. The troops rounded up German nationals and forced them to dig trenches and bury the dead. A number of scientific and military commissions would visit Nordhausen after the war. Tons of V-1s and V-2s were sent back to the United States for testing. Some four hundred German scientists, including Wernher von Braun and Walter Dornberger, who were being held nearby at Bleicherode, managed to escape and surrendered to the Americans at Garmisch-Partenkirchen. They were taken to the United States and interrogated under the auspices of Project Paperclip.

Constance Babington-Smith had spotted "four tailless airplanes" at Peenemünde in aerial photos taken in June 1943 that turned out to be ME-163 liquid-fueled rocket fighters; one was in the takeoff position. On November 13, 1943, Wing Commander Douglas Kendall, the senior photo intelligence officer (SPIO) at the CIU and the only officer there cleared for Ultra, asked Babington-Smith to take another look at Peenemünde. "I knew my first responsibility was to the airfield," she later said,

> but I went beyond and down the road which led to the edge of the sea. There was this strange-looking erection that I did not understand. So I showed it to one of my colleagues in the rocket department and they had seen this structure and they had interpreted it as something to do with the land reclamation work for the airfield. But I didn't really feel convinced by that and I thought I must show it to my boss, Douglas Kendall. He had come back from a meeting in London when he was trying to sort out with the intelligence people what was happening on the French coast. Of course, as soon as he saw the structure he knew that this was the prototype experimental version of the V-1 ramps.[25]

On the evening of March 8, 1987, at a reception given in her honor at the National Air and Space Museum, Mrs. Babington-Smith sat with Arthur Lundahl and Clarence "Kelly" Johnson, the designer of the U-2 and SR-71. She emphasized the importance of sharing collateral information with photo interpreters, especially on new weapons, and maintained that had such information been given to her and others, advanced warning of new V weapons could have been given before they were deployed.

The first V-1 launch site was spotted under construction in a wooded area near Bois Carré. Opinions at the highest levels of Churchill's government differed over the significance of Babington-Smith's find and several sites along the French coast. Army photo interpreter Capt. H. B. Eaton had prepared a three-page report on the new sites seen in the Pas de Calais area. Kendall sent a copy of the report to Sir Stafford Cripps, a member of Churchill's war cabinet, and took Eaton with him to a meeting with Sir Stafford the same day. "Sir Stafford took me carefully through our report," Eaton recalled, "which his legal brain had fully mastered, although the report cannot have been in his hands more than an hour before. By the time I had finished everyone around that table was convinced that the Germans had a secret weapon and that these were the sites from which it would be launched."[26]

Duncan Sandys thought the sites were for launching long-range rockets, while Lord Cherwell, the prime minister's science adviser, believed the sites were intended for launching unmanned aircraft. Churchill asked Sir Stafford to gather all the evidence and make a policy recommendation, and Cripps concluded that unmanned aircraft posed the greatest threat to England.

The British kept information on the German missile programs close to the vest, but American officers at the CIU and at Mount Farm noted the frantic search efforts and reported them to their superiors. The British denied the American Joint Chiefs of Staff critical details of the various German weapons programs, causing a temporary strain in U.S.-British military relations. General George C. Marshall wrote a rather strong note to Sir John Dill, chief of the British Joint Staff Mission to America, saying that it was absolutely necessary for the British to provide all the information they had on German missile and other such endeavors. Among the most alarming estimates before the Joint Chiefs was one from U.S. Army Air Corps headquarters posing the radical possibility that Germany might actually achieve a stalemate in its strategic air offensive by devastating the United Kingdom with bacterial weapons, poison gas, or revolutionary explosives of an "unusual violent character."[27] General Marshall asked Lt. Gen. Jacob Devers, a brilliant plans and intelligence officer, to report to him at once on possible countermeasures.

On June 12, seven days before the invasion of Normandy, the first V-1 missile fired from the Pas de Calais area exploded on a railroad bridge in the center of London. The V-1 pulse-jet-powered cruise missile had a range of 250 miles and carried nearly a ton of explosives at a speed of 350 miles per hour. A gyroscope guided the missile on a predetermined course and terminated its flight, and the explosives detonated on impact. British pilots named the bombs "Doodlebugs" for the putt-putt noise of their pulse-jet engines; others called them "buzz bombs." The British blacked out all information on where the missiles landed to keep the Germans from refining aiming points. Spitfires had some luck chasing the V-1s and shooting them down or using one of the plane's wings to tumble the missile out of its trajectory. Antiaircraft units were deployed opposite Pas de Calais along the flight path of missiles meant for London.

The Allies mounted a massive effort to locate the V-1 sites. Under the code name Operation Bodyline, later designated Crossbow, experts searched all aerial photographs for launch sites in northern France within a radius of 130 miles of London. Photo interpreters tried to confirm or deny reports obtained from the French Maquis (Resistance) and the British Secret Intelligence Service (SIS, also known as MI-6). Fifty-three areas in France were selected for continued reconnaissance coverage. The U.S. 14th Reconnaissance Squadron was selected to conduct the reconnaissance of suspect areas. Interpreters from the CIU were assigned to the U.S. 325th Photographic Wing at Mount Farm to analyze the photos as they came out of the film processors. Each of the suspected V-1 sites had two features in common: a 150-foot-long elevated launching ramp and a square wooden or stone building aligned with the ramp. Photo interpreters labeled the ramps "ski sites" because each appeared to be a ski on its side. The building was used by the German crew "to swing the compass," aligning the magnetic field of the missile with the earth's magnetic field. The first ramps discovered along the French coast were pointed directly at London. Later ones were found pointed at Bristol, Birmingham, and Liverpool. Each site was given a "no ball" (a cricket term) number.

Allied military planners were concerned about how these sites would affect the upcoming Normandy invasion, but at that point it was impracticable to revise the Overlord plans. The invasion would go on as scheduled, and the British agreed to provide the Americans with copies of all scientific and reconnaissance reports.

Eisenhower ordered a massive heavy bomber effort on the V-1 sites, and on December 24, 1943, ten B-17 and B-24 combat wings totaling 722 planes escorted by fighters attacked twenty-four V-1 sites. Altogether fifty-two sites were attacked in December. Once a bombing mission had been completed, five photo reconnaissance aircraft were tasked to fly over the bombed area. Photo interpreters assessed the effect of the raid by comparing pre- and postraid photographs. The British estimated that twenty-one sites had been destroyed and fifteen damaged; in fact, only seven had been completely put out of action. Bomb damage assessment analysts at the CIU reported the extreme scatter of the bombs and noted that a high percentage—up to 90 percent—completely missed their target. A photo of the Bois Carré site that I examined, for example, shows more than five hundred bomb craters and not a single hit on either the launching ramp or the nonmagnetic building.[28] Eisenhower evinced great interest in the poststrike photos and asked if bombing accuracy could not be improved. Gen. Carl L. Spaatz, commander of Allied air forces in England, and Lt. Gen. James Doolittle, commander of the Eighth Air Force, acknowledged that the Crossbow sites were difficult targets to hit and called for a technical and tactical inquiry into the means, methods, and effectiveness of attacks. Hundreds of V-1 photos were prepared and sent to the Army Air Corps Proving Ground Command at Eglin Air Field in Florida, where a test site was constructed. Medium- and high-level bombing missions conducted on simulated V-1 targets proved conclusively that V-1 targets were indeed hard to hit. Fragmentation bombs seemed to be the most effective.

As the number of V-1 bombs falling on England increased, aerial reconnaissance became the principal means for locating V-1 launch sites. The Germans began camouflaging them, and the Allies were forced to initiate low-level flights, sometimes as low as fifty feet, and night reconnaissance missions to find them. American and British recon pilots braved German antiaircraft fire and obtained some of the most exciting shots of the war. The Germans began relocating sites, moving some to other locations and cleverly hiding others among fence rows, in small villages, and in wooded areas.

The V-1 problem could be resolved merely by finding where the weapons were being produced and stored. Well aware that the Allies would bomb any suspect installation they could locate, the Germans developed a plan to make it harder for photo interpreters to spot missile installations under construction and to make such installations bombproof.

Aerial photos obtained on October 3, 1942, revealed a new rail spur leading to an installation under construction at Siracourt near Saint-Pol in the Pas de Calais area. The Germans had dug two deep, parallel trenches, which had been filled and covered by concrete, creating a bombproof sixteen-foot-thick roof. Excavation under the hardened mound was creating a large corridor in which V-1s could be assembled. There was an opening on one side, and the Allies postulated that V-1s could be launched from a ramp outside the bunker that was oriented toward London. The facility was still under construction when conventional bombs were dropped on it on April 23, 1943, with little effect. When Tallboy bombs scored direct hits on the roof a few months later, the Germans abandoned the site.

In August 1943, photo interpreters spotted another new railroad spur, this one leading to a site under construction in a heavily forested area at Lottinghem, also near Pas de Calais. Photos taken in September revealed a long, low building similar to the one at Siracourt in the early stages of construction. The site was photographed again in October and November. The site was being constructed in sections, and a large concrete wall had been completed when the site was bombed. It was abandoned in 1944. Albert Speer, Reich Minister for munitions and war production, was convinced after the bombardment of Peenemünde that the only way to keep strategic missile projects going was to construct underground facilities or to make new installations bombproof. Allied interpreters searching for "ski sites" discovered three huge concrete bunkers being built into hills or quarries. No two sites were exactly alike, and their purpose could not be immediately determined; only study of their structural array and careful measurements of their various components could reveal that. Eisenhower again took a personal interest in these structures and badgered intelligence officers for answers. When high-altitude photography provided limited information, special forward-looking cameras were placed on the wing drop tanks of Mosquito bombers that were sent on low-level flights, some at altitudes below one hundred feet. These "dicing flights" were extremely dangerous and drew heavy opposition from ground antiaircraft batteries, but they gathered valuable information.

The war had entered a new phase with Germany's production of V-1s. Eisenhower was kept well informed on the development of new U.S. and British weapons, including atomic, chemical, and biological systems, and was equally interested in German developments in jet aircraft and guided missiles. His war memoir, *Crusade in Europe*, reports that "from time to time during the spring months staff officers from Washington arrived at my headquarters to give me the latest calculations concerning German progress in the development of new weapons—including as possibilities, bacteriological and atomic weapons. All of this information was supplemented by the periodic reports of Intelligence agencies in London. . . . In addition aerial photos were scrutinized with the greatest care in order to discover new installations that would apparently be useful in some new kind of warfare."[29]

Photo interpreters searching for new installations in the Pas de Calais area concentrated on new rail spurs and roads. On May 16, 1943, they spotted a five-mile-long spur line that branched from the main Calais–Saint Omer rail line and ended at the edge of the Esperlecques Forest. A massive bunker measuring 460 by 330 feet and of unknown purpose was under construction at Watten. On May 17 the CIU issued its first report on the installation, giving details on its size and construction methods. A model of the site was completed on July 6. In the summer of 1943 both the British and the Americans continued photographing the construction. The site was bombed on August 27, 1943, by 185 B-17s of the Eighth Air Force. Concrete was being poured at the time, and the site became a jumble of lumber, steel reinforcing bars, and hardened concrete. Bombing continued until July 26, 1944, when it appeared the site had been abandoned. It was captured by Allied forces on September 6, 1944, and proved to have had two purposes: one section was to produce liquid oxygen while the other would assemble, fuel, and launch V-2s.

After the Eighth Air Force bombed the Watten site, the Germans began constructing a supposedly bombproof shelter for launching V-2s at a quarry in

Wizernes. After digging a large, high tunnel into the hill they began construction of a large dome on top of the hill in November 1943. Beneath the dome they excavated a large chamber. The Allies postulated that V-2s could be assembled and fueled under the dome and then moved out of the tunnel to predefined launch areas. Photo interpreters were reporting construction activity at the enormous hardened site, where hundreds of tons of concrete had been poured, but they could not find any road or rail spurs that could become launch sites. What the photo interpreters did not know was that a series of galleries had also been dug into the hill and under the dome. Today's interpreters would have called for measurements of the soil being dug from the hill, which would have provided evidence of the extent of the underground construction. Concrete was poured over the dome until the cover was more than twenty-five feet thick. Lt. Gen. Lewis H. Brereton of the Air Corps remarked that more concrete had been used in the installations at Watten and Wizernes than in any project in the United States with the possible exception of the Boulder Dam. The dome was raised with concrete jacks, and then the walls were poured.

The first of sixteen bombing missions of the site began on March 11, 1944. B-17, B-24, B-25, and Mosquito bombers using 1,000- and 2,000-pound bombs did little more than chew up the soil around the dome. The area around the installation looked like a moonscape, but the dome remained intact. It took sixteen Lancaster bombers in July 1944, each dropping a 6-ton "Earthquake" Tallboy bomb on the site, to bring it down. The Tallboys caused a landslide from the dome area into the quarry that undercut the concrete braces beneath the dome. The bombs also completely buried the main tunnel and damaged railroad tracks on the quarry floor. The most courageous and spectacular low-level reconnaissance photos of World War II were taken by Mosquito pilots after the site had been bombed. The July 21, 1944, flight resulted in what may be the most amazing dicing photo of World War II inasmuch as the pilot actually dove down into the quarry to photograph the damage done by the Tallboy bombs. The Germans subsequently abandoned the structure. Canadian forces captured the site in November 1944, and it is now a tourist attraction.

Still another large site was spotted under construction on October 31, 1943, on images of Sottevast, eight miles south of Cherbourg. The site consisted of a large excavation about 1,200 feet long, 300 feet wide, and about 30 feet deep. There was speculation that it would eventually be a large bunker like the one at Watten. A large stairway led down to the initial installation of the concrete forms and rebar. Between November 25 and December 1943, 450 tons of bombs were dropped on the site. A similar construction effort was under way at Martinvast, about four miles from Sottevast. Bombing of that site began in February 1944. Both sites would be captured on June 21, 1944, by American forces. It was later determined that the whole structure would probably have been covered with a concrete roof almost flush with the ground and would store V-1 and possibly V-2 missiles. When the two sites on the Cherbourg Peninsula were captured, Eisenhower and Bradley hastened to inspect the Sottevast missile facility to see how these installations might have functioned.

On photographs from September 18, 1943, interpreters spotted a new railroad spur being tunneled through a hill at Mimoyecques, near Calais, barely five miles from the English Channel. A concrete slab eighteen feet thick had been poured over what would be muzzle openings. The weapon it was planned to house was variously called the "V-3," the "high-pressure pump," or the "London gun." This project, one of two approved by Hitler soon after the Peenemünde raid, involved engineers from well-known German heavy equipment firms. The original plans called for two adjacent gun sites, although only the eastern site was built. Each site was to have five clusters, each consisting of five 416-foot smoothbored barrels housed below the ground with only the muzzles visible. A series of small charges on branches of each barrel would be fired electrically in sequence to accelerate a 9-foot dart-like shell. The barrels, inclined at a 50-degree angle in concrete-lined shafts, were aimed on central London, ninety-three miles away. The Nazis planned to fire six hundred of the shells at London every hour. The site was bombed by the Ninth Air Force in November 1943, but tunneling continued throughout the winter. Concrete had been poured over three of the clusters. In May 1944 the British Joint Chiefs of Staff warned that the Mimoyecques site would soon be complete and invulnerable to air attack. Several attempts to destroy it failed.

The Eighth Air Force had established a special project, Aphrodite, to use high explosives on heavy construction sites. The operation began on June 23, 1944, at the 338th Bombardment Group at Knettishall. A B-17 was stripped of its armament and packed with 20,000 pounds of Torpex, an explosive one and a half times more powerful than TNT. A pilot and an engineer would take the plane up, set the controls, arm the explosive, and then bail out over the sea, to be picked up by the British coast guard. The B-17 would then become a drone controlled by a mother ship flying nearby. The mother ship and drone were to be accompanied to the designated target by a fighter escort and reconnaissance aircraft. Such drones had been sent to bomb Siracourt, Watten, Wizernes, and Mimoyecques, but they caused little damage and were regarded as failures. After more failures, Aphrodite was canceled.

The U.S. Navy was experimenting with a similar system using a B-24 as the drone and a Lockheed Ventura as the mother ship. The Navy also selected Mimoyecques as its target. The B-24 was loaded with 20,570 pounds of Torpex and a 600-pound TNT detonator. Lt. Joseph P. Kennedy piloted the plane, accompanied by a radioman. The B-24 took off as planned, made all the necessary turns, and leveled off, and the mother ship began to take control of the drone. While Kennedy and his engineer were checking the controls and the fuse set, the drone exploded, killing both of them. Countless rumors have circulated over the years about the secret mission and the death of the older brother of the future president.

On July 6, 1944, the RAF caused some damage to the Mimoyecques site with Tallboys. Construction finally stopped as Canadian forces neared the site in August. British demolition experts destroyed the site to prevent France from ever using it to bomb Great Britain.

The next concern became the V-2. Designed by Wernher von Braun, the V-2 was a liquid-fueled rocket that traveled at five times the speed of sound and reached an altitude of fifty miles in its trajectory. After the V-2s were driven from hardened sites, V-2 crews began employing a mobile system. A Meillerwagen served as a transporter-erector that carried the forty-six-foot V-2 to a launch site and used a hydraulic lift to place the rocket over a cone-shaped metal plate that photo interpreters referred to as a “lemon squeezer.” Once the erected missile was fueled and launched, the Meillerwagen and supporting vehicles would follow the old artillery adage to “shoot and scoot” and move to a new launch position.

Launch sites were set up in The Hague and its suburbs on September 5, 1944, and a V-2 launched from The Hague on September 8 fell on the London village of Chiswick with devastating effect when the one-ton warhead exploded on contact. The supersonic V-2s were invulnerable to any form of interception then being employed. Britain attempted to mask the V-2 damage with cover stories of mysterious gas explosions, but as V-2 launches became more frequent the damage was more difficult to disguise. Reconnaissance missions were flown, and photo interpreters searched images for launch sites. By the fall of 1944, V-2s were raining down on London. Their accuracy had improved to such a point that it was believed the Germans had selected the Tower Bridge as their aiming point. Although aerial photography revealed V-2 sites in The Hague, reconnaissance officials admitted that by the time the aircraft had returned to base and the film had been processed and interpreted, the V-2 units had been moved to a new launch area. By war's end 1,115 V-2 rockets had been fired at London and other cities. The last V-2 was fired on March 27, 1945, from The Hague.

General Spaatz saw the bombing missions on V-1 sites and hardened structures as a terrible waste of heavy bombers when the medium bombers and fighter-bombers of the Ninth Air Force could do the job just as well. Two other missions were far more important to Spaatz: to cripple German fuel production and storage facilities, and to support the invasion of Normandy. He could not complete either while more than 40 percent of the entire Allied air forces was directed against Crossbow targets. The diversion of bombers from fuel bombardment missions particularly rankled Spaatz because the bombing of synthetic fuel plants was beginning to show results. On June 28, 1943, he sent a strongly worded letter to Eisenhower asking for a new bombing policy using medium bombers, fighter-bombers, and fighters on missile sites. Eisenhower rejected the proposal and on June 29 indicated that attacks on V-1 and V-2 sites would "continue to receive high priority."[30]

Eisenhower believed that Operation Overlord—the invasion of Europe—would have been "exceedingly difficult, perhaps impossible" if the Germans had been allowed to perfect and use the missiles. Indeed, if the Germans had made the Portsmouth-Southampton area a principal target, "Overlord might have been written off."[31] The air offensive against V-1 and V-2 sites from August 1943 to March 1945 came at a terrible price: 498 aircraft and 1,950 crewmen. Anglo-American forces had flown 68,913 sorties and dropped 136,789 tons of bombs on missile sites and storage areas.[32]

While the initial emphasis of aerial reconnaissance had been on western Europe, southern Europe received its share of attention after the Allies invaded Italy. The North African Photo Reconnaissance Wing was transferred to San Severo, Italy, and redesignated the Mediterranean Allied Photo Reconnaissance Wing (MAPRW). Col. Elliott Roosevelt remained its commander with Col. Karl Polifka as his deputy. Soon almost every building in the town had been taken over for photo processing and billeting. Most of the reconnaissance flights took off from nearby Bari Airfield. The MAPRW conducted the reconnaissance for the Fifteenth Air Force and provided all the imagery intelligence required for ground and air operations against Italy, Austria, Germany, Rumania, and Yugoslavia (including Partisan support forces) and for planning the invasion of southern France.

The MAPRW became the largest photo processing and printing plant in the world, using up to 20,000 gallons of water and 600 gallons of chemicals each day. One month's operation required thirty-one tons of photographic paper. A sign in the laboratory named the facility "Eastman Kodak's best customer." When General Spaatz took command of all air forces in England on January 20, 1944, he asked that Colonel Roosevelt be transferred to England to help with preparations for the Normandy invasion. Six weeks later, on March 3, Roosevelt took command of the 325th Reconnaissance Wing in England, bringing with him a number of officers from the MAPRW, experienced individuals who played a key role in the days and weeks leading up to the invasion.

Two factors were uppermost in planning the invasion of Normandy. Eisenhower wanted up-to-the minute information about the enemy, and he wanted to deny the enemy any opportunity to learn more about the Allies' strengths, disposition of forces, and intentions. The Allies presumed that the Germans did not know that efforts were under way for the invasion. But the Germans did know. German documents examined after the war revealed that German reconnaissance pilots had spotted the Allied invasion fleet by the end of April. German reconnaissance indicated that the harbors west of the Isle of Wight were teeming with activity while those in the areas of Dover and Folkestone were silent. By May 1944 the Germans had gained photographic coverage of twenty-eight of the so-called invasion ports. That intelligence combined with other information was sufficient to estimate the probable date of the invasion to be between June 4 and June 11.[33] A ten-day breakdown in German aerial reconnaissance in mid-May interfered with the Germans' ability to determine whether the invasion forces would attempt to land in Brittany or Normandy. David Kahn, an authority on communications intelligence, noted that "when the reconnaissance resumed, though it penetrated far to the west, it provided only unintegrated details. The Luftwaffe could not provide the full picture that alone could show where the shipping concentrations were."[34]

The invasion planners realized that when Allied forces moved to the continent, reconnaissance, processing, and interpretation activities would have to be moved there as well. The facilities at Medmenham and Mount Farm would still be maintained, but it was decided that laboratories, interpretation operations, and supply units could be put aboard vans and transported across the channel. Specially constructed and equipped forty-five-foot air-conditioned trailers containing the latest film-processing and printing machines were made ready. In a test just two weeks before the invasion, one of the mobile stations produced 120,000 prints for the Army Air Corps. The RAF mobile stations were painted blue and became known as the "Blue Train." The U.S. mobile units were painted brown and were called the "Shit Train."

The planners grappled with many challenges and contingencies. After a successful penetration of the enemy's boundary defenses, for instance, a beachhead had to be established so that the attacking force could build up troops and arms in sufficient numbers to enlarge the penetration. The planners tried to anticipate how the enemy would react to contain the beachhead. German defenses had to be attacked along with communication and supply points. The next stage would involve breaking out of the beachhead and overrunning portions of France. In each of the myriad aspects of this planning, photo interpreters contributed essential detailed terrain and road information to help Allied forces advance.

Operation Overlord represents the largest photo interpretation effort ever undertaken. Photo interpreters aided in the selection of landing areas and then constantly monitored them. Selected areas were mapped aerially, and minute bits of information pertaining to the invasion were extracted from aerial photos. Photo interpreters pored over thousands of aerial photos, pinpointing new enemy beach defenses, troop dispositions, radar, flooded areas, and communication and transportation lines. The Germans, for example, were known to be placing poles in fields (facetiously referred as Rommel's asparagus) to prevent glider landings. More than 1,700 officers and enlisted men at the Allied Central Interpretation Unit (ACIU), as the CIU was called by then, worked around the clock studying more than 85,000 negatives and prints daily. This task alone took more than half a million man-hours. All areas of the beaches, marshes, hills, valleys, and natural cover were carefully monitored. More than thirty miles of underwater obstacles could be seen only at low tide and could be identified only with low-level photography. Photo interpreters helped in giving high priority to the destruction of the Würzburg fire-control and Freya early-warning radar sites, which could detect Allied aircraft up to fifty miles away. Information from these missions was transferred onto tactical maps known as "Bigots." Eisenhower recalled that "the air plan, in both its preparatory and supporting phases, was worked out in minute detail and as the spring wore on the results obtained in the preparatory phase were reviewed weekly. Reconnaissance by submarine and airplane was unending, while information was gathered from other sources."[35] No fewer than sixteen Allied squadrons of eighteen aircraft each acquired and interpreted aerial photos for the European theater.

The comprehensive photographic reconnaissance continued from dawn to dusk. But as the window for D-day narrowed, adverse weather began to seriously restrict the flow of photos. There was only one way to get the required information—fly under the weather with dicing missions. The hazards of low-level aerial photography in an area so heavily defended made even Eisenhower and his commanders hesitate. Maj. Gen. Pete Quesada, commander of the Ninth Tactical Air Force, told Eisenhower that he had called his reconnaissance group together and suggested practice missions and diversionary attacks but had been met with a blast: “Hell no. We’re ready now. Just tell us what you want and we’ll get it.” Quesada left the details to the group, and they brought back spectacular photographs of the Normandy coastal defenses. Reconnaissance aircraft roared low over all the French rail lines leading to the invasion area, the pilots looking for any movement of armor and troops. These photos were later compiled in an amazing book, *Above the Battle: D-Day, the Lost Evidence*.[36] Doolittle recalled that “the weather presented a number of command problems. The invasion was accomplished under the most difficult weather conditions and was one of the most satisfying jobs the 8th ever performed. This was largely due to the fact that we had several weeks to plan, to prepare reconnaissance aids such as the H2X radar photos of the coastlines and enemy defenses and to train our people.”[37]

As Allied troops headed toward the Normandy beaches on June 5, Eisenhower composed a hand-written press statement to be released if the invasion failed. It read in part, “Our landings in the Cherbourg to Le Havre area have failed. I have withdrawn the troops. My decision to attack at this time and place was based on the best information available. The troops, the airmen and the Navy did all that bravery and devotion to duty could do. If any blame or fault attaches to the attempt it is mine alone.”[38]

Photo reconnaissance flights began at dawn on June 6 and continued until dark. Forty-five sorties were flown in Spitfires, Mustangs, Mosquitoes, and Lightnings. RAF reconnaissance aircraft landed at RAF Benson and RAF Northolt airfields while U.S. recon aircraft landed at Chalgrove and Mount Farm airfields. The film was developed and rushed to the ACIU at Medmenham so that Allied leaders could determine the status of the invasion.

One recon pilot reported that the Germans were not the greatest hazard they faced that day: “The greatest danger to us pilots lay from the mass of Allied aircraft which roamed restlessly to and fro over the assault areas. Medium bombers, light bombers, fighter-bombers, fighters, light reconnaissance, and naval aircraft swamped the limited airspace below the clouds. That day over 12,000 Allied aircraft were in the sky. On two occasions we had to swerve violently to avoid head on collisions."[39] Among the pilots in the air that day were General Doolittle, the commander of the Eighth Air Force, flying a P-38, and General Quesada in a P-51 escorted by three other P-51s. Wedged into a makeshift observer's seat behind Quesada was General Eisenhower. Their boss, Gen. George C. Marshall, expressed displeasure when he was informed about their joyride behind enemy lines.

The photo interpreters handled one task after another. An emergency job involved construction of two artificial harbors for the invasion forces to use until Allied forces captured the ports. U.S. Mulberry (Mulberry A) was to be constructed off Omaha Beach, and British Mulberry (Mulberry B) was to be constructed off Gold Beach. A storm that began on July 19 and lasted until July 21 wrecked Mulberry A while it was being installed. With Cherbourg about to fall, it was decided to use parts of Mulberry A to construct Mulberry B. Poststorm aerial photography was used extensively to help Allied forces move the salvaged elements of Mulberry A to Mulberry B.

Pinpointing the Germans' interior defenses required highly skilled interpreters. The interior defensive lines were carefully camouflaged or covered with earth. Once these positions had been buried and new vegetative cover had hidden the soil marks, it became almost impossible to identify their purpose on aerial photographs. Interpreters scanned frame after frame trying to locate guns, tanks, and vehicles that had been hidden in towns, courtyards, and farms; next to tree lines; or along hedgerows. Vehicles or guns placed next to a house or farm building and hidden by the building's shadow were particularly difficult to find.

Aerial photography was important even in the taking of a singular objective, such as the Merville battery, which threatened the invasion. Lt. Col. Terrance Otway of the British 9th Battalion, 6th Airborne Division, which took the battery, had high praise for the RAF's efforts: "Aerial photography, in my view played such a critical role that I don't think that I would have been successful without it. We owe a hell of a lot to the Royal Air Force, not only for the risks they took getting those photographs, but the courage they had showed taking us in."[40]

On July 4, Assistant Secretary of War Robert Lovett visited England. After a briefing on the reconnaissance efforts, he issued the following statement: "One of the most impressive advances made in the Air Forces operating overseas is the great improvement in our photographic reconnaissance and tactical reconnaissance work. During my stay in England, the ground officers went out of their way to state that the Photo Reconnaissance unit work done in support of the ground assault and in preparation for the invasion was outstanding as a contribution to the success of the enterprise."[41]

Eisenhower would add his congratulations to the model makers via Air Minister Sir Archibald Sinclair:

> Supreme Headquarters
> Allied Expeditionary Force
> Office of the Supreme Commander
> 14 June 1944
>
> Dear Sir Archibald:
> On behalf of the troops who have had occasion to use relief models in connection with operations now in progress, I desire to express my sincere appreciation for the whole-hearted cooperation and diligence with which the demands of this headquarters for various relief models have been met.
>
> During the past five months there have been transmitted to you numerous requirements for relief models, which considered collectively represent a construction program of great magnitude. These requirements have been met in accordance by unavoidable alterations in the program and readjustment of priorities.
>
> I should be pleased to have you convey to the members of your staff concerned and to the combined British and American Model Making Section my commendation for a task well done. It is appreciated that they must have been called upon to work long hours and still maintain high standards and accuracy and workmanship. Many feel that theirs is a real contribution to our ultimate victory.
> Sincerely,
>
> [Signed] Dwight D. Eisenhower

Deception, including fooling the media, played an integral role in winning World War II. Fortitude South, a plan to persuade the Germans that the Allies would invade the Pas de Calais area, was a deception effort. The main element of this plan, code-named "Quicksilver," was centered on the fictitious U.S. First Army Group (FUSAG) under Gen. George Patton. An integral part of FUSAG was bogus radio traffic supposedly reporting the stationing of British, U.S., and Canadian units in the area. Several double agents were provided with false information to pass along to their handlers. Eisenhower was determined to keep the possibility of an invasion in the Pas de Calais area alive for as long as possible. Heavy, obvious reconnaissance activity in the area to find suspected V-weapons sites helped convince the Germans that the invasion would take place there. An equally fictitious British 4th Army was supposedly in Scotland. The idea was to make the Germans believe that the landings on the coast of Normandy were only a diversion, thereby keeping the German forces from moving to the Normandy region.

Quicksilver entailed the use of a large number of dummy tanks, trucks, guns, and landing craft. Decoy tanks and trucks were dispersed in the fields and woods along with real ones, and dummy LSTs were moored with real ones near embarkation ports. Dummy fuel installations for pumping gas across the channel at Dover were also constructed. These dummy installations were meant to deceive the enemy at ranges of five hundred yards or more. Dummy and real military equipment was covered with camouflage netting to enhance the deception. After the war, when I looked at aerial photos of the deployment of the dummies, especially those placed in the countryside, I noticed that an important element was lacking—the tracks real vehicles would make. The maintenance also could have been better. Some of the tanks and trucks sagged because they were not properly inflated. Photo interpreters would have spotted all of those deficiencies. Gen. Hans Kramer, the last commander of the Afrika Korps and a prisoner of war in England at the time, was taken through the assembly areas and introduced to General Patton in the hope that he would get word back to Germany that Patton was indeed heading an invasion army.[42]

Although the Allies maintained control of the air, a new threat appeared on August 4, 1944, in the form of the German Arado 234 "Blitz" (Lightning), a high-altitude reconnaissance jet carrying out the world's first jet reconnaissance mission. Allied fighters could not intercept a craft flying at 30,000 feet and a speed in excess of 460 miles per hour. The jet overflew the entire Normandy beachhead area, but by that time it was too late to stem the Allied advance into the continent. The Arado 234 later saw action as a bomber during the Allied Ardennes offensive of December and January 1945, and joined with Me-262 jets in pounding and destroying the Ludendorff railway bridge over the Rhine at Remagen later that year.

Aerial reconnaissance continued unabated as Allied armies moved off the beaches and into France. On August 12, 1944, the 7th Reconnaissance Group set a record by flying fifty-six successful reconnaissance missions out of Mount Farm. The photo lab and camera repair crews worked around the clock, and the lab turned out 71,000 prints—59,000 within twenty-four hours.

The winter of 1944–45 was the worst in fifty years in the Ardennes. A blanket of impenetrable fog, mist, snowstorms, and blizzards created poor visibility and restricted photo reconnaissance activity for days on end.[43] Reconnaissance planes flew whenever weather reports indicated an opening. The general opinion at higher Allied command levels was that the Germans did not have sufficient forces to stage a large offensive operation in western Europe because they were fighting the Russians in the east at the same time. On December 16, 1944, however, the Germans smashed into the Ardennes, routing American divisions along a seventy-five-mile front. Eisenhower later acknowledged the role of the weather in the Germans' success: "In gaining this degree of surprise the enemy was favored by the weather. For some days aerial reconnaissance had been impossible and without reconnaissance we could not determine the locations and movements of major reserves in the rear of his lines."[44]

Desperate for information, the Allies attempted to get aerial photos of the extent of the German offensive. The British Meteorological Service furnished weather forecasts and information to reconnaissance and bomber groups. Reconnaissance units always looked for "windows," openings in cloud cover over targets, and needed to know how long the window would remain open. It was pointless to send out pilots unless they had some chance of getting decent photos. Mission after mission was scrubbed because of bad weather, and transport aircraft were finding it difficult to deliver supplies to the besieged Allied forces. Each problem solved revealed another. Radar photography, investigated at Eisenhower's request, proved relatively useless. Bombers flying blind with the assistance of H2X radar brought back little information; the few photos received were extremely difficult to interpret.

Years later, Gen. Kenneth Strong, who had been Eisenhower's intelligence chief, compared the reconnaissance failure in the Ardennes with that in the Kasserine Pass. Eisenhower also saw some similarities. "Although . . . the Kasserine affair was a mere skirmish in proportion to the Ardennes battle," he wrote in *Crusade in Europe*, "yet there were points of similarity between the two. Each was an attack of desperation: each took advantage of extraordinary strength in a defensive barrier to concentrate forces for a blow at Allied communications and in the hope of inducing the Allied high command to give up over-all plans for relentless offensives."[45]

The weather supposedly had even General Patton praying for divine intervention. "Sir, this is Patton talking. The last fourteen days have been straight hell. Sir, I have never been an unreasonable man; I am not going to ask you for the impossible. I do not even insist on a miracle. Give me four clear days so that my planes can fly."[46] Whether or not Patton's plea was responsible, the weather cleared and reconnaissance aircraft filled the air. The photos revealed what the Allies needed to know: behind the Ardennes, German supply lines and armor alongside the roads were extremely vulnerable.

These photos probably were the most difficult to interpret of any taken during the war. Everything was white. Vehicles off the roads were covered by snowdrifts, making identification difficult if not impossible. It was likewise difficult to determine which Allied vehicles were still operable since little or no track activity was visible. While the interpreters had some success in locating German forces, it was initially difficult to locate Allied forces scattered in fields. The interpreters scrutinized everything black or gray on the aerial photos. To make things even more difficult, Americans had covered their armored vehicles with white sheets and tablecloths taken from nearby villages to disguise them from the enemy.[47]

During the fall of 1944 the Luftwaffe began singling out reconnaissance aircraft on long missions, and the toll of downed recon pilots increased. Attacks were most frequent when the pilot approached the target, when the aircraft was most vulnerable from behind and below. Wing Commander Adrian Warburton, rated the best British reconnaissance pilot of World War II, had been injured in an automobile accident in Tunis and was pleased when he was welcomed back to the 7th Photo Reconnaissance Group. Warburton wanted to fly again, and Col. Elliott Roosevelt approved a mission. On August 12, 1944, escorted by eight P-51s, Warburton flew an F-5 deep into Germany to photograph damage done by Eighth Air Force bombers and disappeared without a trace. His fate remained a mystery until 2003 when the wreckage of his plane and his body were found near the village of Engling an der Parr, forty miles northeast of Munich. He was buried on May 14, 2003, at the Durnbach Commonwealth War Graves Cemetery in Bavaria.

Preparations for the invasion of southern France proceeded rapidly following the invasion of Normandy. The southern French coast and the Rhône Valley had been extensively mapped and targeted. The success of the invasion seemed to hinge on an unknown factor. In the harbor of Toulon, protected by eighty-two heavy antiaircraft guns, were remnants of the French navy under German control. Reconnaissance flights over Toulon and coastal areas on August 17, the third day of the invasion of southern France, revealed that the ships were being repositioned. On August 18 the 321st Bombardment Group bombed the harbor. Direct hits sank the battleship *Strasbourg*, the cruiser *La Gallissoniere*, and a submarine. Several destroyers managed to escape.[48]

After the Allies crossed the Rhine, reconnaissance efforts concentrated on transportation hubs and bridges. Supply dumps, bridges, and communication centers became targets for medium and heavy bombers. P-51s were now escorting nearly all reconnaissance aircraft. Anything that moved along the roads or rail lines was bombed and strafed. As the Allied armies moved deeper into Germany, thousands of German army, air, and naval forces surrendered. Recon photos showed them in POW camps or being marched along the roads.

The Allied forces sent back dispatch after dispatch describing hideous scenes at concentration camps in Germany and Austria. Eisenhower, perhaps unable to believe what he was reading, decided to view the Ohrdurf camp along with Patton and Bradley. There, Eisenhower wrote, they came face to face with "indisputable evidence of Nazi brutality and ruthless disregard of every shred of decency." That evening he sent messages to Washington and London urging that newspaper reporters and representative government groups be sent to view the evidence, which "left no room for cynical doubt." He ordered that Germans from surrounding villages be ushered through the camps and even made to bury the dead. Get it all on record now, he was reported to have said. Get the films—get the witnesses because somewhere down the track of history some bastard will get up and say that this never happened.

Reflections and testimonials after the surrender of Germany emphasized the value of aerial reconnaissance. Eisenhower called recon aircraft "a most valuable means of obtaining information of the enemy, not only at his major bases but along the actual battlefront. Airplane photography searched out even minute details of defensive and offensive organization, and our techniques were developed to the point that information so derived was available to our troops within a matter of hours."[49] Talbert Abrams, a noted reconnaissance officer, agreed. Aerial photography, he wrote, "furnished a fast and easy means of obtaining military information concerning enemy movements and methods of attack. Approximately ninety percent of military intelligence comes from this one source alone."[50]

During the course of the war, Constance Babington-Smith saw a new kind of photo reconnaissance come into existence that was strategic as well as tactical. "The intelligence it yielded gave answers of a rapidity, scope, and accuracy which had never before been envisaged."[51] A captured German divisional order in 1944 noted that enemy aerial reconnaissance was detecting every movement, every concentration, every weapon, and immediately after detection was smashing every one of those objectives.

The war in the Pacific continued after the Allies brought Europe under control. Just as Eisenhower relied on photo intelligence to conduct his planning and operations, so too did commanders in the Pacific theater. The U.S. Navy created a cadre of specialists to extract information from aerial photographs for use in planning amphibious landings and battle actions. The Joint Intelligence Center Pacific Ocean Area (JICPOA) was charged to collect, collate, evaluate, and disseminate strategic and tactical intelligence for the commander in chief of the Pacific Ocean Areas. Some of the material was used to select targets for aerial bombardment, including the atomic bombing of Hiroshima and Nagasaki. JICPOA had 1,800 personnel assigned to its facility at Pearl Harbor in 1945 as well as hundreds at the Advanced Intelligence Center in Guam, where aerial photography was being assembled for the invasion of Japan. In May 1945 Adm. Chester Nimitz inspected the center and commended its work. The introduction of B-29 photo reconnaissance aircraft extended the Allied reconnaissance capability in the Pacific.

The Allies used extensive strategic bombing missions to cripple German and Japanese industries during the war. The field planning for some of these missions left a lot to be desired. In the fall of 1944, the Joint Target Group, established by the Army Air Corps and the Navy in Washington, became the planning and coordinating agency for targeting. The group nominated the targets, recommended the type of ordnance to be used, and proposed the strategy for conducting operations in various weather conditions. With the accumulation of additional experience and research, the methods and techniques of the many phases of target analysis were refined. Reconnaissance and photo interpretation were crucial in all aspects of planning—in the development of sea and air navigation charts, reconnaissance maps, battle maps, terrain studies, bombardment and bombing aids, underwater depth determination, amphibious operations aids, bomb damage surveys, camouflage and concealment studies, and preliminary surveys for base reconstruction—and the science of photographic analysis advanced in scope and responsibility as a result.

The Joint Intelligence Publishing Board, created in 1943 with representatives from the War Department, Army Intelligence, the Office of Naval Intelligence, the Office of Strategic Services, Air Intelligence, and the Office of Chief of Engineers, commissioned a series of joint Army-Navy intelligence studies (JANIS). The studies assembled information from twenty governmental agencies and provided topographical data on likely operations areas and included maps, aerial photography, target data, and estimates of the enemy order of battle. A large study for the invasion of Japan was under way when the war in the Pacific ended. JICPOA was disbanded in October 1945. The chief of staff of the Pacific Ocean Areas "praised JANIS studies, indicating they were indispensable references for the shore base planner."[52] Adm. Richmond Kelly Turner, commander Amphibious Forces Pacific, called photo intelligence "the most important source of information throughout the Pacific during World War II. Its importance cannot be overemphasized."[53]

Aerial reconnaissance did not end with the end of World War II. Indeed, it became one of the principal means of accomplishing the U.S. Strategic Bombing Survey. The USSBS, initiated in November 1944 by President Roosevelt, was an attempt by a group of civilian and military specialists to measure the results of the strategic bombardment campaigns. Its mission was to conduct an impartial and expert study of the effects of aerial attacks on Germany and establish a basis for evaluating the importance and potential of air power as a strategic instrument of national defense. The survey's evaluation of the many aspects of the air war made one fact apparent: the disintegration of a nation's ability and will to wage war could be planned and effected to a remarkable degree through systematic air attacks on its strategic components. This was the proof and validity of the strategic concept—a concept that would completely revolutionize warfare and affect all future planning efforts.

The report the USSBS issued on Europe revealed that "intelligence appraisals made by photo interpreters were the principal source upon which to determine types of construction, assess bomb damage, compute weapon effectiveness and decide when a plan should again be hit." The survey's field studies generally confirmed the accuracy of photo interpretation when related to building types and building damage. Minor errors in details occurred, but these tended to balance and were relatively unimportant. Several special studies made in advance and later checked out on the ground disclosed a high degree of skill in the work of photo interpreters. Also, many targets were hit just as they were about to go back into large-scale production following repair. Such results came from using photo interpreters who were specialists in the particular industries to assess results in those industries.[54]

In August 1945 President Truman requested a similar study on the effects of all types of air attack against Japan. The USSBS became a mammoth project involving a team of nearly 1,300 military personnel augmented by a large number of civilian experts. The conclusion for the Pacific survey stated: "Although viewed with indifference and skepticism at the beginning of World War II, aerial photography ultimately became the most important single source of intelligence in the Pacific War. [It] played an important part in more phases of military and naval operations than any other sources."[55] Among the young officers who participated in the survey studies who later achieved prominence were Paul H. Nitze, John Kenneth Galbraith, Fred Searls Jr., and George Ball. President Eisenhower frequently referred to the USSBS findings and the importance of the proper interpretation of aerial photography. In effect, World War II transformed an infant science into a highly technical craft requiring precision equipment, highly trained personnel, and considerable problem-solving abilities.

The need for interpreters declined after the war, as did aerial photography. Thousands of cans of World War II aerial photos and thousands of boxes of photographic prints stored in footlockers found their way to Washington and were stacked in the Old Torpedo Plant in Alexandria, Virginia. The war had produced a wealth of information whose value was just beginning to be perceived. The German Luftwaffe photographed practically all of Europe, including Russia up to the Urals, and a large portion of North Africa. U.S. forces photographed 16 million square miles for the construction of aeronautical charts, and approximately 2.5 million square miles for large-scale mapping of areas where Allied forces were deployed.[56] A new vision of the world was slowly being pasted together.

Experts hoping to preserve their "lessons learned" during the war produced a number of photo interpretation keys. Reconnaissance had taken on many forms, most notably from the ground, the air, and the sea, but also from beneath the sea through the use of periscope photography. Intelligence procedures were also established for the location and analysis of underground military and industrial installations. The war not only greatly advanced the art and science of aerial photography and photogrammetry, it also spurred the development of remote sensing devices, including color infrared, thermal infrared, and radar systems. In the postwar period these detectors were applied to the development of airborne optical-mechanical scanners, radiometers, and spectrometers.

Long before the first U-2 took wing, those who championed the development of a special aircraft for reconnaissance got their wish when the Republic X-12 Rainbow was approved. It was built to exact specifications drawn up by the Photographic Section of the Air Technical Service following recommendations from Col. Elliot Roosevelt. A long-range aircraft that could fly more than four hundred miles an hour at 40,000 feet, the Rainbow had four high-powered engines and was considered the embodiment of what a reconnaissance aircraft should be. A contract was awarded to Republic Aircraft for two aircraft. The first prototype rolled out of the factory in December 1945 and flew in February 1946; the second did not fly until August 1947. The Rainbow had three camera compartments to hold a variety of cameras and a complete darkroom for in-flight processing. In a test flight on November 4, 1948, the Rainbow came to an untimely end when the number two engine exploded and the aircraft crashed. The Air Force lost interest in the Rainbow after that and reverted to the idea of placing cameras in bombers or fighters.

Aerial reconnaissance seemed to be in danger of disappearing altogether when the United States demobilized a significant percentage of its conventional military power after the war. The 1947 Defense Reorganization Act attempted to look at new weapons as well as the roles and missions of the various services. Intense interservice rivalry roiled the Defense Department, which was in the throes of reorganization, consolidation of roles and missions, and severe budget cuts. Gen. Curtis LeMay touted the B-36 as the major strategic weapon of the future, and many at the upper levels of government questioned the need for additional aircraft carriers for smaller aircraft. The matter came to a head in the famous 1949 Navy–Air Force budget battle and the "Revolt of the Admirals," the most serious challenge to civilian control of the military in the modern area. The future role of reconnaissance and the importance of maintaining a photo interpretation capability were lost in the melee.

At war's end there appeared to be no need for foreign intelligence, and on September 20, 1945, Harry Truman signed Executive Order 9621, "Termination of the Office of Strategic Services and Disposition of Its Functions." U.S. military planners felt comfortable, almost complacent, with the technological advantage the United States had achieved in both long-range bombers and nuclear weapons. Production lines were being tooled for the B-36 intercontinental bomber, and plans were well under way for the design and production of B-47 and B-52 heavy jet bombers that could carry atomic weapons. There was a feeling, especially among the military, that the Russians were all whiskers and thumbs. President Truman did have a science adviser, Dr. Oliver Buckley, but neither Truman nor Buckley seemed to have clear convictions about what they should do. William O. Baker, chair of the board of AT&T Bell Labs, called their relationship "very amiable" but saw "no real projection of science and technology into national security or general affairs."[57] Even the Berlin blockade, Mao's victory in China, and the outbreak of the Korean War did not stimulate international intelligence operations, especially photographic intelligence-gathering efforts. Indeed, for five years after Truman signed Executive Order 9621, the CIA had no photo interpretation capabilities.

Some visionaries continued to pursue improved intelligence-gathering capabilities. Theodore von Karman, one of the world's leading aerodynamicists, was among them. After the war, Gen. Henry "Hap" Arnold asked von Karman to "gather a group of practical scientists for all the new things and prepare a report." He received the report in December 1945. Titled *Towards New Horizons*, it "outlined developments and opportunities in areas of high speed aerodynamics, aircraft materials and structures; power plants, including gas turbines; pulse jets, and ramjets; the design and development of solid and liquid fuel rockets; high temperature materials; aircraft fuels and atomic power; guided missiles and 'pilotless' aircraft, automatic flight controls; heat, television guided, and radar homing missiles; explosives and terminal ballistics; radar and communications; and aviation medicine including psychological research."[58] Two years later, as chief of staff of the Army, Eisenhower echoed those sentiments in testimony before the House Military Appropriations Subcommittee: "In the field of guided missiles, electronics and supersonic aircraft we have no more than scratched the surface of possibilities which we must explore in order to keep abreast of the rest of the world. Neglect to do so could bring our country to ruin and defeat in an appalling few hours."[59]

Lt. Gen. Walter Bedell Smith, who served as Eisenhower's chief of staff during the war and remained a close friend afterward, became director of the CIA on October 7, 1950, replacing Adm. Roscoe Henry Hillenkoetter. Smith realized that vast areas of the Soviet Union had been curtained off from the outside world and Soviet military preparations, production, and deployment activities were carried out in the utmost secrecy. All of their strategic capabilities—bomber forces, ballistic missiles, submarine forces, and nuclear weapons plants—were concealed from outside observation. The Soviet air defense system, a prime consideration in determining U.S. retaliatory policies, was also largely unknown. Having served as U.S. ambassador to the Soviet Union from 1946 to 1949, he realized that obtaining knowledge of Soviet geography and economic issues—the traditional means of obtaining intelligence—would not apply to Russia. Smith was well aware of the contributions that photo interpretation made during World War II, and the CIA's inability to conduct such operations was especially disconcerting to him.[60] Above all else Smith wanted to improve the Agency's ability to produce high-quality intelligence.

In the postwar years, each U.S. intelligence department and organization had its own information service, and none of them communicated with each other. The president had to contact two or three departments to get essential information. Even then, it was usually not readily accessible. At the invitation of General Smith, Truman spoke to a number of CIA officers about his intelligence predicament. "Only two people," he told them, "Admirals Leahy and Brown, knew what was going on in the military affairs department." Frustrated, he had asked Admiral Leahy to devise an intelligence program, and the precursor of the CIA was the result. On January 22, 1946, Truman had issued a presidential directive creating the National Intelligence Authority. The Central Intelligence Group, with Gen. Hoyt Vandenberg as its director, was created to "plan, develop and coordinate all Federal foreign intelligence activities related to the national security."[61] The National Security Act of July 26, 1947, established the position of the director of central intelligence along with the Central Intelligence Agency under the aegis of the National Security Council. The military was not at all in agreement with Truman's decision. They resented having to provide a civilian agency with military intelligence, especially when doing so was detrimental to their own service. The military also thought that civilians could not properly understand or analyze military intelligence data.

In an interview years later Col. Lawrence K. "Red" White, the CIA's executive director, said, "Smith really shook the place up. He really rocked not only CIA, but also the community."[62] Smith understood that the Agency was struggling to obtain critical intelligence for estimating Soviet capabilities and that all of its functions needed to be reorganized. There was no doubt in the intelligence community that he was also the president's chief intelligence officer. Smith had the managerial savvy and decisiveness to run the Agency, which was riven by countless turf wars as well as personality and operational conflicts with the military. To combat the infighting and to build a more efficient and cohesive structure, Smith—who outranked the service chiefs—supervised sweeping administrative changes and created the basic organization that exists to this day. He maintained close relations with Eisenhower and many of the ranking officers who had served with him during the war, such as Omar Bradley, Lucien Truscott, Hoyt Vandenberg, and Jimmy Doolittle. His prominent position in the government allowed him to get things done. He chose William H. Jackson as his first deputy (Allen Dulles followed) and reorganized the CIA by creating a deputy director for intelligence, a deputy director for administration, and a deputy director for clandestine services. He created the Office of Research and Reports to conduct basic research and made the Office of Current Intelligence responsible for daily current intelligence bulletins. He abolished the Office of Reports and Estimates and created the Board of National Intelligence.[63]

Nicknamed the "American Bulldog" by Winston Churchill, General Smith was plagued with an ulcer and was a terror when it was acting up—bellowing, threatening, and insulting his subordinates. When Smith arrived at work each morning, Dr. John R. Tietgen, director of the Agency's Office of Medical Services, would meet with him and assess his health. If Smith was in pain, Tietgen would often give him medication to ease his discomfort. On those "bad" mornings his deputy directors dreaded meeting with Smith before his medication took effect. It was a common practice to check with Dr. Tietgen first. Deputy directors who dragged their feet were summoned with a phone call: "Get your ass up here, now."

Stories about Smith abounded. Gen. Anthony McAuliffe, for instance, who had served under Smith as a major, called him about a project, expecting praise for his work. Instead Smith responded, "You were a dumb shit when you were a major and you are still a dumb shit." Smith wanted pithy answers from his subordinates. He once told a rambling State Department analyst that he did not know what in the hell he was talking about. When Smith was later asked if the analyst could come to a follow-up meeting, Smith said yes—provided someone put a cork in the man's mouth and another in his behind.

My boss, Dr. James M. Andrews, the assistant director for collection and dissemination, was a favorite target. Andrews was an academician and an ornithologist, and he wrote with a flowery flourish. Smith sent back one of Andrews' papers with an attendant note: "This is the biggest pile of unadulterated crap I've ever read." He once remarked that he had hoped for an energetic go-getter in collection, but they had hired a "fucking birdwatcher." Smith was partial to World War II veterans. He would always ask CIA personnel if they had served in the military and where they served. He would also ask if they were being treated well by their superiors.

Smith had visited Soviet weapons installations while serving as the U.S. ambassador to the Soviet Union, and he frequently checked with us to see what information we had on those installations and how current it was. When Smith demanded information about a particular installation, Andrews usually sent me. Smith had great respect for Soviet engineering capabilities and frequently displayed a Russian camera he called his Soviet Leica.

Acquiring solid intelligence and producing good estimates was a key challenge for the CIA, and Smith pressed for the development of coordinated intelligence analysis and the precise use of language for estimates. He used the expression "war is possible" to illustrate its importance. In Washington, he said, the message would be met with a shrug; in the field it would bring on a full military alert.

The U.S. military services generally refused to help the CIA gather intelligence. The military intelligence branches felt they had proprietary responsibilities for military intelligence and that the CIA was duplicating their efforts. This parochial attitude frequently hindered objectivity. Intelligence papers prepared by a second agency were often automatically rebutted rather than objectively considered and coordinated. The coordination process was interminable, and too frequently the dissents were merely bureaucratic. More often than not, military estimates were inventories of ignorance rather than precise analyses. U.S. policy makers needed independent estimates, and the CIA was the logical agency to produce them. The founding director of the Board (later Office) of National Estimates was the Harvard historian William L. Langer. Sherman Kent, his deputy and successor, came from teaching modern European history at Yale. It would be Kent who would hone the craft of intelligence analysis and estimates into a science.

The Agency selected Fred Brown, the headmaster of the Fountain Valley School in Colorado and an intelligence officer during the war, to do an independent study on the need for a photo interpretation unit. The lack of a central unit to determine and process photo intelligence requirements, receive and interpret the information gained, and maintain the records was causing chaos and confusion within the Agency. Among the organizations claiming responsibility were the Psychological Warfare Division, the Office of National Estimates, the Procurement and Supply Office, the Paramilitary Division, the Map Division, and the Industrial Register. On February 11, 1953, Dulles designated the latter as the central point of contact for the CIA in all matters of Air Force support. After some complaining by Gen. Hoyt Vandenberg, Dulles, on March 6, designated the chief of procurement and support to be responsible for the conduct of discussions on behalf of the various support elements of the Agency. I worked with Brown on a project that showed that an aerial photo was far more accurate than human intelligence for locating targets. Brown used German Luftwaffe aerial photos to prove his point. Based on his findings Brown recommended that the CIA establish a photo interpretation unit. On August 4, 1952, after reading Brown's report, Smith authorized the establishment of a photo interpretation unit within the Agency's Office of Research and Reports, but nothing was done during his administration.

Neither Dulles nor the covert people were "with it" as far as photo intelligence was concerned. Richard Helms, chief of operations, deputy director of plans, was against overflights altogether. Always a case officer at heart, he stated, "I am persuaded that this Agency should stick to its knitting and not permit itself to be pushed into an area of activity which would inevitably overstrain its resources."[64] The director of Air Intelligence, Gen. John A. Samford, told Dulles that he "was tired of pulling on one end of a strand of limp spaghetti," and Dulles agreed to bring up the matter of aerial reconnaissance overflights before the NSC.[65]

On June 1, 1952, Eisenhower returned from Europe and was chosen to be the Republican presidential candidate. The war raging in Korea was a major issue in the upcoming election. In a June speech Eisenhower promised: "Without weakening the security of the free world, I pledge full dedication to the job of finding an intelligent and honorable way to end the tragic toll of American casualties in Korea."[66] President Truman instituted the custom of providing candidates for the presidency with confidential briefings on foreign affairs and potential trouble spots. In 1952 he authorized the CIA to brief General Eisenhower and his opponent, Governor Adlai Stevenson. Truman felt that whoever won the election should be well informed when he took office. In a speech in Detroit on October 24, 1952, Eisenhower announced his intention, if elected, to go to Korea the following January to determine for himself the conditions "in that unhappy country."[67]

After Eisenhower was elected, Truman invited him to the White House for a presidential briefing. There are two versions of what happened at this November 18, 1952, meeting. Truman believed that he discussed some of the most important foreign intelligence issues with Eisenhower. And he gave Eisenhower a comprehensive National Intelligence Digest prepared by the CIA, supposedly "the most important national intelligence on a worldwide basis."[68]

Eisenhower saw it differently. In his memoirs he wrote that Truman "received me cordially; however, in such a short span of time the conversations, which included briefings by several outgoing Cabinet heads, were necessarily general and official in nature. So far as defense affairs were concerned, under the direction of the President, I had been briefed periodically by General Walter Bedell Smith and his assistants in the Central Intelligence Agency on developments in the Korean War and on national security. This meeting therefore, added little to my knowledge, nor did it affect my planning for the new administration, but I did thank the President sincerely for his cooperation."[69]

When Dwight David Eisenhower was inaugurated as the thirty-fourth president of the United States on January 20, 1953, he faced a sobering series of problems:

> Two wars, with the United Sates deeply engaged in one, and vitally concerned in the other [in Indochina], were raging in Eastern Asia; Iran seemed to be almost ready to fall into Communist hands; the NATO Alliance had as yet found no positive way to mobilize into its defenses the latent strength of West Germany; Red China seemed increasingly bent on using force to advance its boundaries; Austria was still an occupied country, and Soviet intransigence was keeping it so; European economies were not yet recovered from the effects of World War II; Communism was striving to establish its first beachhead in the Americas by gaining control of Guatemala."[70]

As supreme commander of the Allied Expeditionary Forces, Eisen-hower had been privy to Ultra intelligence and a wide variety of aerial recon-naissance information. He thus valued and understood intelligence. But when he assumed his presidential duties he had neither reliable nor current information on the Soviet Union. His former aide, Gen. Andrew Goodpaster, noted that

> Eisenhower held very strong views on the importance of intelligence; he always sought to acquire the best intelligence that could be realistically achieved. As a former soldier and military commander, he had a thorough personal and professional understanding of both the capabilities and the limitations on intelligence. He knew of the secret code breaking operations during the Second World War, for example, and how such efforts on the part of the Americans and British helped with the battle of the Atlantic against the German U-boat menace. He also knew the limits of intelligence, especially against a clever and highly professional and determined opponent who was adept at denial and deception, as evidenced by the surprise the Germans had achieved in launching the Battle of the Bulge in December 1944. What the Axis powers of World War II could accomplish, Eisenhower realized, America's adversaries during the Cold War, especially the Soviet Union could do as well.[71]

Eisenhower had been in office less than a month when he met with the National Security Council on February 11, 1953. Gen. Omar Bradley, chair of the Joint Chiefs of Staff, gave a report from intelligence sources, including reconnaissance, indicating a buildup of Chinese forces in the Kaesong sanctuary, a twenty-eight-square-mile area where Chinese and North Korean troops and equipment had massed. Gen. Mark Clark believed the Chinese were preparing to launch an offensive and asked permission to attack Kaesong. Eisenhower, who had been briefed in November on the U.S. weapons arsenal, asked about the possibility of using atomic weapons (twenty-kiloton types were available in the theater). He thought Kaesong might be "a good target for this type of weapon." Although the military were frighteningly eager to use nuclear weapons, Secretary Dulles was against it. Eisenhower acceded but warned that the United States could not continue in Korea "indefinitely."[72]

Fortunately, the tide changed. The Chinese and North Koreans were finding it increasingly difficult to supply their troops along a wide front. They realized that their losses had become militarily insupportable and that progress could be made only in negotiations. They were also well aware that the United States had an atomic arsenal and that Eisenhower was willing to use it. When armistice talks stalled in April 1953, the Joint Chiefs suggested that Eisenhower consider using atomic weapons as a means of forcing a settlement. The 49th Fighter Bomber Wing, based in Japan, had a squadron of F-84Gs equipped to deliver tactical nuclear weapons in July 1953. The aircraft were not under the control of the Strategic Air Command (SAC). They were under full presidential control and were being maintained for a battlefield emergency if the North Koreans and Chinese tried to gain territory before signing an armistice. In a show of force, a B-36 wing was deployed to Okinawa, Guam, and Japan. Eisenhower was reluctant to use nuclear weapons in a limited war and instead authorized attacks on the Yalu River hydroelectric stations and the dams that held the water vital for North Korean rice farming. Finally, on July 27, 1953, Chinese, North Korean, American, South Korean, and UN military leaders agreed to an armistice agreement that produced a cease-fire. Reconnaissance revealed a pullback of Chinese and North Korean troops from Kaesong. Reconnaissance of North Korea continued for many years.

Later that year Eisenhower wrote to Emmet John Hughes, his speechwriter:

> I learned one lesson through all these many months and many experiments. It is that in war there is scarcely any difficulty that a good resounding victory will not cure—temporarily. And I learned that there is a priority of procedure in the preparing for . . . great tasks that the leader ignores at his peril. . . . But obviously in the hurly burley of a military campaign . . . or a political effort—loyal effective subordinates are mandatory. To tie them to the leader with unbreakable bonds one rule must be observed—take full responsibility, promptly for everything that remotely resembles failure—give extravagant and public praise to all subordinates for every success. . . . But in our complicated political system . . . success is going to be measured, over the long term, by the skill with which the leader builds a strong team around him.

And Eisenhower began building his team of scientists and devoted public servants.[73]

TWO
the awakening

A target dossier must be created on all Soviet industries and military installations.

Adm. Roscoe Henry Hillenkoetter

The Berlin blockade and the Korean Conflict spurred new initiatives in intelligence. NSC-68, delivered to President Truman on April 7, 1950, called for major increases in defense spending, more military aid, increased reconnaissance, and psychological warfare against the Soviet Union. A global struggle against the Soviet Union had begun, and many budgets hid funds to learn more about the Soviets as the various branches of the U.S. armed services continued operating their own reconnaissance programs.

The U.S. Navy decided to convert the Navy Photographic Intelligence Center (NAVPIC) into a combined military-civilian center. Arthur C. Lundahl, still in uniform, was selected to determine the center's mission, functions, position descriptions, budget and staffing allowances, equipment lists, and other operating and administrative needs. Among other things, the Navy at the time was heavily involved with the Ronne Antarctic Research Expedition (1946–48), which involved extensive reconnaissance flights over Antarctica. After NAVPIC was converted, Lundahl was asked to stay on as chief of the Photogrammetry Division and then as chief of the Chief Engineer's Office, where he worked with Valentine Van Keiren, NAVPIC's director. Many years later, Lundahl wrote that "probably most important was the fact that the Navy continued photogrammetry and photo interpretation training and held an experienced cadre of officers and civilians together to meet many intelligence needs which erupted when the Korean War began."[1]

U.S. Air Force reconnaissance activities were controlled by the Air Force Office of Intelligence (A-2). The Reconnaissance Branch was situated in the Pentagon. The Photo Intelligence Section consisted of a photo interpretation unit of about twenty interpreters in Annex 3, also known as the "Pickle Factory," a former brewery building in the Pentagon's south parking lot. Theodore "Ted" Tate commanded the unit with Bob Sager as his deputy. In addition to conducting photo interpretation of sensitive missions, the branch had all of the photo interpretation reports that had been prepared in World War II. Some Air Force interpretation of sensitive missions was also conducted in a special area of the 544th Reconnaissance Technical Squadron (RTS) at SAC headquarters in Omaha, Nebraska.

An Air Force unit housed in a former World War II barracks in downtown Washington was making plans for possible war against the Soviet Union. The number of Soviet cities that were to be "busted" initially ranged from one hundred to two hundred but was finally reduced to seventy. Aiming points were selected not only to incapacitate the Soviet military and industrial machine in one swift blow but also to destroy the enemy's will and ability to continue or resume hostilities. As a first step in the planning, the Air Objective Folder Program was established to create target folders of the designated Soviet cities. Each city had a large map-sized folder with a 1:25,000 photo mosaic as the centerpiece. All of the targets within the city were delineated, described, and assigned Bombing Encyclopedia (BE) numbers. The folders included analyses of all of the buildings (stone, wood, brick, etc.) in the city and the type and size of nuclear weapons that would be required to destroy it. If aerial photography was not available, a sketch was made from the other information at hand. The CIA's Industrial Register became deeply involved in the targeting process and provided new textual, aerial, and ground photos of the seventy cities. The target folders were used to train SAC bombardiers.

SAC later began using 1:100,000 scale maps and still later demanded 1:200,000 charts on the entire Soviet Union. When the Communists took over China, target dossiers were created on Chinese targets and on some communist-leaning countries in Southeast Asia using aerial photographs taken by Army Air Corps and Navy reconnaissance units during World War II.[2]

The targeting was made much more difficult by the lack of information on many Soviet cities, and the unit creating the dossiers recommended airborne reconnaissance over the Soviet Union and the Sino-Soviet bloc to remedy the situation. A reconnaissance program on that scale would require a great deal of planning, the proper aircraft, and bases to house them. Proper cameras would be needed as well, especially oblique ones, which had been used only sparingly in World War II. The task was enormous. The Soviet Union had 11,000 miles of shorelines and borders and more than 8 million square miles of territory. When the People's Republic of China and the Eastern Europe satellites were included, the total increased to some 13 million square miles. The mere idea of covering the entire area was beyond imagination, yet some planners were advocating daily, weekly, or monthly aerial coverage to prevent a surprise attack.

At the same time, the postwar military establishment was realizing the need to rebuild along more modern lines. Modernization became a matter of devising and producing new weapons for the future. The Air Force was the first military service to realize that its technical resources were inadequate to the task. Air Force research and development was scattered throughout the United States in a half dozen turf-protecting commands, and little constructive work was being done. The Air Force decided to have several private organizations survey its research and development efforts and make recommendations to streamline and improve productivity.

The first recommendation resulted in the creation of the Ridenour Committee (named after its chair, Louis Ridenour, of International Telemeter). The committee's 1949 report indicated that the Air Force program "was antiquated in its methods, incomplete in its coverage and unsuccessful in its efforts to best utilize university and industry scientists. . . . Satisfactory progress in Air Force research and development can be made only when a single agency, headed and staffed by technically qualified personnel, is charged with this single purpose and is given the entire job."[3]

Acting on the Ridenour Committee's recommendations, the Air Force activated the Air Research and Development Command on January 23, 1950, and later placed one of its most brilliant innovators, Col. (later Lt. Gen.) Bernard A. Schriever, in charge. Colonel Schriever shed his service orientation for the benefit of the program. In those days, flying back and forth between the power center in Washington and the West Coast, where much of the research was performed, was a taxing proposition. Schriever proposed holding some of the meetings halfway, at Wright-Patterson Air Force Base (AFB) in Dayton, Ohio. A gentleman in all of his dealings, Schriever would remark years later that there were conflicts with and within commands that left "a lot of blood on the floor." He had the foresight to see that the research and development process was incomplete without including procurement and production, and the newly formed Air Force Systems Command incorporated the entire weapons systems development process.

The Air Force deputy chief of staff approached the Massachusetts Institute of Technology (MIT) in May 1951 about conducting a study of U.S. strategic reconnaissance and intelligence. Early in 1952 Dr. Edwin Land and Col. Carl F. J. Overhage, representing the Air Force, contacted prominent experts such as James Baker, Savelle Davis, Allen F. Donovan, G. K. Geering, Peter C. Goldmark, G. W. King, Dick Leghorn, Stewart E. Miller, Richard S. Perkin, Edward Purcell, Louis N. Ridenour, Gordon P. Saville, S. S. Stevens, and James Thompson to form a study group to consider data gathering, intelligence assessment, and dissemination. The study, named Project Lincoln, would "obtain the collective judgment of a selected group of scientists and engineers not normally associated with Air Force problems."[4] The participants, who became known as the Beacon Hill Study Group, assembled under the direction of Colonel Overhage to propose changes in emphasis and new areas for research, and to suggest directions for future technical efforts. The committee was active from January to April 1952. Edwin Land, an eminent photo scientist, played a leading role in formulating the group's report, which advocated radical approaches in applying scientific and technical methods to obtain information for national intelligence estimates. Noting the success of Allied aerial reconnaissance during World War II, the group recommended improvements in sensors and identified vehicles that could overfly Soviet territory. The vehicles included high altitude-aircraft; high-altitude balloons; sounding rockets; and the Air Force's Snark, Navaho, Matador, and Rascal air-breathing missiles for use as photographic drones.

On June 15, 1952, the Project Lincoln participants released their epochal report, "Problems of Air Force Intelligence and Reconnaissance." The report summarized the nation's reconnaissance needs as follows: "We have reached a period in history when our peacetime knowledge of the capabilities, activities, and dispositions of a potentially hostile nation is such as to demand that we supplement it with the maximum amount of information obtainable through aerial reconnaissance. To avoid political involvements, such aerial reconnaissance must be conducted either from vehicles flying in friendly airspace, or—a decision on this point permitting—from vehicles whose performance is such that they can operate in Soviet airspace with greatly reduced chances of detection or interception."[5]

The Project Lincoln report fostered bold new thinking and recommended a departure from the standard method of reconnaissance, which used converted conventional bombers and fighters. Among other things the report urged the development of a high-flying airplane to be used primarily for photographic reconnaissance. The report did bother Colonel Overhage, who became concerned that the role of the Air Force might be diminished if future reconnaissance programs were taken away from the service.

The Air Force Science Advisory Board, led by Gen. Jimmy Doolittle, was asked to evaluate and make recommendations on the Project Lincoln report. The board began by considering reconnaissance options ranging from high-altitude power platforms to a high-altitude dirigible.[6] The board could not agree, however, on the functions of the recommended high-flying airplane. I do not know if President Truman read or knew about the report, but he was certainly disturbed enough about the state of U.S. intelligence gathering at the time to take the initiative to establish a peacetime intelligence service.

Shortly before leaving office in 1953, Truman formed the Net Evaluations Subcommittee to evaluate the net capabilities of the Soviet Union to inflict injury on the United States up to July 1, 1955. His successor, President Eisenhower, received the subcommittee's findings in May 1953. The report was not optimistic. America's continental defenses were judged inadequate to forestall a Soviet aerial attack on the United States using atomic weapons. The report also indicated that the Soviet Union had sufficient bombs and aircraft to inflict serious damage on the United States if the planes were used on one-way missions, especially in a surprise attack. The state of U.S. defenses constituted an unacceptable risk to the nation's survival. Making them acceptable was a large order. Eisenhower inherited a chaotic military beset by turf protection, fiscal infighting, and congressional meddling.

The truce ending hostilities in the Korean War in July 1953 provoked a thorough reexamination of U.S. military and political strategy. Eisenhower, under NSC directive 162-2, inaugurated the New Look program on October 30, 1953. As atomic weapons entered the arsenals of the Air Force and Navy, the entire concept of strategic bombardment underwent a radical rethinking. The New Look concept drew heavily on the product of Jimmy Doolittle's Solarium Project, named after the room in the White House where the project was first discussed in May 1953.[7]

New Look placed greater dependence on long-range strategic air power and greater reliance on nuclear weapons as the primary deterrents to Soviet aggression. The Air Force was the big winner under this policy. Nearly half of the U.S.

defense budget funding was allocated to the Air Force to procure manned bombers and missiles capable of executing a first strike. The Army allocation was reduced to a quarter of the budget. The Marine Corps was threatened with extinction when Gen. Omar Bradley, chair of the Joint Chiefs of Staff, deemed amphibious warfare unnecessary in any future war. The Navy came under attack when SAC commander Curtis LeMay and other Air Force generals argued that the B-36 intercontinental bomber made the aircraft carrier redundant. Further, Le May saw long-range reconnaissance as the sole purview of SAC and fought Navy and Army attempts to play a role in strategic reconnaissance. Flag officers such as Arthur Radford fought this concept and came out swinging with substantial support from Secretary of the Navy James V. Forrestal. The fight over policy direction and control raged through the halls of the Pentagon while Eisenhower attempted to put the conflicts in context.

Eisenhower saw the Soviet Union as a dangerous opponent that appeared to be inexorably moving toward military parity with the United States, but he had little evidence to support that view. An estimate dated March 31, 1953, noted: "Our estimates of Soviet long range plans and intentions are speculations drawn from inadequate intelligence."[8] An estimate dated September 15, 1954, added: "We believe that the USSR will continue to pursue its expansionist objectives and seek and exploit opportunities for enlarging the areas of Soviet Control."[9]

The challenge of developing an intercontinental ballistic missile (ICBM) force was given to the Strategic Missiles Evaluations Committee headed by John von Neumann, the brilliant mathematician of Princeton's Institute for Advanced Study. Gen. Andrew Goodpaster saw von Neumann as a visionary who "studied the growing accuracy of long-range missiles, those capable of intercontinental flight, and the vastly increased destructive power of the new thermo-nuclear weapons. He determined that the two together would be a very powerful force for use against the Soviet Union should its leaders ever start an actual war."[10]

Eisenhower, who also greatly admired von Neumann, made the development of a long-range missile a priority. Colonel Schriever was put in charge of the effort, and the results of his study were presented to the Pentagon in February 1954. Some design issues caused concern, particularly the missile's nose cone. Eisenhower was concerned that the nose cone would not survive reentry into the atmosphere and be able to deliver the bomb. "I don't know if these nose cones will work," William O. Baker reported him saying, "whether we are ever going to be able to use these bombs, if we ever deliver them, if we have to do it."[11] Von

Neumann assured the president that small, lightweight thermonuclear warheads would fit aboard long-range missiles and would survive reentry. Baker related that when an ICBM fired with the test composite nose cone—developed by General Electric at its Valley Forge, Pennsylvania, plant—survived reentry and was recovered in the South Atlantic, Eisenhower insisted they bring the nose cone to his office.

The Strategic Missiles Evaluations Committee called for a crash program to build intercontinental missiles that included the Titan, Minuteman, and submarine-launched Polaris IRBM. The Atlas was already under development at the time.[12]

When the Western Development Division was charged with developing a workable ICBM, the Air Force once again summoned Bernard Schriever for the task. Schriever was a visionary as well as a brilliant innovator. In a speech given on February 19, 1957, eight months before the Soviets launched the first Sputnik, he stated, "My thought is that the evolution of space vehicles will be a gradual step-by-step process, with the first step beyond ballistic missiles being unmanned Earth satellites and then perhaps unmanned exploratory flights to the Moon or Mars. Many of the things that we can learn from satellites will lead not only to a better understanding of conditions to be encountered in space, but will lead to a better understanding of our own planet."[13]

In November 1952 the United States detonated the world's first thermonuclear atomic bomb. President-elect Eisenhower was briefed on the results of the test, code-named "Mike." He was horrified by the power of the blast and was determined to avoid ever using this weapon.

Gathering a Data Base on the Soviet Union

Intelligence professionals often refer to their task as "the trilogy": collecting information, arranging the information into patterns, and extracting the desired intelligence. The CIA's contribution to U.S. security during the 1950s must be judged on the quantity and quality of the data it gathered. When Adm. R. H. Hillenkoetter, CIA director from May 1, 1947, to October 7, 1950, ordered target dossiers created on all Soviet industries and military installations, I was a junior analyst in the CIA's Industrial Register. I met with Admiral Hillenkoetter often to show him the type of data we were collecting. It was his successor, General Smith, however, who gave added impetus to one of the largest government efforts ever undertaken, an effort that involved thousands of collectors and cost millions of dollars.

To process the influx of information the CIA created the Office of Collection and Dissemination (later renamed the Office of Central Reference), the Industrial Register, the Biographic Register, the Graphics Register, the CIA Library, and a liaison unit. The critical unit for target information was the Industrial Register. Countless shards of information gathered worldwide were combined with other highly classified information to create an intelligence base on the Soviet Union. The Industrial Register was designated to select, synthesize, and integrate all of this information into plant files and plant and town folders. The Industrial Register began receiving information from all over the world, only a small portion of which contained current information on Soviet strategic capabilities. By 1955 the files occupied a greater part of the Riverside Roller Skating Arena in Foggy Bottom, which the Industrial Register then occupied.

When Eisenhower became president, intelligence came primarily from thirty-eight sources, listed below in order of importance.

1. *World War II Luftwaffe aerial photographs (GX).* With the cessation of hostilities in Europe, American intelligence officers fanned out across Germany seeking information on German intelligence activities. It was known that the Germans had outstanding photo-taking and interpretation capabilities. Although the Germans had established the Department of Air Photos in the Inspectorate of Reconnaissance in 1942, there was no central facility in Germany such as the Americans and British had established at Medmenham in England. It was believed that a large central print library was at Zossen, just south of Berlin. When American officers arrived, they were told it had been moved.

   During its campaigns in the East, the German Luftwaffe had photographed all of eastern Europe and the Soviet Union up to the Ural Mountains. With the collapse of the Third Reich, the Wehrmacht Command ordered all aerial photography and related documents burned. Allied officers familiar with the value of aerial photography decided to collect whatever remained, and the effort was formalized under Operation Dick Tracy. Intelligence officers visited Luftwaffe and Wehrmacht installations and found about twenty tons of aerial photography in paper print, paper roll, and negative form hidden in eleven locations. A large cache was found in boxes in a barn at Bad Reichenhall. Another cache was discovered at a field headquarters, and a large quantity was found half-burned in barges. Some, also partially destroyed, was even found at Hitler's retreat at Berchtesgaden. The enormous quantity of film and photos obtained in Operation Dick Tracy was shipped back to the United States in leftover footlockers, most often without any identification. The aerial photos continued to surface in Germany for years. As late as 1993, more than one hundred rolls of film were found in the basement of the ruined Frauenkirche in Dresden when reconstruction work began. Research indicated the film had been sent from Berlin to Dresden for safekeeping.

When they reached the United States, the footlockers were stacked one atop another in the Old Torpedo Warehouse in Alexandria, Virginia. I visited the warehouse along with Arthur Lundahl and was appalled to find that much of the film was nitrate based and posed a danger to the structure where it was housed. Nitrate-based film goes through five stages in storage: (1) it turns amber; (2) the emulsion becomes adhesive and the film sticks together; (3) the film further softens and gas bubbles give off poisonous and corrosive fumes that are dangerous to human life and other types of materials being stored; (4) the film welds together into a viscous froth; and (5) the film degenerates into a brownish acrid powder that undergoes spontaneous ignition. The National Archives became aware of the problem when a large fire and explosion of old nitrate-based motion picture film occurred at the Suitland, Maryland, film repository, and proposed destroying all aerial photographs taken during the 1930s along with that from most World War II missions. With the help of Senator Howard Baker and Senator Barry Goldwater, Lundahl convinced Congress to appropriate funds to duplicate the nitrate-based photographs on safety-based film, thus saving a treasure trove of historical information.

We opened several of the lockers, and I noted that most of the film was of the Soviet Union. The U.S. Army Air Corps, and later the Air Force, tried to identify the areas photographed. This batch of photography was given the code name "GX." Before the film could be of any value to the intelligence community, each frame had to be plotted on a chart. A contract was let to two former naval officers, Gomer McNeil and Everett Merritt, who founded Photogrammetry, Inc., in Silver Spring, Maryland. The firm employed some sixty people to identify the area on each frame and plot it on a chart. This photography gave us some idea of Russia's European cities and installations, but we knew that as the German armies advanced into Russia, more than 1,500 Soviet manufacturing plants had been dismantled in Moscow, Leningrad, Ukraine, and the western USSR and sent to the Urals, Siberia, Kazakhstan, and Central Asia. Cities such as Sverdlovsk, Irkutsk, Omsk, Novosibirsk, Ulan Ude, and Tashkent had grown phenomenally, but we knew little about the production operations at these reconstructed or expanded plants.

2. *Prisoner of war information.* Precise figures are lacking, but it is estimated that only about three million of the seven and one-half million Axis prisoners of war captured and sent to the Soviet Union were returned. In addition to the German and Japanese nationals who fought against the Soviets, troops from other nations joined the Axis forces. Rumania, Hungary, Bulgaria, and Italy sent division- or battalion-strength forces. Smaller military units were provided by Finland, Spain, and Vichy France. Large numbers of *Volksdeutschen*—ethnic Germans from Holland, Denmark, Norway, Estonia, Latvia, Bosnia, Croatia, Dalmatia, and Sweden—fought alongside the Germans as well. POW camps holding people of all these nationalities were scattered throughout the breadth of Russia. Thousands of POWs were sent to the dreaded camps of Vorkuta, Karaganda, and the Kuznetsk Basin to mine coal. Thousands of others were sent to the Fergana Valley, Norilsk, and Dalstroy Kolyma to mine nonferrous metals for the industries in the Urals and Siberia. Many POWs were assigned to rebuild the defense factories that had been destroyed during the war in Stalingrad, Minsk, Kiev, and Kharkov. Others were sent to Siberia to expand the plants that had been moved from European Russia during the German invasion; to construct the Vorkuta-Salekhard and BAM (Baykal-Amur Magistrate) rail lines; and to do the dirty work in chemical and munitions combines.

   The Russians began releasing some German, Japanese, Italian, and Austrian POWs in 1948 and continued doing so into the late 1950s. These released POWs constituted a valuable source of information on the Soviet Union. Interrogation centers were established near ports or railroad stations to process the returning POWs, and a massive effort was begun to glean every scrap of information they could provide on Soviet industrial installations. Japanese POWs were interrogated in Japan by Gen. Douglas MacArthur's intelligence organization, headed by Maj. Gen. Charles Willoughby. Reports came in from the Far Eastern Command, U.S. Forces Austria, and the British on the Rhine in the British Zone of Germany. POWs were interrogated by U.S. forces at the European Command as well, but by far the largest interrogation operation ever undertaken was the U.S. Air Force Project Wringer.

3. *Dragon Returnee.* Beginning in about October 1946, Soviet NKVD officers began rounding up some 1,500–2,000 German scientists, engineers, and workers in the fields of missiles, aviation, nuclear technology, electronics, and chemistry and relocating them to the Soviet Union. Intercepted letters told us that a number of German scientists were being held on Gordodomlya Island in the Seleger Sea, northwest of Moscow. Missile and engine specialists were kept in the Moscow area to work in several important plants. Nuclear specialists were sent to installations in Sinop and Agudzeri near Sukhumi, in Georgia. The Russians were squeezing the Germans until they had no more information to give on their areas of expertise.

   After they had told the Soviets all they knew, the scientists were detained for more than a year—"cooled off"—before they were repatriated to East or West Germany. Interrogations told us that those who returned to West Germany possessed solid information on Russian missile and nuclear research and development complexes, along with what the plants produced. The United States and Britain established a large-scale interrogation effort called Dragon Returnee to interview the repatriated scientists. Intelligence experts in the fields of missiles, aircraft, and atomic energy conducted interrogations with translators present. Intelligence analysts were surprised on two fronts by what they learned. First, the Russians were moving ahead with an ICBM program and an elaborate space program; second, the caliber of the Soviet missile and nuclear scientists was far greater than expected. British, American, Canadian, and Australian intelligence services met frequently to sort out information obtained from the interrogations, some of which was later used to target U-2 missions.
4. *Defector Reception Center.* The CIA set up the Defector Reception Center at Camp King in West Germany to interrogate Russian and East European military defectors. Although most were enlisted men, the defectors provided a wealth of information on Soviet military units in Germany, the Soviet order of battle, and the readiness status of Soviet forces. Some Russian defectors provided valuable information on military training organizations within the Soviet Union.
5. *Displaced Russians.* Many Russians who had been forced to work as slaves in German industries during the war did not want to return to Russia afterward and were willing to be interrogated. Of special interest were those who had lived and worked in industries in the Urals, Siberia, Kazakhstan, and Central Asia.

6. *Spanish repatriates.* After the defeat of loyalist forces during the Spanish Civil War, a number of Spanish Communists went to Russia. In the 1950s and 1960s a small number were allowed to return to Spain. With the cooperation with the Spanish government, some were interrogated. While most were common workers who did not provide anything of strategic value, they did furnish information on cities and industries where they had been employed.
7. *Special Document Section.* The U.S. Army established the Special Document Section (SDS), staffed with German and Japanese linguists, at Camp Ritchie and later Fort Hollabird in Maryland to translate German and Japanese documents related to the Soviet Union. The documents judged to be reliable included detailed German target dossiers, intelligence documents, and aerial photographic reports on Soviet cities and industrial installations.
8. *Air Information Division.* The U.S. Air Force established the Air Information Division in the Library of Congress. All of the library's holdings on Russian and East European magazines, newspapers, journals, and books were collected, and a battery of Russian and other linguists—most without security clearance—translated any items that had information on Russian industries. Thousands of "flimsies," usually one-sheet reports, were created from this information and distributed to intelligence organizations. Each flimsy provided the name and location of the plant or industry and usually indicated what was produced or the accomplishment noted in the article. These reports were particularly helpful because they gave the proper name of the installation, listed key personnel, and often cited awards or visits by important Russian officials.
9. *Air Research Division.* This Air Force division, also in the Library of Congress, was staffed mainly by Americans who were cleared to the secret level and familiar with the creation of target folders on Soviet cities and industries. They collected all the photos, maps, diagrams, and sketches produced by the Air Information Division and were also permitted to use aerial photos and information from the files of the CIA's Industrial Register. They combined these resources to produce town plans of Soviet cities along with descriptions of the industries within the cities. One member of this unit, Earl Shoemaker, later joined the CIA's Photo Intelligence Division.
10. *Office of Strategic Services files.* When President Truman disbanded the OSS in October 1945, boxes of intelligence reports on Eastern European countries were left behind. During World War II the OSS had collected thousands of

photos of foreign cities and industries from U.S. repositories, private agencies, and citizens who had traveled abroad. The photos were collected, catalogued, and reproduced. There were a few reports on Eastern European plants (Skoda, for example) and several on the Soviet Union. The photos were stored in boxes in one of the temporary buildings along the Mall in Washington, D.C. Personnel awaiting CIA clearance reviewed the photos and reproduced those of interest. I worked nearly three months on such photos. Many were of the "Aunt Millie" variety—a person, usually a woman, photographed in front of a famous building or industrial installation. The best photos found their way into the Industrial Register's plant and town folders.

11. *Mar-Geo and Mil-Geo.* Mar-Geo (sea) and Mil-Geo (land) were Nazi organizations of specialists in geography, geology, transportation, terrain, and oceanography formed by the High Commands of the German navy and army. Mar-Geo prepared special coastal maps of occupied Europe that embodied features of both nautical charts and topographic maps. Mil-Geo's mission was to create maps, charts, and collateral information on areas the Germans occupied or planned to occupy. The organizations drew on existing topographic, nautical, and special maps; scientific literature; aerial photographs; field inspections from the air and ground; and personal knowledge. Photographs, maps, and descriptive information on towns, cities, rock types, vegetation, roads, railroads, harbors, and anchorages were placed in book-sized folders to be used by commanders in the field. The Mil-Geo studies of the Soviet Union were especially valuable initially to the CIA and later to the Army Map Service and the Aeronautical Chart and Information Center. After they were no longer useful, the folders were deposited in the Library of Congress.[14]
12. *Allied World War II aerial photography.* During World War II, Allied bombing and reconnaissance units photographed targets in Germany, Poland, Bulgaria, Czechoslovakia, Hungary, and Rumania, which all became satellites of the Soviet Union after the war. Target folders created during the war were updated and became the basis for new targeting efforts. We also reviewed aerial photographs of the Soviet Union taken by Allied forces during a brief period when shuttle-bombing missions from Italy and England were flown over distant German targets and landed in the Soviet Union.
13. *Berlin corridor aerial photography.* The first active postwar reconnaissance program involved aerial photographic flights over the Berlin corridor, three

twenty-mile-wide corridors established under a protocol signed by Eisenhower and Marshal Zhukov that provided airspace for U.S., French, and British aircraft to supply their garrisons in Berlin. Although the four-power agreement governing the use of the Berlin corridor did not prohibit any specific type of aircraft, the Russians maintained that access to Berlin was only to support Allied garrisons. The flights were controlled by the USAFE 7499th Support Group at Wiesbaden Air Base, Germany, and, at times, at the nearby Rhine-Main Airport. In addition to the Berlin corridor flights, the 7499th operated aircraft over the Baltic, Adriatic, and Black seas; along the border of East and West Germany; and on airways over Yugoslavia. The reconnaissance flights over the corridor began in 1947 with K-20 World War II handheld cameras; later the United States outfitted cargo aircraft with covertly mounted cameras. From that point until Germany was reunified, the Air Force flew a variety of cameras with focal lengths ranging from 6 inches to 240 inches in RC-47s, RC-54s, RT-29s, RC-97s, and RC-130s. Camera-equipped aircraft flew nearly every day over six key Soviet army installations and eight airfields. The covertly configured cargo carriers did not fool either the East Germans or the Russians. Though sliding external panels covered the camera ports, the lens barrels could be easily spotted when the portholes were opened. Soviet fighters frequently flew near the aircraft when the camera ports were open.

As the Cold War progressed, aircraft flying the Berlin corridor produced volumes of valuable imagery. Known by different code names in the intelligence community, the corridor flights were most commonly referred to as either Red Owl or, later, Creek Misty, but Bold Bantam, Ocean Gem, Flintstone, Eager Beaver, Creek Flea, and Creek Flush were used as well. This photography was immensely valuable for a number of reasons, but primarily because it gave the intelligence community a sense of the time it took the Soviets to prepare for maneuvers, conduct training exercises, and practice river crossings. Since crack Red Army divisions were involved, analysts were also able to view new Soviet military equipment being delivered and deployed. They also obtained information on Soviet tank and motorized rifle divisions of the Group of Soviet Forces, Germany (GSFG), which were armed with the latest weapons and were sometimes at a high state of readiness.[15]

The 497th RTS in Schierstein, on the Rhine River near Wiesbaden, analyzed the images and sent copies to the States. High-quality Berlin corridor photographs were especially valuable in training photo interpreters and became extremely important during the Cuban Missile Crisis, when some feared that the Soviets would put pressure on, or possibly take, Berlin. The British and French also flew aerial missions in the corridor with a variety of cameras—some installed, some handheld.

14. *U.S. plants and Lend-Lease plants in the Soviet Union.* In 1924 the Soviets established an organization (Amtorg) in New York to hire U.S. firms to design plants and to purchase entire U.S. plants that came on the market. The latter included all the manufacturing equipment of Ford's large River Rouge plant after it ceased producing Model A-AA automobiles. Ford workers were sent to Russia to help build the Gorki automobile plant. Among them was Walter Reuther. Ford also shipped chassis to be assembled at the AMO (later the Zavod Imeni Stalin [ZIS]) plant in Moscow and helped establish the KIM (later the Moskvitch) plant. When the Ansonia Clock Company of New York went broke during the Depression, the Soviets bought it and rebuilt it in Moscow. The Duber Hamden Watch Company of Canton, Ohio, was likewise dismantled and rebuilt in Moscow. During World War II the Badger Company of Boston built Lend-Lease oil refineries at Orsk, Krasnovodsk, Guryev, and Krasnodar. The Universal Oil Products Corporation constructed catalytic cracking facilities at Ufa, Saratov, and Grozny. The Austin Engineering Company of Cleveland, Ohio, designed not only the Gorki automobile plant but also the Magnitogorsk and Stalinsk steel complexes. General Electric provided the generators for the Dnepr Dam, and the Caterpillar Tractor Company provided information for constructing a tractor factory in Stalingrad. Some of the design work for the construction of the Nizhniy Tagil railroad car building works was done in the United States. When approached by the CIA, many of these firms provided blueprints of the plants they had helped construct. The skilled American workers Amtorg recruited to aid in constructing these plants also provided information when they returned home.
15. *German prewar aid to the Soviets.* The Treaty of Versailles forbade the Germans to develop an air force or an armored force, or to conduct experiments with chemical warfare. From the 1920s until Hitler came to power in 1933 the Germans cooperated secretly with the Russians and built a number of military installations in the Soviet Union. Among them was a large secret airfield near Lipetsk where both German and Russian aviators were trained. A large armored training and experimental center was established at Kazan;

a chemical warfare training area was built near Volsk/Shikany; a Junkers aircraft plant and an aircraft engine plant were constructed in Moscow; and armament plants were constructed in Tula and Sverdlovsk. Captured German documents provided details on a number of these installations.

16. *Dismantled German strategic industrial plants.* After the war, the Soviets dismantled many German missile, aircraft, armament, chemical warfare, and research establishments and relocated them in newly constructed or expanded plants in Russia. German technicians often went along with the equipment. When they returned, they provided details on where the equipment had gone. German POWs employed to help reconstruct these plants were interrogated as well.
17. *Gen. Reinhard Gehlen files.* Reinhard Gehlen, an influential intelligence chief in Nazi Germany, foresaw the demise of Germany and defected, taking with him several Soviet files that he turned over to Allied officials. The most important file pertained to the Soviet military order of battle. When translated, it was found to contain information on prominent army divisions and battalions along with their locations, equipment, and the various honors they had received. While we knew that the wartime information could have dramatically changed, it was of substantial help in locating and identifying Soviet military units.
18. *Joint Factory Markings Center.* This effort began with the capture of Russian material in Korea in the form of arms, ammunition, tanks, and vehicles. Military equipment and ammunition bore a trademark, a logo, a plant number, a batch or serial number, and a date. The CIA established the Joint Factory Markings Center with a group of experts in Washington who deciphered the markings and numbers on the captured material. This information gave the Agency some indication where the armament plants were located in the Soviet Union. Soviet military equipment was kept in a special area at the Aberdeen Proving Ground in Maryland. Each piece of equipment that had a trademark or special marking number was photographed and catalogued. A number of CIA personnel visited the facility, and the Army put on a special show that included driving trucks over the test area and firing tanks. Markings Center personnel also visited trade shows, military displays, and parades in countries that had Soviet equipment. Detailed analysis of the markings data—especially dated ammunition—often produced the location of plants and production rates.

In one of the biggest intelligence coups ever, experts from the Markings Center temporarily kidnapped the Soviet Lunik satellite while it was on display at a trade fair in Mexico. They managed to get it to a warehouse, dismantle it, record all factory markings, repack it, and get it to the trucks that were to transport it to the next exhibition without the Soviets ever realizing that it was missing.[16] The CIA experts were able to measure the vehicle and estimate that its loaded weight would be 18,000 pounds—enough information for estimators to calculate the throw weight of the Soviet SS-6 missile.

The marking efforts project received a big boost when a defecting Communist pilot delivered a MiG 15 to Allied forces in September 1953, reaping a large financial award. Experts determined that while the MiG's electronics and engine technology were behind those of the United States, it was nevertheless a well-designed aircraft. Aircraft marking specialists from the Air Force's Foreign Technology Division in Dayton, Ohio, along with experts from the Markings Center analyzed a number of captured or purchased Soviet aircraft and missiles.

19. *Trade fairs.* When the Soviets began showing a variety of military and civilian equipment at trade fairs, the CIA secretly purchased some of the electronic and technical equipment and analyzed it for factory markings and performance. CIA agents sometimes stole the passport that came with the equipment because it provided information about where the equipment was produced. Often the passport even had a serial number. Brochures passed out at trade fairs were collected and placed in target folders. Brochures about Soviet agricultural machines were particularly interesting because the factories that produced them also had lines for producing military equipment.
20. *Foreign Broadcast Information Service.* A holdover from the OSS, the FBIS monitored overseas broadcasts by Communist countries for the CIA and published daily bulletins for the intelligence community. Of special interest were Soviet production and honor awards because they provided indications of the efficiency of the plant.
21. *Foreign Documents Division.* The FDD, also a CIA division, had representatives abroad who collected open-source Soviet materials such as newspapers, magazines, travel books, maps, postcards, government reports, scientific research reports, and journals dealing with industrial processes that often contained targeting information. These same materials were also purchased from commercial vendors in the United States. The Soviets had a large store in New

York that FDD agents periodically visited. FDD staff produced digests of the division's acquisitions and provided translations.

22. *Domestic Contact Service.* The DCS, part of the CIA, had offices in Washington, New York, and San Francisco and solicited information from travelers who visited Iron Curtain countries. Citizens traveling to the Soviet Union on business or to attend meetings, or who had contact with scientists and engineers, were often briefed on what to look for and what questions to pose to their foreign counterparts. When they returned, DCS agents interrogated them and reported on their findings.
23. *U.S. Military Liaison Mission to Commander in Chief, Group of Soviet Forces.* Formed in 1947 and maintained in a lakeside villa in Potsdam, the USMLM comprised fourteen highly trained U.S. intelligence officers who traveled constantly in order to photograph and report on Soviet military equipment on roads, in installations, and beyond secure fencing. Most important, they also reported indications and warning intelligence. They carried "binoculars, cameras with an endless array of lenses, video cameras, tape recorders, night vision goggles, compasses, maps and charts."[17] The agents photographed newly introduced combat vehicles, aircraft, and missiles. Particularly valuable were photographs of Soviet military convoys, which showed not only Soviet equipment but often the type and amount of equipment that made up a unit. The USMLM obtained valuable information on individual pieces of Soviet command, control, and communications equipment. Agents' attempts to photograph Soviet and East German military installations, field training areas, river crossings, and activity at railroad sidings frequently brought them into direct contact with soldiers guarding the installations. They were often threatened and more than once fired on. The USMLM's administrative, communications, briefing, mission planning needs, and a full photo lab were in a large building in West Berlin originally built for the German General Staff.
24. *BRIXMAS* (*British Commanders in Chief Mission to the Soviet Forces in Germany*). Using a variety of aircraft, but especially DHC-1 Chipmunk trainers, this unit captured fantastic small-scale aerial images of Soviet equipment in the Berlin corridor and along the northern border between East and West Germany. Ostensibly used to keep up the flying abilities of RAF personnel, Chipmunk trainers were flown at low levels and carried a two-person crew: the pilot and a photographer with a handheld camera. The aircraft often flew outside the corridor when Soviet military exercises were under way.

25. *Travel Folder program.* U.S. military attachés accredited to the Soviet Union constituted the only military collection effort against Soviet targets, but their efforts were often sporadic and poorly coordinated. While they did provide some information on activities in the cities they were allowed to visit, there was no formal organization to forward collection requirements to them. The situation changed when the Department of Defense created the Travel Folder program, which sent a folder on each Soviet city to the U.S. attachés in Moscow. The folder outlined information Washington wanted for each city. As the attachés walked, used streetcars, or motored in Soviet cities, they made careful note of activities along the routes they traveled. In Moscow and Leningrad they attempted to walk different routes each day, supposedly for exercise. The attachés invented all kinds of excuses for taking trips to Russian cities. One might file a request to visit the cemetery holding American sailors who died on the American convoys transporting supplies to Murmansk during World War II, for example. Not coincidentally, the cemetery afforded an excellent view of the naval port. Requests to visit historic monuments in Leningrad were common as well—the journeys actually intended to observe activities at the shipyards. Trips to visit the large monument to the battle of Stalingrad were an excellent way to observe tractor and armament plants.
26. *Attaché's photos.* U.S. attachés were trained to use cameras for various purposes. The May and October Moscow parades provided two important sources of Soviet military information. Attachés would be positioned in various parts of the city to get both overall and close-up photos of Soviet military equipment, especially the missiles. The parades usually featured the latest aircraft as well, and attachés were positioned on the roof of the U.S. embassy, across the street from the Kremlin, with an array of still and movie cameras to photograph the craft as they flew by. When the Soviets held air shows at the Tushino Aerodrome near Moscow, attachés were dispatched to photograph the aircraft on the ground and in the air.
27. *British reconnaissance photography.* The British operated Joint Air Intelligence Reconnaissance Centres (JARICs) in several areas of the world. JARIC Near East at Episkopi, Cyprus, provided detailed reports on the conflicts between the Greeks and the Turks and acquired aerial photographs of Middle Eastern states. JARIC Far East at Seletar, Singapore, reported on border incursions and the activities of Communist China in Malaya. A JARIC unit in Hong Kong photographed Chinese coastal areas. Images acquired by RAF Dum

Dum in India were interpreted by the Central Photographic Interpretation Centre at New Delhi, which also provided valuable information on China-India and India-Pakistan border areas. RAF aircraft were flown out of Heliopolis, Egypt, to cover Egypt-Israel border problems.

28. *Communications intelligence.* COMINT information derived from National Security Agency intercept, decryption, and analysis of foreign communications was disseminated and stored in the Special Register of the CIA's Office of Central Reference. This information required special security clearance and was valuable in identifying personnel, organizations, and plants engaged in the production of strategic weapons.
29. *Electronic intelligence.* ELINT, acquired by the Air Force and the Navy, was based on the interception and analysis of radar and other signals associated with defense and was valuable in pinpointing radars in the Soviet defense system.
30. *Telemetry intelligence.* TELENT was a new system for the collection and analysis of telemetry derived from missiles in flight.
31. *Joint Intelligence Center, Pacific Ocean Area files.* During World War II, JICPOA maintained folders on Chinese, Japanese, and Russian cities. The folders contained aerial and often ground photographs along with photo interpretation reports. Of interest were Sakhalin Island and the other islands the Soviets had taken from the Japanese. Target folders on cities and industries in Manchuria were also valuable.
32. *Outhouse intelligence.* When we needed data on possible nuclear research activities or production plants in the Soviet Union, attachés devised clever ways to collect it. An attaché traveling in a remote area, for example, would stop along the route downwind from a suspected nuclear installation and go into a wooded area supposedly to relieve himself. Normally, the KGB agents who accompanied the attachés did not think it necessary to observe this activity and would remain in their car. The attaché would drop his pants, grab a clump of grass with roots, and pretend to use it as toilet paper, then place it in a plastic bag and send it back to the United States for analysis. The roots and soil samples would offer clues about what was occurring at the nuclear installation.

    There were several nuclear research installations in Moscow, and captured German sanitation documents indicated where refuse from these installations was being discharged into the river. On a dark evening, an attaché pretending to be drunk would walk along the river and stop, supposedly to drink from a bottle. The bottle, with a string attached, would be tossed into the river where the sewer discharged and would quickly sink. Pretending to vomit, the attaché would retrieve the filled bottle, hide it in his coat, and later send it back to the States for analysis. Attachés traveling on the Trans-Siberian Railroad would purchase radishes and turnips sold by vendors at railroad stations. The Russians were always surprised when the attaché took the vegetables with the most dirt on them rather than the clean ones. Attachés bought more than the usual amounts of vegetables at Krasnoyarsk and Novosibirsk, where known atomic energy plants were located. During Vice President Richard Nixon's visit to the Soviet Union in 1959, Ray Garthoff, a translator, scooped up soil samples in all the principal cities the president's party visited.

33. *Ground photos.* Postcards and travel books were good sources of ground photos, as were photos taken by Western tourists, attachés, and covert sources. Ground photos were of particular value combined with other photos. A large number of ground photos collated with aerial ones formed a comprehensive base of information about a plant or area that provided details on the nature of construction that were used in targeting efforts.
34. *Project Paperclip and Project Overcast.* U.S. forces in Europe conducted an extensive search of German installations after the war to recover equipment and locate scientists who had been involved with nuclear and missile projects. Project Paperclip involved a number of prominent scientists, including Wernher von Braun, who were rounded up at Oberammergau in Bavaria and sent to the United States for interrogation. The Guggenheim Foundation provided the Jay Gould medieval castle at Sands Point, Long Island, as a special office and lodging for them. The scientists provided information on the latest German advances in missile and aircraft technology along with a wealth of biographical information. Von Braun and a number of scientists who worked for him were sent to Fort Bliss, Texas. Some, including von Braun, helped U.S. technicians prepare V-2s for launching at the While Sands Proving Ground in New Mexico. Thousands of blueprints, models, and prototypes of new aircraft and missile systems found in the Nordhausen Mittelwerk missile plant in Germany were used in interrogating the German experts. A number of German innovations were incorporated into U.S. aircraft and missile systems. At the end of the war, the German submarine U-234 en route to Japan surrendered to U.S. forces. Project Overcast examined the drawings and blueprints of

new German airplanes, electronics, fire control equipment, radios, radars, and radar equipment in the submarine to be used by the Japanese in the Pacific war.

35. *Covert shipboard photography.* Foreign seamen under contract to the CIA took hundreds of photos of ports and naval bases around the world. Photos taken in countries receiving Soviet military and industrial equipment were of special interest. Port security was often lax in developing countries, and the seamen obtained excellent images; those taken from crow's nests provided excellent oblique coverage.
36. *Periscope photography.* The Navy first placed regular cameras in the eyepieces of periscopes during World War II and continued developing the cameras afterward. Capt. J. H. McElroy called the Mark 4 periscope camera "an invaluable contribution to military intelligence."[18] Submarines photographed Soviet vessels at sea during the Cold War at every opportunity.
37. *Prominent officials and travelers.* Prominent travelers provided invaluable information prior to the Cold War. Our first view of the Soviet Far East came from Vice President Henry A. Wallace's trip in the summer of 1944 described in his book *Soviet Asia Mission*. Averill Harriman and other U.S. ambassadors traveled to places not previously visited by attachés. Senator Allen Ellender became friendly with Khrushchev and was allowed to visit spots forbidden to U.S. attachés. Later, during Vice President Nixon's visit to the Soviet Union, Ray Gartoff took a number of photos that we processed and interpreted with him at the Photographic Interpretation Center. Some travelers, such as cabinet member Stewart Udall, were provided with high-quality cameras to photograph installations of intelligence interest.
38. *Operation Gold—Berlin tunnel information.* During the early 1950s the CIA and British MI-6 knew that most Soviet-bloc telephone and teletype circuits passed through Berlin. They built a tunnel to tap into the lines and monitored Soviet communications from 1955 to 1956, when the Soviet discovered the tunnel. Only in 1961 was it revealed that the operation had been compromised right from the start. George Blake, a member of MI-6 who was also a Soviet agent, informed the Soviets of the tap, and they used it to funnel useless or misleading information to the West. After the operation was compromised, all of the documents with information from the tap were stamped with a warning about its possible inaccuracy.

THREE
cold war overflights

> Strategic surprise is caused not by one wrong hypothesis but a set of misconceptions.
>
> *Ephraim Kam*

Long before the introduction of the U-2, American and British aircraft flew "spy flights" over and around the Soviet Union to learn more about Soviet defenses and to accumulate information that could be used to penetrate those defenses in the event of war. Three different types of missions were conducted: ferret missions, radar scope missions, and photographic missions. They were carried out under a variety of code names and security levels. Most were flown along the periphery of the Soviet Union, and their success depended on avoiding Soviet defensive systems. Not a single Soviet strategic installation was photographed, however, because such complexes were located in the hinterlands.

Ferret Missions

The first ferret mission was flown in a modified B-24D in March 1943 to collect data on Japanese radar on Kiska Island. The flight was dubbed "Ferret 1" after the domesticated polecat that enters the lairs of rats and other vermin and chases them out in the open where they can be killed, and the term "ferret mission" has continued in use through the years.

The first airborne reconnaissance missions using RB-29s against the Soviet Union began in 1946 when the 46/72 Strategic Reconnaissance Squadron based at Ladd Air Base in Alaska began collecting radar and photographic intelligence along the periphery of the Chukchi Peninsula. When another RB-29 flew along the Chukchi coast on December 25, 1947, the Soviets protested that the aircraft had flown within their twelve-mile territorial limit. The United States did not recognize territorial limits extending beyond three miles at sea, and the State Department denied that any violation had occurred. Territorial limits were a contentious issue for a number of years. For example, the State Department "viewed with great concern" Gen. Lauris Norstad's May 19, 1948, proposal to take aerial photos of the Soviet coastline from the twelve-mile limit.[1] The State Department upped the distance to forty miles, then reduced it to twenty miles provided there was a sufficient intelligence requirement to justify the risk. The experimental K-30 100-inch-focal-length camera, the only one that could produce photos of any value from twenty miles out, was installed in an RB-29, whose pilot was instructed to fly at 25,000 feet in a straight line twenty miles offshore. The resultant images left a lot to be desired but "disclosed no extensive build-up of facilities which would indicate preparations for an attack against the United States."[2]

A number of sources indicated that the Soviets had been more active than other countries in developing their Arctic territories and were willing to bear the exceptional costs involved in doing so. There were vast areas of Siberia that we knew absolutely nothing about. In the early 1950s the issue came to the forefront when the Soviets began building fighter and bomber bases in the Arctic. The bases were supplied by a river and sea transport system known as the Northern Sea Route. The Soviet Arctic shipping route stretched 1,740 miles along the Soviet Arctic coast from Novaya Zemlya to the Bering Strait, with connections to Murmansk and Pacific ports. Several hundred ships used the route during the two to four months it was navigable each year. Convoys of ships usually left Soviet far eastern ports in July and August accompanied by icebreakers and aided by aircraft and helicopters to spot the course from above.[3]

When U.S. reconnaissance aircraft began to reconnoiter the periphery of the USSR, the Russians moved MiG fighters to bases along their coastal borders from the Kola Peninsula in the west to the Chukchi Peninsula in the east and southward along their Pacific coast. Air bases were constructed at Provideniya, Artem, Vankaren, Mys Schmidta, Pevek, Tiksi, Norilsk, Dickson Island, and Vorkuta. When the Soviets began staging their Tu-4 Bull bombers and MiG fighters to and from these airfields, Americans were alarmed. The proximity of the air bases to U.S. soil combined with the fact that the Soviets had an atomic bomb had a substantial impact on both Truman and Eisenhower. There was no information indicating that the Tu-4s were capable of aerial refueling, but when they took off from northern airfields they were within range of striking targets in the continental United States on one-way missions. Pearl Harbor had an enormous influence on American political and military leaders, who understood that the Russians were equally capable of a surprise attack. Without refueling, bombers from Provideniya and Anadyr on a 3,200-mile mission could strike all of California as well as bases in Arizona. Soviet aircraft flying from air bases on the Kola Peninsula, again on a 3,200-mile, no-refuel mission, could reach Chicago and New York. If the bombers could refuel in the air, the entire United States was vulnerable.

The threat of a bomber attack from Siberia or the Kola Peninsula, areas we knew little about, prompted the military to seek permission from President Truman for reconnaissance flights. JCS chair Gen. Omar Bradley pressed for deep penetrations of the Soviet Far East and Siberia. On August 12, 1952, Secretary of Defense Robert Lovett delivered to President Truman a memorandum from Bradley and CIA director Gen. Walter Bedell Smith requesting two overflights of Soviet Siberia. Truman approved both—one over Siberia's northern shore and the other over the eastern shore—and on October 15, 1952, a KC-97 and an RB-47 took off from Eielson AFB in Alaska and flew over northern Russia, exiting over the Chukchi Peninsula. The photographs of Provideniya's airfield were the first I was privileged to see in the sensitive intelligence (SENSINT) category. This flight established the precedent and framed the policy for future overflights. Directed by the Air Force or the Navy, the flights were known collectively as the Peacetime Airborne Reconnaissance Program, or PARPRO. I later saw photographs of airfields in the Murmansk area and photographs from later flights in the Pacific over Sakhalin Island, and four other former Japanese islands the Soviets had occupied.

Thus began a series of highly classified missions over the Soviet Union and the People's Republic of China about which little has been written and much remained secret until the Early Cold War Overflights symposium, chaired by R. Cargill Hall, took place in Washington, D.C., on February 22 and 23, 2001. A number of the people who were involved in many phases of the program participated, and a great deal of information finally saw the light of day.

In the early 1950s there was virtually no coordination of military reconnaissance activities, even within individual services. Theater commanders and commanders of unified and specified commands conducted independent reconnaissance activities. Each mission was supposed to be approved by a higher authority, but people in Washington often knew neither the kind of mission nor its location. It was generally believed that Eisenhower authorized overflights in principle but delegated approval authority to service chiefs and eventually to theater commanders. It is difficult to discern where the Joint Chiefs of Staff fit into the picture. It appears that approval was given when the chief of naval operations or the Air Force chief of staff met with the president. The tasking would then move down the chain of command to a unit or an individual pilot or flight crew that would conduct the mission. No one else was privy to the information until the flight was completed. Even when photography was received in Washington, it was not clear which organization had acquired it.

Andrew Goodpaster, who was directly involved, recalled "that authorizations were handled by direct, very brief comments between Eisenhower and [the] chairman of the Joint Chiefs of Staff, either Admiral Arthur W. Radford or U.S. Air Force General Nathan F. Twining. I do not recall specific discussions regarding time limitations or the numbers or types of aircraft or specific regions targeted for overflights. But I do recall that once the overflights began, the Soviets began to protest, their accusations becoming more severe and more precise regarding details of these overflights."[4] The State Department, which had to deal with the Soviets' protests, was often completely in the dark. Gen. Jacob E. Smart, the director of operations for the Air Force Far Eastern Command (FEC), described the process in his command as follows: "Once the President approved an overflight, authority to proceed was passed through channels to the operational unit. In Far East Air Forces, we selected the optimum date and time for each mission based on a wide range of factors including sun-angle, weather, status of crew, aircraft and equipment, perceived activity in the target area, preparedness of supporting units—notably real-time intelligence gathering, air/sea rescue, etc.—all with care to avoid alerting friend, foe, or the media that something unusual was underway or planned."[5]

Because no single government organization was in charge of the reconnaissance flights, there was no central repository for the reports created as a result of them. Although I would be informed that an overflight had occurred, I had a devil of a time trying to find what organization was producing the report on it or where the images could be obtained. The secrecy that shrouded flights was so tight that even today no one knows how many flights occurred or how many reports were prepared. There are no written SENSINT records on them, either classified or unclassified, in the Dwight D. Eisenhower Library. The FEC flights always posed problems for CIA analysts. Although we were told that a flight had taken place, the FEC would not admit it and never released images or reports. Months later we would receive a series of "town plans" of Soviet and Chinese cities that we knew were based on a SENSINT flight.

These were dangerous missions. Most of them were beyond the range of search and rescue efforts, yet they were considered vital to the defense of the United States. Goodpaster, for example, was firm in his belief that "our view then, and it would be my view now, is that we had to do it."[6] When a flight was shot down near or over the Soviet Union, Moscow refused to reveal any meaningful information about the fate of the plane or the missing crew, although in some cases we had reason to believe that some crew members survived.

The overflights flown along the periphery of the Soviet Union were intended to "excite" the Soviet radar defense installations and record their signals. This information allowed U.S. analysts to determine the precise location and capabilities of electronics and radars along Soviet borders. The fact that the Soviets had few early warning radars along their northern border was "operationally significant," Goodpaster noted, "in case we should ever get into a conflict."[7]

Using primarily Boeing RB-47 Stratojets, SAC controlled the lion's share of the missions. SAC had three strategic reconnaissance wings engaged in peripheral reconnaissance. The 26th Strategic Reconnaissance Wing (SRW) based at Lockbourne AFB in Ohio, which was combined in 1958 with the 55th SRW at Forbes AFB in Kansas, was equipped with twenty-nine RB-47Hs, three ERB-47 laboratory ELINT aircraft, and three B-47Es. Aircraft from Lockbourne and Forbes were frequently flown from Ladd and Eilsen. Operations were later transferred from Ladd to Eielson in Alaska, which normally had two RB-47Hs and two KC-135 tankers for missions around the Soviet Arctic, Kamchatka, and Petropavlovsk areas. Much later, long-range oblique photographic missions were conducted with U-2s under Operation Congo Maiden. A third wing was established at the 4080th SRW at Laughlin AFB in Texas. The 4080th had twenty-four U-2s —twelve configured for photographic missions, four for ELINT, two for high-resolution radar photography, and six for high-altitude atmospheric sampling. U.S. forces frequently staged reconnaissance missions from Brize Norton Air Base in England to the Barents and Baltic seas and along the borders of West Germany. Missions usually involved an RB-47H and a KC-135 tanker. More spacious RC-135 aircraft capable of carrying a crew of thirty entered the inventory in 1961. All were subsequently assigned to the 55th SRW at Offutt AFB in Nebraska, although they were often deployed to alternate bases on Hawaii (Hickam AFB), Guam (Anderson AFB), and Wake or Johnson islands.

The U.S. Navy was also engaged in these monitoring efforts, using PBM, P4M-1, PB4Y-2M, P2V-3W, P2V2, WV-2Q, and A3D-2 patrol planes. A VP

931 Squadron established on Whidbey Island, Washington, flew a number of missions from the Kodiak Island Naval Base. These aircraft carried a large array of electronic devices.

Radar Scope Missions

The second of the three types of missions involved obtaining radar scope images of targets. The images were used to prepare radar ultrasonic trainer (RUT) plates. The plates, which were about a yard square, sat on a Plexiglas sheet imbedded with a variety of strips of metals—such as copper, silver, and gold—that represented the radar returns from a designated target. The sheets were mounted on a pedestal near the floor, and bombardiers assigned to the target would make bombing runs across the Plexiglas target mockup atop a long-legged vehicle that looked like a log carrier. With the trainer, a bombardier could practice various approaches to the target. The images could also be used for strategic purposes in the event of war.

Photographic Missions

The earliest overflight of Soviet territory occurred on January 19, 1951, when a U.S. Air Force reconnaissance aircraft overflew a portion of Sakhalin Island. Soon afterward an RB-50E out of Alaska carried a 100-inch-focal-length camera to photograph coastal areas of the Chukchi Peninsula. Photographic missions were flown from a number of bases and carried a variety of cameras employing the latest technology that allowed the acquisition of high-acuity long-range oblique images of areas inside Soviet borders. "Penetration photography," as it was called, occurred along the northern and Pacific borders of Russia. After diplomatic protests failed, the Soviets began an aggressive air defense policy against the flights, deploying MiG fighters to several northern airfields.

Eisenhower authorized a number of photographic missions as part of the SENSINT program, a closely held and compartmented effort involving only military aircraft. The film acquired was labeled "TOP SECRET SENSINT" on both the leader and the trailer, and also carried a code word marking. One of the most common ones I remember was "TOP SECRET WINDFALL."

Some people have alleged that the SENSINT flights were rogue missions secretly carried out by SAC commander Gen. Curtis LeMay to provoke the Soviets into a war. Paul Lashmar's *Spy Flights of the Cold War*, for example, quotes General LeMay's remark to Col. Hal Austin as the colonel was about to make a penetration flight over the Kola Peninsula. "Well, maybe if we do this overflight right, we can get World War Three started."[8] When Colonel Austin reminded LeMay of his statement in the 1980s, LeMay supposedly replied, "Maybe we'd all have been better off if we'd got it over with then."[9] Those of us who knew LeMay and were familiar with his style agree with Lashmar that LeMay was a "hard line hawk" and ardent anticommunist, but most would disagree that the flights were meant to start World War III.[10] LeMay was a braggart who made many such statements for their effect rather than their literal intent. The flights were ordered at the highest level, and General LeMay was carrying out those orders.

No official count has ever been released, but figures produced at the Cold War symposium indicate that at least 252 crewmen were shot down while flying reconnaissance missions in the 1950s and 1960s. Many died in the crash or were imprisoned. Some who were known to have survived disappeared and were never heard from again. The Truman and Eisenhower administrations, particularly the latter, can be faulted for their handling of the Cold War overflights and the downed airmen. Sometimes it seemed that more concern was expressed about the loss of an aircraft and its equipment than the crew. A JCS memorandum from August 1952, for instance, notes that in a discussion between Eisenhower and Secretary Dulles on June 26, 1952, on reconnaissance requirements, "the President expressed concern about the possibility of loss of the B-47 aircraft to the Soviets and the consequent compromising of our latest equipment. He wished to make sure that the Joint Chiefs of Staff had considered this aspect of the problem as an added element of risk."[11]

The families of the lost men were never told what their mission had been or what really happened to them, merely that they had been on "secret missions," "training missions," "electromagnetic research missions," "photo mapping missions," "studying the propagation of radio waves transmitted by U.S. radio stations," or had died in "a military aircraft accident." Families' requests for further information were met with silence from the Defense Department. Cover-ups were common. When a B-29 was shot down north of Hokkaido on a reconnaissance mission over Soviet-occupied Kurile Island on November 7, 1954, ten men survived and one was killed. Secretary Dulles remarked to President Eisenhower about the incident, "Wherever the boys go over there, it's a deliberate risk." Eisenhower mused to Dulles, "We don't want to admit too much."[12] I fault both administrations for not trying harder to get the men back. The State Department was particularly feeble in its attempts to gain their release. The matter usually was brought up whenever there was a high-level meeting with the Soviets, but it was broached only perfunctorily in relation to other things being discussed. After the demise of the Soviet Union, information surfaced confirming that some U.S. air crew members had been alive when they landed or parachuted into the Soviet Union.

The services were also inconsistent in rewarding the men for their efforts. It was up to a unit's commander to bestow commendations. Some gave posthumous Distinguished Flying Crosses to the families of lost men and some gave Purple Hearts, but most families received nothing but the man's personal effects. And because these were secret missions conducted by a field command, a change of field commander meant that the fate of the men was soon forgotten. Several participants at the Cold War symposium described meeting an attitude of "it didn't happen on my watch and therefore I am absolved of any blame."

In 1991 President George H. W. Bush and President Boris Yeltsin agreed to establish "Task Force Russia," headed by Malcolm Toon, a former ambassador to the Soviet Union, to investigate the whereabouts of Americans known to have fallen into Soviet hands, but the Russians have yet to provide any information on the status of these individuals. For its part, the United States has still not admitted that it was spying on the Soviet Union.

Prominent Cold War Recon Missions

The more prominent overflight missions were flown with the approval of President Eisenhower. While Eisenhower remained wary and concerned about the ferret missions, he allowed them to continue with the provision that the aircraft not cross Soviet boundaries. The missions continued to seek out radar and air defense units surrounding the Soviet Union. In the event of war, these installations would be targets. Once the radar units were knocked out, SAC bombers could penetrate deep into the Soviet Union and release their missiles. A number of secret missions were engaged in these endeavors. The more prominent ones are listed below.

Project Seashore. In March 1955 four RB-47E aircraft equipped with modified 100-inch side-looking cameras flying from Eielson AFB photographed Siberia's northern and eastern shores. The interpretability was quite good and a number of air defense sites were photographed.

Project Home Run, or the Thule Mission. The Air Force was determined to obtain images of the Soviet Union's northern and Arctic air bases. Between March 21 and May 10, 1956, SAC launched more than 150 RB-47E photo reconnaissance and RB-47 E and RB-47H electronic reconnaissance aircraft from Thule AFB in Greenland. Flown in daylight missions over the North Pole into northeastern Siberia, the aircraft overflew and photographed the Soviet Arctic airfields of Dickson, Igarka, Makarova, Chelyuishin, Ust Olensk, Khorgo, Tiksi, Nordvik, Ambarchik, Tal Tumus, Anadyr, Mys Schnidta, and Wrangel Island, as well as a number of radar stations. The images they recorded proved that no Tu-4 Bull bombers were stationed permanently at any of these bases. One of the deepest penetrations was achieved by the flight that covered the airfield at Dudinka, the massive slave-labor operations at the Norilsk nickel-mining complex, and the major timber port of Igarka. On May 14 the Soviets protested the flights. On May 29 the State Department responded that navigation difficulties in the Arctic region may have caused unintentional violations of Soviet air space. If such had in fact occurred, the State Department regretted it. Eisenhower would not admit to any of the overflights until years later when Gary Powers' plane was downed.

The Two Peters. In 1951 the Navy deployed the new Banshee F2H-2P photo-reconnaissance planes to the Sixth Fleet. The Banshee's photo equipment consisted of six camera stations providing the "possibility of simultaneously taking any three-way combination of verticals with a focal length of 6, 12, 24, of 36 inches, or obliques providing horizon-to-horizon with the 12 or 24-inch lenses."[13] Project Pegasus obtained coverage of Austria, Czechoslovakia, Hungary, and Yugoslavia. A bigger planned effort, Project Steve Brody, was intended to overfly the Crimea, the Ukraine, and western Russia. Eisenhower had left his position at Columbia University to return to uniform and establish Supreme Headquarters Allied Command Europe (SHAPE) in Paris. He visited the Sixth Fleet on October 15–17, 1952, and was briefed on the Banshee's capabilities and on Project Steve Brody. He was pleased about the Banshee's reconnaissance capabilities but lukewarm about the planned Soviet reconnaissance endeavor.

Navy P2V-3W and RB-50 flights. U.S. Navy Patrol Squadron VP-931 operated out of Kodiak and Adak, Alaska. The squadron's P2V-3Ws were equipped with electronic equipment and could also take radar scope photographs. The RB-50E flew reconnaissance missions down the Soviet coast to the Kamchatka Peninsula and westward over the Chukchi Peninsula. These two aircraft usually flew together on intelligence-gathering efforts.

Korean War aerial photography of the Soviet Union and China. When hostilities commenced on the Korean Peninsula in June 1950, intelligence agencies in Washington immediately gained access to huge quantities of tactical reconnaissance photography. Although this imagery was rapidly processed in the field for immediate tactical exploitation, it was often reinterpreted in Washington by analysts looking for bunkers, caves, and gun positions that might have been missed during the initial viewing. Strangely enough, World War II photo interpretation keys of Japanese bunkers and caves were used to analyze similar fortifications used by the Chinese and North Koreans. It was after China's intervention in the war that the United States began flying reconnaissance missions over China and the Soviet Union. Images of good resolution were obtained of Khabarovsk, Komsomolsk, Sovetskaya Gavin, Vladivostok, Spaask Dalny, Artem Airfield, Sakhalin Island, and the Kuriles occupied by the Soviets; and of Mukden, Changchun, and Harbin in China. RB-29s flew aerial recon missions along the coastline from Hong Kong to Port Arthur and from Vladivostok to Kamchatka.

Projects 0, Lightweight, and Heartthrob. The Air Force had long wanted a high-flying twin-engine aircraft to fly deep missions into the Soviet Union. As part of Project Bald Eagle, the Air Force chief of staff, Gen. Nathan Twining, pushed the program of converting B-57 Canberra bombers into reconnaissance vehicles. Lt. Gen. Frank F. Everest, deputy chief of staff for operations, monitored a program modifying ten Canberras into RB-57A lightweight models at the Martin aircraft plant outside Baltimore, Maryland. With J57 engines and its guns and armament removed, an RB-57A could carry two K-38 36-inch-focal-length cameras installed aft of the bomb bay. The new model carried a crew of three and could reach an altitude of 60,000 feet with a combat radius of 1,030 nautical miles.[14] The project was named Lightweight and later renamed Heartthrob. Four of the RB-57As were sent to the 6007th Reconnaissance Group (Composite) at Yokota AFB in Japan. In the later stages of the Korean War, the RB-57A was used as a replacement for the RB-26. Six RB-57As were attached to the 7499th Support Group at Wiesbaden AFB for European operations. The Joint Chiefs of Staff, through the Far East Air Forces (FEAF) and the headquarters of the U.S. Forces in Europe (USAFE), authorized SENSINT flights over China and the Soviet Union.

The starting of the Canberra's engines was quite a spectacle. A ten-pound charge of black powder would be detonated to energize and start rotation of the engine's turbines on each wing, and a huge pall of black smoke would appear. The first time I witnessed it I thought the bomber was on fire. Ten pilots from various operational backgrounds were assembled to fly ten specially modified RB-57A aircraft, and a new organization—the 4080th Strategic Reconnaissance Wing—was formed for personnel training and aircraft maintenance.

Long-range oblique photography (*LOROP*). The K-42, a 240-inch camera often referred to as the "Boston camera" or "Pie Face," was developed in the early 1950s. The lens was designed in 1947 by Dr. James G. Baker for installation in a camera designed by the Boston University Optical Research Laboratory. The camera weighed about three tons, and eight hundred pounds of lead shot were required to balance it. Supposedly, it was first installed and test-flown in an RB-36 (probably an RC-97), then installed as a left-looking oblique camera in an RC-97. The first photo Arthur Lundahl and I saw from this project was of New York City. The aircraft was seventy-two miles away, and yet we could see people in Central Park. The camera had an 18-by-36-inch format about the size of a newspaper. When the RC-97 was deployed in Europe, we received photography of East Germany and Czechoslovakia acquired while the aircraft was flying along their borders. The Air Force was also authorizing LOROP missions from Eielson AFB along the Soviet Union's far eastern border. The K-42 camera was plagued with problems that caused it to vibrate and produce smearing on the newspaper-size images, so that photo interpreters would see several smeared frames along with several clear ones.[15] This K-42 camera is now in the Air Force Museum in Dayton, Ohio.

The RB-57C Canberra was equipped with a new version of the 240-inch camera called the "Sharp Cut." It was often referred to as the "bomb camera" because it looked like a bomb and was installed in the plane's bomb bay.

Project Slick Chick. In 1954 six RF-100As at the North American plant were designated for reconnaissance purposes and equipped with K-17 and K-38 cameras. Three of the aircraft went to the Pacific and three to Europe. Pilots selected for Slick Chick were stationed at Bitburg AFB in West Germany and assigned to the newly activated 7499th Support Group. Even though they flew above 50,000 feet and at Mach 1 speed, they were picked up and tracked by Soviet radar. In 1955 they flew a series of missions over East Germany, Czechoslovakia, and Hungary focusing on capitals, industrial cities, and Soviet installations.[16] I remember especially excellent photos of Sofia, Bulgaria. The photography, of good to excellent interpretability, was processed by the 497th Reconnaissance Technical Squadron in Wiesbaden. Some of the missions were flown when the Soviets conducted spring maneuvers. There were reports that Slick Chick aircraft had overflown the Soviet missile test center at Kapustin Yar, but this was not true. On one mission Soviet fighters scrambled to intercept an RF-100 before it could reach the West German border. Slick Chick missions were flown over Communist China, but we had little information about the aircrafts' home bases or what their targets were other than airfields along the China coast.

U.S. Navy air and sea patrol reconnaissance. The Navy operates a system of offshore scouting and patrol to give timely warnings of an attack. Cold War reconnaissance was conducted on new and old Russian combatants and merchant ships. Close-up photographs of Soviet ships provided details not obtainable from other sources. Of special interest were Soviet technical research ships and intelligence collectors. Navy patrols obtained images of Soviet merchant vessels carrying Soviet military supplies and industrial equipment to Syria, Egypt, Ghana, Indonesia, and, most important, Cuba, during the Cuban Missile Crisis.

Royal Air Force "special duty flights." The Radar Production Program operated a number of projects that acquired radar scope images for use in the event of war and to train SAC bombardiers. In 1951 the U.S. Air Force transferred RB-45C Tornados to the RAF that were subsequently painted with RAF colors and manned by RAF personnel. With approval by Prime Minister Winston Churchill, on April 17–18, 1952, the RAF flew three night penetration missions from Sculthrope Air Base over the Soviet Union, capturing images on radar scopes. The first mission was over the Baltic countries, the second flew over Byelorussia, and the third involved a deep penetration of the Ukraine over Kiev and Kharkov. The operation was repeated on April 28–29, 1954. The RAF flights stopped in mid-1954 when the last mission came under attack.

Projects Cherry and Wild Cherry. Reconnaissance aircraft were in great demand, but aircraft capable of dropping agents into hotspots saw action as well. In 1954 the CIA purchased seven U.S. Navy P2V Neptune patrol planes. The planes were designated RB-69s and given an Air Force cover story. The aircraft, some with foreign crews, performed a variety of duties, among them ELINT collection, leaflet drops, insertion of special agents, and nuclear monitoring in Europe. One of the aircraft designed for aerial reconnaissance and used for missions along the China coast was further modified with strobe lights to take pictures at night. Chris Mares and John Cain of the CIA's Photo Intelligence Division worked closely with the covert agents assigned to the missions. John described a U.S. test flight on which the aircraft flew a low-level flight path with its strobe lights flashing. Chris Mares was lying in a marsh to observe the strobe lights and said the pilot flew so low that he had difficulty seeing because of the insects that splattered his windshield. One mission with flashing strobe lights was flown over Communist China's shores, and according to John it scared the hell out of the Chinese.

Most of the photos from that mission were from areas where we were already getting excellent aerial photographs from the Chinese Nationalists. We heard that the program was compromised in Europe and that the European aircraft were flown to Taiwan. The operation was later disbanded.

CHINAT photography. After the Nationalist Chinese forces were defeated by the Communists in late 1949 and expelled to Taiwan, the United States furnished the Nationalist air force with P-38s. Later it sent F-51s, T-33s, RF-84s, and RF-86s for reconnaissance purposes. The Chinese Nationalists flew missions along the coast of China and made some penetrations inland, particularly over the many fighter airfields the Communists were building. The images were shared with the Department of Defense and the Central Intelligence Agency. When the Soviets provided the Chinese with MiG-15 and MiG-17 fighters, analysis of the imagery gave us a good idea of the structure of jet fighter squadrons inside the Soviet Union and all the attendant service gear. The Nationalists continued to overfly many of the Chinese naval bases and ports searching for buildups that could threaten Taiwan. The missions also produced good naval and ground order of battle information on the Communist Chinese forces.

FOUR
allen dulles becomes CIA director

One of the difficulties is getting a man who will understand intelligence.

President Dwight D. Eisenhower

Gen. Walter Bedell Smith had hoped to become the Army chief of staff. When Eisenhower denied him that position, he resigned as director of the CIA on February 9, 1953, and was succeeded by his deputy, Allen Welsh Dulles. Dulles was well qualified for the post. He had worked ten years with the Diplomatic Service of the Department of State. During World War II he headed the OSS office in Bern, Switzerland. He had served as the covert chief of the Agency's Directorate of Plans and had been Smith's deputy director since August 1951.

Eisenhower liked Allen Dulles and liked the idea of a career intelligence officer heading the CIA. "One of the difficulties is getting a man who will understand intelligence," Eisenhower said. "He must show a bent for it and be trained all the way up."[1]

On the day Dulles was sworn in as director, Lt. Gen. Charles P. Cabell was appointed his deputy director. Cabell came to the position with extensive experience in both intelligence and photographic collection techniques. Like many West Pointers of his day, he saw the career potential in the U.S. Army Air Corps and transferred from the cavalry. He gained experience in the early 1930s as an aerial observer and later commanded an aerial observation squadron. Following attendance at U.S. Army staff and command schools during the 1930s, his career turned to photo intelligence with an assignment to the Photography Laboratory in the Experimental Engineering Division at Wright Field in Dayton, Ohio.

During World War II, as a ranking officer assigned to a number of key decision-making positions, he became an active supporter of the rapidly developing technical intelligence collection systems. Cabell was also keenly attuned to the inner workings of Washington politics, reflected by his appointment as director of the Joint Staff of the Office of the Joint Chiefs of Staff. It was his performance in that position that attracted the attention of President Eisenhower. He was responsible for much of the progress the CIA made in the development of technical intelligence systems. Always in Dulles' shadow, but always aware of new and potential collection systems, he brought order to chaos.

As soon as he took office, Eisenhower began to address the problems the Soviet Union posed to U.S. security. The most recent national security estimate, issued in 1951, predicted that the Soviets would have as many as two hundred atomic bombs by mid-1953 and about six hundred to seven hundred Tu-4 heavy bombers capable of carrying them to practically every important target in the United States. The estimate also indicated that "the USSR should be able to overrun Western Europe and the Near East by mid-1953."[2] There was rarely a day when Eisenhower failed to give earnest attention to estimates of Soviet capabilities.

In August 1953 the Soviets succeeded in detonating a hydrogen device manufactured with lithium deuteride—an alarming development. This represented a more advanced technology than the heavy water method used by U.S. scientists to detonate a hydrogen bomb. Were the Soviets that far ahead of the United States in atomic research? The intelligence community rushed to find out.

Prior to 1953 the U.S. intelligence community had concluded that the Soviets had little capability for intercontinental attack. Their main bomber, the Tu-4 Bull, a copy of the U.S. B-29 bomber, had no in-flight refueling capability and because of its limited range could reach the United States only on a one-way mission. A large turboprop version of the Bull, the Barge, appeared in a July 1951 Soviet air show at Tushino Airfield. Intelligence predicted further production of the Barge, but that did not happen.

In late 1953 a U.S. attaché spotted a heavy jet bomber (later designated the Bison) at the Ramenskoye test and development airfield outside Moscow. It appeared to be a counterpart of the B-52, and at the same stage of development. The Soviets now possessed atomic weapons and the clear capability to deliver them to targets in the United States. The president was not pleased to hear this with no prior warning. U.S. intelligence collection activities were inadequate to give the U.S. military time to prepare to meet the menace and to take countermeasures in the event of an attack. The president and his advisers needed immediate, reliable information about the Soviets' strategic forces and their disposition. The USSR's size, internal security measures, and close monitoring of embassy personnel and visitors were not conducive to old-fashioned collection methods. Some new way to acquire precise information on the scientific and strategic production capabilities of the Soviet Union was required. Eisenhower knew that it would not be possible to build the right capabilities for competent intelligence-gathering methods overnight.

Although Japan's surprise attack on the U.S. Pacific Fleet at Pearl Harbor was a decade in the past, grave concerns about the organization, structure, and purpose of American intelligence remained. The fear of another Pearl Harbor was still very real in the Eisenhower administration, and the president on numerous occasions expressed fear of a surprise attack. He emphasized that "our safety and that of the Free World, demand . . . effective systems for gathering information about the military capability of other powerful nations, especially those that make a fetish of secrecy."[3]

Strategic intelligence—intelligence required for the formulation of strategy, policy, and military plans and operations at national and theater levels—on the Soviet Union was sorely lacking. The limited human intelligence available and Luftwaffe photos of the Soviet Union acquired during World War II did not provide the substance or volume of information required for current strategic intelligence estimates. We had neither current nor reliable information on Soviet military preparedness. Richard Helms would later recall, "There was an extraordinary absence of knowledge. It was totally frustrating to learn anything, no matter how hard we tried or how imaginative we were. Eisenhower was sorely pressed to know what his enemy was about."[4]

The CIA had no sources in the Kremlin, and CIA estimates of Soviet capabilities relied more on speculation—myths, really—than on hard evidence. We had no way of monitoring foreign developments that could involve a threat to the United States; to Allied military, political, and economic interests; or to U.S. citizens abroad. The years 1953 and 1954 proved to be especially fortuitous for the Agency because it hired two brilliant innovators who became prime movers in projecting the Agency into the era of scientific and technical intelligence: Richard M. Bissell and Arthur C. Lundahl.

Richard Bissell was born into a wealthy family, attended Yale, and after studying at the London School of Economics returned to teach at Yale, where he received a doctorate in economics. During the war he worked as an economic analyst at the Department of Commerce. Afterward he taught at MIT before returning to Washington to serve as assistant deputy administrator of the Economic Cooperation Administration (the Marshall Plan). He worked for the Ford Foundation before Dulles hired him as a special assistant to the director of central intelligence (DCI). Calm, deliberate, articulate, and a good listener, he believed in small but competent staffs, collegiality, and adaptability to changing situations. On arriving at the Agency he found little to do. But within four months his career would shift dramatically when Dulles tapped him to manage the U-2 development program.

One of the assignments that General Smith left behind at the CIA was his order to create a photo interpretation organization. To staff the newly formed photo interpretation unit in 1953, the Agency lured the brilliant photo interpretation expert and photo scientist Arthur C. Lundahl away from the U.S. Naval Photographic Interpretation Center at Anacostia. Lundahl had served as a photo inter-preter at Adak, Alaska, during World War II, analyzing information derived from photographic missions flown over the Aleutian Islands, Japan, the Kuriles, and a few covert missions over Soviet territory. After the war Lundahl served first as chief of the NAVPIC Photogrammetric Division and then as assistant chief engineer between 1946 and 1953. He immersed himself in all aspects of photo interpretation and photogrammetry and represented the United States at several overseas conferences. I was impressed with his ability and vision when we served together in working groups.

Lundahl joined the CIA on May 11, 1953, with a mandate to organize a first-class photographic intelligence center. He was initially placed under Otto Guthe, the chief of the Map Division, to organize a Photo Intelligence Division in the Geographic Research Area of the Office of Research and Reports. The Map Division consisted of geographers and cartographers who were largely veterans of the OSS. A number were proficient in German and Russian, and most regarded photo interpretation as beneath their status. The blurred lines of authority between the Photo Intelligence Division (PID)* and the Map Division generated strained relationships.

* The Photo Intelligence Division became operational in January 1955. When the division was augmented with Army, Navy, and Air Force photo interpreters in August 1958, the name was changed to Photo Intelligence Center. It remained so until January 20, 1961, when NSC Directive 8 changed the name to National Photographic Intelligence Center (NPIC).

When Lundahl arrived at the CIA, he later said, "it was not a very hospitable environment to work in. . . . [T]here was no place for me, no office, no building, and no equipment. Nothing. In fact, I didn't have a desk." He was finally given a "broom closet" for conducting photo interpretation projects and meetings. "The clandestine services were coming in most heavily, because they had problems related to intervisibility. They wanted to place agents into locations where they could see into industrial complexes or place devices into the right places to record sounds of trucks and aircraft."[5]

All that changed in December 1954 when Allen Dulles' secretary called Lundahl and said: "You are relieved of all your duties. Come to Mr. Dulles' office immediately." When he arrived, Dulles and Bissell "pulled back a drape and showed pictures of the proposed U-2. I was told they wanted me to forgo prior duties and commit myself to the creation of the photo interpretation organization."[6]

During the 1950s CIA personnel met frequently with Gen. George Goddard, who loved to quote Eisenhower's concern for good intelligence: "Without it you would have only your fears on which to plan your own defenses and your whole military establishment. Now if you're going to use nothing but fear and that's all you have, you're going to make us an armed camp. So this kind of knowledge is vital to us."[7] Andrew Goodpaster agreed:

> President Eisenhower's . . . decision to initiate overflights grew from his careful appraisal of the evolving intelligence needs of the United States in the 1950s. He brought to the presidency a deeply rooted view that intelligence was of vital importance to the national security and to the conduct of military and diplomatic affairs. He also brought to the presidency a personal commitment to try to cool the state of tension and hostility existing between the Soviet Union and the United States and its allies in the 1950s that could, if unchecked, escalate into a catastrophic military confrontation involving nuclear weapons.[8]

While the Soviet Union's strategic capabilities were causing great concern in Washington, the "domino theory" dominated military thinking at the time, and the Joints Chiefs of Staff were preoccupied with what was happening in Southeast Asia. The domino theory held that communism was spreading, and if one critically situated nation fell, its neighbors would fall as well. The Communists were involved in unstable regions of the world in an unrelenting effort to impose an alien Soviet "model" on independent countries. The communist tide had to be stopped. The domino theory gathered credibility among U.S. policy makers, who also believed that the Soviets were determined to achieve military superiority and were continuing their usual practice of stretching treaties to the verge of violation, and in some cases beyond. Many in Washington felt the United States should work to restrict Soviet expansion by responding positively to the economic, political, and security problems of less-developed countries. Failing this, the United States had to make it clear to the Soviets that it would resist encroachments on its vital interests and those of its allies and friends.

The communist tide seemed about to overwhelm Southeast Asia. During the siege of Dien Bien Phu in March–May 1954, President Eisenhower resisted a call for American intervention in spite of being urged to do so by the State Department and the Joint Chiefs of Staff. On April 7, however, he did authorize Adm. Arthur Radford, chair of the Joint Chiefs, to use aircraft carrier planes to conduct extensive reconnaissance of Dien Bien Phu and the Vietminh supply routes leading to it. Extensive reconnaissance was also conducted over southern China. Pairs of aircraft flew at high altitudes and photographed railroads from Nanning and Kunming to Hanoi, not neglecting the port facilities and airfields around Hanoi, Haiphong, and Hainan. The Chinese did not react to the incursions.[9]

Admiral Radford proposed sending fifty U.S. B-29 bombers from the American base at Clark Field escorted by 150 fighters from the aircraft carriers *Essex* and *Boxer* in the South China Sea in a single strike to attack Vietminh positions around the besieged French army. Eisenhower would have none of it. On February 10 Eisenhower reassured the nation that he could conceive of no greater tragedy than for America to become involved in an all-out war in Southeast Asia.

In March 1954 French army chief of staff Paul Ely came to Washington to press for an increase in the flow of American military supplies to the beleaguered French forces. He met with both Eisenhower and Secretary of State John Foster Dulles. While Eisenhower agreed to furnish the French with C-119 transports, he would not commit to further supplies until the French made some effort to grant independence to the Indochinese.

On April 7 Radford met with the Pentagon's Joint Advanced Study Group, which had concluded that three tactical atomic weapons, properly employed, would be sufficient to smash the Vietminh effort at Dien Bien Phu. After further meetings Ely and Admiral Radford together approved a joint U.S.-French plan, named Operation Vulture, for an air strike against the Vietminh around

Dien Bien Phu. On April 23, in a statement to NATO ministers, Dulles said that atomic bombs must now be treated as conventional weapons.

The precise details of Operation Vulture seemed to be in question as the situation at Dien Bien Phu became increasingly desperate. The French hinted that they expected two or three atomic bombs to be dropped on the Vietminh, and that also seemed to be the view of Radford, Ely, and Vice President Nixon. Secretary Dulles, on the other hand, thought Vulture entailed "massive B-29 bombing by U.S. planes using conventional bombs."[10] The Navy contributed a lengthy paper to the debate along with recent aerial photos of Dien Bien Phu that included two targets delineated for atomic weapons and the circles of destruction that would result. On May 1, Robert Cutler, Eisenhower's special assistant for national security, brought the president the draft of an NSC paper, which Eisenhower may have forgotten commissioning, that explored the possibilities of using atomic bombs in Vietnam. Eisenhower was appalled. He told Cutler, "I certainly do not think that the atom bomb can be used by the United States unilaterally." He went on, "You boys must be crazy. We can't use those awful things against Asians for the second time in less than ten years."[11] Yet, there had been serious planning for the use of atomic weapons, including the delineation of targets. Further confusion arose when French foreign minister Georges Bidault leaked a story that the United States had offered atomic bombs to the French. Although the NSC's Planning Board had discussed it, there is no evidence that this actually occurred.

Dien Bien Phu surrendered on May 7, and the French cause in Indochina seemed lost. Eisenhower reconsidered intervention and decided that the American people would not stand for it. He could see no reason to fight for a French colony less than a year after the armistice had ended the unpopular war in Korea. Yet the continued Soviet menace did call for a dramatic shift in U.S. policy regarding Southeast Asia. The Southeast Asia Treaty Organization was formed in Manila on September 8, 1954, to unite Southeast Asia against the Communists. The organization comprised Pakistan, Thailand, the Philippines, the United States, Britain, France, Australia, and New Zealand, which were committed to take joint action against subversion and aggression in Asia. Secretary Dulles spoke of the need for Western nations and their friends in Southeast Asia to oppose the Communists. In a speech on June 12, 1954, Dulles stated that the president and the National Security Council had decided "to depend primarily upon a great capacity to retaliate instantly, by means and at places of our own choosing."[12] The terms "brinkmanship" and "massive retaliation" were born to stare down adversaries with American nuclear might. Moscow clearly understood that the United States might respond to a Soviet conventional attack against the United States or its allies with a nuclear attack on the Soviet Union.

The Joint Chiefs of Staff at the time consisted of its chair, Adm. Arthur W. Radford; Gen. Nathan F. Twining, USAF; Adm. Arleigh A. Burke, USN; Gen. Maxwell D. Taylor, USA; and Gen. Randolph Pate, USMC. Each man was directly responsible for the military operations and readiness of his service. But there were differences of opinion and power struggles among them. Each service chief fought to maintain control of what he had and to gain additional power. At a time when the U.S. military services should have been united against the nation's enemies they were squabbling among themselves. Taylor advocated "flexible response" with less emphasis on strategic air power and more emphasis on ground forces. The Navy, whose strategic role had been diminished when its budget was slashed, also advocated a strategy of minimum force for deterrence. The Navy and the Air Force were fighting over control of targets.

The question of which targets in the Soviet Union should be struck if the United States did go to war remained unanswered as well. After a visit to SAC in January 1954, Allen Dulles reported that General LeMay "was roaring like a just-neutered bull" that he did not have solid information on which targets he was to strike in the event of war.[13] Dulles sent Deputy Director for Intelligence Robert Amory to SAC to hear LeMay's demands for target information. A few weeks later, General Cabell suggested that SAC list the targets it considered of vital interest. In response, LeMay presented a list of 113 targets in three priority groups.

I was ordered to go to Omaha to determine what information in the Agency's Industrial Register files would be of value to SAC. I took several folders of information for meetings with SAC's intelligence director, Brig. Gen. James H. Walsh, and his deputy, Col. Robert Smith. I had flown on bombing missions during World War II and realized the value of having the appropriate target materials. The target charts used during the war consisted of an aerial photo on one side of the chart and a map on the other. But for a number of targets SAC had neither. I reported back to Amory that while most of the information we had in target dossiers was at the secret level, I was sure that some arrangement could be made to allow SAC to microfilm our files. I also suggested making special arrangements to allow SAC access to Top Secret materials.

After receiving permission from Amory, I met again with General Walsh and said that SAC officers would be allowed to screen the Industrial Register files of interest and microfilm those they found pertinent. A special SAC detachment was established at Andrews AFB outside Washington, and thousands of documents were reproduced and sent to the three reconnaissance technical squadrons responsible for producing charts for SAC—the Second Air Force, headquartered at Barksdale Air Force Base, Louisiana; the Eighth Air Force, at Westover, Massachusetts; and the Fifteenth Air Force, at March AFB in California. There was a reconnaissance technical squadron in England as well, but it was ruled out for security reasons because British photo interpreters were part of the squadron. I visited Barksdale and saw firsthand the difficult job Air Force personnel had in trying to create target charts of cities in Siberia, Kazakhstan, and Central Asia using sketches made by returning German and Japanese POWs.

When Maj. Gen. John A. Samford, the Air Force assistant chief of staff for intelligence, heard about the arrangement, I received an irate call. "What in the hell are you up to?" he asked. He stated bluntly that all SAC requests for information had to go through his office, and that if I proceeded, he would reprimand me. I called Amory, who told me that if Samford called again, I was to tell him to go ahead with his reprimand and say that Dulles would take it up with General Twining. The microfilming of Industrial Register files continued until SAC had the photographs it needed of the important target cities.

The CIA and the Air Force made frantic efforts to obtain aerial images of the Kapustin Yar Missile Test Range for NIE-11-6-54, "Soviet Capabilities and Probable Programs in the Field of Guided Missiles," which was scheduled for approval on October 5, 1954. Dulles was prodded by H. Marshall Chadwell, his assistant director for scientific intelligence, to get the Air Force to do the job. In a letter to General Twining, Dulles admitted that "clandestine penetration efforts have not been sufficiently rewarding, and the electronic intercept approach is slow and the data is inherently difficult to analyze and interpret. Photographic coverage of the known guided missile test range at Kapustin Yar appears to be the most promising short range solution."[14] The Air Force prepared for a mission over Kapustin Yar but did not indicate which reconnaissance aircraft would be used; most presumed it would be an RF-57A.[15]

In August 1953, as part of burden-sharing reconnaissance efforts with the United States, the RAF flew a mission over Kapustin Yar. We first learned of the flight from Amory. Although many questions remain regarding when and how the flight occurred, there is general agreement that it was a daylight flight in a specially modified Canberra aircraft carrying a 100-inch camera and that the aircraft took off from Giebelstadt Airfield in West Germany. It supposedly approached but did not fly directly over the test range. The plane was damaged by fighter fire and had to land in Iran. When we received a U-2 photo of Kapustin Yar in 1957, I asked the Air Force for a copy of the 1953 British photo for comparison purposes. I was told the 1953 photo was no good. When I insisted, I was told that it was badly smeared and of no value.

As mentioned earlier, the appearance of the Bison bomber in 1953 generated an intelligence crisis. Intelligence assets maintained a watch over Soviet skies and at developmental airfields to gain more information on the craft. A single Bison was seen in the air on April 18, 1954, and several Bisons were seen in rehearsals for the annual May Day celebrations. The rehearsals lasted for several days, and the bombers consistently flew down the parade route and over the Kremlin. Across the street from the Kremlin, on the roof of the U.S. embassy, attachés with long-focal-length cameras photographed the bombers each time they appeared. The exposed film was expedited to Washington for processing. Enlargements of the photos revealed two-digit bort numbers in the teens on the noses of the bombers, which would normally indicate series production of at least twenty of these bombers. A number of intelligence analysts raised the possibility that different numbers were being painted on a relatively small number of bombers to fool observers, but the U.S. Air Force, which had the prime responsibility for estimating Soviet bomber strength, did not agree. Democrats led by former secretary of the Air Force Senator Stuart Symington of Missouri charged that the Eisenhower administration was permitting the Soviets to exceed the United States in bomber strength. In fact, as Allen Dulles would admit in his book *The Craft of Intelligence*, the intelligence community had been "taken." "The number [of Bisons] far exceeded what was thought to be available. The impression was that many more had recently come off the assembly line and the Soviets were, therefore, committed to an increased force of heavy bombers. Later, it was surmised that the same squadron had been flying around in circles, reappearing every few minutes. The purpose was to emphasize Soviet production. In fact, they were soon to shift the emphasis to missiles."[16]

The "bomber gap" controversy began to increase after the May 1954 May Day celebration. General Twining, speaking before a crowd of hundreds in Amarillo, Texas, claimed that the Soviet Air Force was by far the biggest air force in the world and that the Soviets had thousands more combat planes than did the U.S. Air Force, Navy, Marines, and Army combined. Donald Quarles, assistant secretary for defense and research, reported that "our technical position vis-à-vis the Soviets is less favorable than it was a year ago and we must face the sober inferences to be drawn from these facts."[17]

When the Soviets flew three Bisons in the 1954 May Day celebrations, it created a new sense of urgency in American defense programs. The Bison was immediately—and mistakenly—evaluated as having the capabilities of the U.S. B-52. LeMay characteristically bellowed demands for information about the size, capabilities, and location of the Soviet strategic air arm. In a memorandum to the Air Force intelligence director, Dulles admitted, "We have learned through experience that agent operations are extremely difficult to conduct and are not apt to produce the kind and quality of intelligence of this sort which is so urgently in demand."[18] Two months later, in a letter to Twining, Dulles again admitted the failure of classical methods of gathering strategic intelligence and called for high-tech reconnaissance methods.

> As I look into our future intelligence requirements, it is clear to me that the Nation will be forced to call more and more on air photographic and electronic reconnaissance for the performance of tasks that will be increasingly essential to its security. In no other way does it appear to me that we can be assured of obtaining the valid intelligence concerning many vital matters upon which major decisions have to be based. Accordingly, I recommend that no effort be spared in the development and acquisition of the specialized aircraft and operational capabilities necessary for such operations.[19]

The Soviets also began to deploy jet-powered Tu-16 Badger medium jet bombers in 1954. From their bases in the western and far eastern USSR the Badgers could reach U.S. bases in Europe and Japan. The U.S. military, and especially the Air Force, viewed these advances in Soviet aviation with great concern. Not merely the potential numerical superiority was cause for alarm, but also the pace with which the Soviets were supposedly constructing the new bombers. The Soviets were no longer constructing copies of Western aircraft; they were enhancing the capabilities of their air force across the entire spectrum. It was obvious that the Soviet Air Force had undergone a radical shift from the defensive to the offensive, made possible by new advances in aviation. The Soviet Air Force was being developed in four distinctive elements: long-range aviation, frontal aviation, transport aviation, and air defense of the motherland. The U.S. intelligence community needed to know much more about all of them.

FIVE

the awakening of science as an intelligence collector

The world's greatest need is an appetite for the future.

C.P. Snow

James Killian, President Eisenhower's first science and technology adviser, would write that fear of a surprise attack on the United States haunted President Eisenhower throughout his term.[1] Eisenhower was obsessed with reducing the danger of such an attack by the Soviet Union and was determined to ensure that the United States never again suffered another Pearl Harbor. During his administration he marshaled the intelligence community and America's best scientists to attack that danger head-on.

The Hoover Commission, chaired by former president Herbert Hoover, was established in 1954 to evaluate the organization of executive branch agencies charged with defending the United States. A small task force under Gen. Mark Clark was assigned the responsibility for evaluating the intelligence agencies. The prospect of Congress receiving a report giving details of the covert services prompted CIA director Allen Dulles to ask President Eisenhower for a separate review of the Agency's covert Directorate of Plans, to be delivered to Eisenhower personally. Dulles expressed concern about revealing covert sources and methods and compromising the Agency's ability to carry on covert operations afterward. President Eisenhower agreed and authorized a four-man Special Study Group in July 1954 to undertake a comprehensive study of the CIA's covert activities and make recommendations calculated to improve the conduct of these operations. Gen. James H. Doolittle chaired the group, which also included William B. Franke, later secretary of the Navy; Ambassador William Pawley; and Morris

Hadley. The president instructed Dulles to give the team unfettered access to the Agency and its personnel.

The Special Study Group's report was completed on September 30, 1954, and Doolittle hand-carried a copy to the president. Among other things, the report recommended that a committee of civilians be appointed to oversee the Agency's operations. Doolittle would write that: "both the report itself and the discussion I was privileged to have with the group when the report was presented . . . were of unusual value in providing an appraisal and stocktaking of those operations."[2] While the report focused primarily on the Directorate of Plans and its clandestine operations, the Special Study Group also took a hard look at a technical approach to intelligence problems, writing: "It is now clear that we are facing an implacable enemy whose avowed objective is world domination by whatever means and at whatever costs. There are no rules in such a game. Hereto acceptable norms of human conduct do not apply. If the US is to survive, long-standing American concepts of 'fair play' must be considered. We must develop effective espionage and learn to subvert, sabotage and destroy our enemies by more clever, more sophisticated means than those used against us."[3] Doolittle later related that he was attempting to light a fire under those in the administration who were unwilling to change and indifferent to modern ideas and methods.

General Clark was deeply concerned about the lack of adequate intelligence data coming from behind the Iron Curtain, and Eisenhower was as well. He was willing to wage an aggressive covert offensive against the Soviet Union, but not without having adequate information. Covert information from inside the Soviet Union was sparse, and the CIA did not have—and probably would not have for the foreseeable future—agents inside the country. Eisenhower had expressed his grave concern for better intelligence at a meeting of the Science Advisory Committee of the Office of Defense Mobilization on March 27, 1954, at which he disclosed the existence of the Bison intercontinental bomber and the threat it posed to the United States. "To anyone bearing the responsibility for the security of the United States," he said, "the situation [is] highly unsatisfactory."[4]

William O. Baker, the president and chairman of the board of AT&T and Bell Laboratories and a member of the Science Advisory Panel, related in a 1996 interview that "the science was there. It had to be put to work. The scientific field had exploded, especially in the fields of chemistry and electronics. Solid state circuitry and the transistor created a computer that gave the opportunity to create very compact collection systems. Now the missile technology would allow for throwing these endeavors in space. Unlike Truman's science advisor, the scientists on Eisenhower's Science Advisory Panel were well aware of Soviet missile work, of nuclear work, of various indicators the intelligence community had received."[5] Cold War technology, Baker noted, "was going to be very central, it was going to be very dynamic. . . . Eisenhower was entirely alert to this, but he did not at first feel—and had no basis, really for feeling—that he was going to launch any new initiatives there. . . . But what he did was to assign the people that knew about this and that were concerned about it."[6]

Eisenhower was pleased with the efforts of the Science Advisory Panel and decided that a "looking ahead" group had to be formally organized—a "group . . . to be forward looking with respect to defense and challenges to national security of the United States."[7] One of the panel's recommendations was the creation of a National Indications Center to identify and track warning indicators to prevent a strategic surprise. Eisenhower, familiar with all-source intelligence from his war experience, approved the recommendation and called on Allen Dulles, for whom he had great respect, to create such a center. The National Indications Center was established on July 1, 1954. Its charter called for the CIA's deputy director to chair its weekly meetings, but later the responsibility was passed to the Agency's deputy director of intelligence, and still later to the director of the Office of Current Intelligence. In times of stress or crisis, representatives from the various intelligence agencies would gather to discuss the intelligence and create a weekly watch report on worldwide problems. The center designated warning indicators that were applied to stages of military preparedness and formalized the various defense conditions (DEFCON 5 to DEFCON 1, the latter being war). James J. Hitchcock, a driving force at the center, created a matrix of all the indicators that would be apparent before war or a surprise attack.

Early in 1954 Eisenhower asked MIT president James Killian to advise him on science and technology. Killian was a graduate of MIT, but he was not a scientist. He had, however, established a reputation as a gifted administrator and had gained the respect and loyalty of scientists and engineers. On July 26, 1954, the president asked Killian to direct a study of the country's technological capabilities to meet some of its current problems—principally those concerned with offense, defense, and intelligence needs in response to concerns about U.S. vulnerability to a surprise Soviet attack.

Killian was an exceptionally accomplished leader, and the team he assembled was extraordinary. He encouraged free-flowing discussions and different views, and he appreciated new suggestions and solutions to old problems. William Baker said that Killian "translated science and engineering into policy terms that Eisenhower just absorbed, in which Eisenhower just delighted. He just felt comfortable with it."[8] With the president's approval, on August 27, 1954, Killian created the Technological Capabilities Panel (TCP). The TCP brought together forty-one renowned scientists, engineers, and experts in military matters and communication; they were assisted by sixteen military and civilian members of the government. Dr. James Fisk, vice president of research at the Bell Lab, was appointed Killian's deputy. Others on the panel were Leland J. Havorth, Brookhaven National Laboratory; Lee A. DuBridge, California Institute of Technology; James H. Doolittle, Shell Oil Company; James P. Baxter, Williams College; Robert C. Sprague, Sprague Electric Company; Dr. Edwin H. Land, the eminent photo scientist; James G. Baker, Harvard University astronomer and acclaimed optics designer; Joseph W. Kennedy, a chemist from Washington University; Nobel laureate Edward M. Purcell; John W. Tukey, a mathematician from Princeton University; Allen Latham of the Arthur D. Little Corporation; and Allen F. Donovan of the Cornell University Aeronautical Laboratory. Killian said that interdisciplinary congeniality made possible the group's stellar achievements.

The TCP was not an ordinary government panel. Killian stipulated that all appointed members take leaves of absence from their workplaces and devote full time to the panel's effort. The panel usually met in Room 206–208 of the Old Executive Office Building, next to the White House. Meetings were also held in Land's Polaroid boardroom, Killian's MIT conference room, at various offices in the CIA and Pentagon, and at contractor facilities. Eisenhower referred to them as "my scientists" and accorded them his full confidence. He was able to communicate his own enthusiasm and energy, and he made them feel that they were members of a team—that the work they were doing was very important for the security of the nation. "Eisenhower, at various times, said organization will not make a genius out of a dunce," Andrew Goodpaster noted. ". . . But organization can give the decision maker the facts he needs, presented in a way that would enable him to make wiser decisions and guard him from making serious mistakes."[9] Killian, Land, and other TCP members would meet with Eisenhower after TCP meetings to seek the president's approval on a variety of programs, discussed below, that were quickly undertaken.

Eisenhower's management style worked perfectly with the panel members, and he gave their recommendations and proposals serious consideration. Gen.

Brent Scowcroft admired Eisenhower's "sort of hidden-hand approach; not out in front, not chest-pounding, but getting things done, maneuvering people around so that the decision came naturally."[10] The panel had teeth, too, as the military services soon found out. If the panel did not receive answers from questions posed, especially to the military services, Killian or Land would schedule an appointment with the offenders at the White House.

The U.S. Intelligence Board, an assemblage of statutory heads of intelligence organizations that sought solutions to intelligence problems, played only an ancillary role in the TCP's work. William Baker noted that the panel "interacted cautiously with them in the sense [that] . . . we pursued issues with . . . President Eisenhower's encouragement and that of his successors, with a certain amount of arrogance with respect to White House sources, realizing that these bureaucratic entities, as diligent or patriotic as they were, simply weren't with it. Things were moving so fast for them and they did not have enough technical skills in their background. So we regarded these things like the U.S. Intelligence Board as inevitable accessories."[11]

The TCP unanimously concluded that greater reliance on science and technology was needed to assist and complement the classical intelligence methods and determined to overhaul the country's antiquated intelligence system. The panel members were like-minded in interpreting the Soviet conundrum, its origins, and the implications for the future. In frank and open discussions they took on one concrete problem after another and then had lunch, during which they exchanged broader perspectives. To accelerate the panel's progress, Killian divided it into three distinct groups: offense, defense, and intelligence.

Project One members were charged with investigating U.S. offensive capabilities. Marshall G. Holloway of the Los Alamos Scientific Laboratory headed this effort along with E. P. Aurand, R. L. Belzer, S. C. Hight, B. Horton, Ruben F. Mettler, E. H. Plesset, W. Stratton, J. West, and G. Zimmerman. Mettler, who came to the panel from the staff of the assistant secretary of defense for research and development, later co-founded Space Technology Laboratories, which subsequently became the TRW Corporation.

Project Two, headed by Leland J. Haworth of Brookhaven National Laboratory, investigated the nation's defensive capabilities. The twelve-man panel included E. Barlow, D. Dustin, R. Emberson, R. Gilruth, A. G. Hill, J. L. Morton, J. Mouzon, R. Rolletson, Herbert "Pete" Scoville Jr. (then of the Armed Forces Special Weapons Project), and M. A. Tuve. Scoville would later join the CIA and become the assistant director for scientific intelligence. Brockway McMillan of the Bell Lab, who also served on this project, later became the director of the supersecret National Reconnaissance Office.

Project Three was to investigate the nation's intelligence capabilities, including communications. Polaroid's Dr. Edwin "Din" Land was appointed to head it, and he cast himself into the role with abandon. The six-member group soon became known to all in the intelligence community as "the Land Panel" or the "Taxicab Committee" (because all the members could fit in a taxicab). In addition to Land the panel included Harvard's brilliant lens designer James Baker; Joseph W. Kennedy, a renowned chemist responsible for isolating plutonium; Allen Latham Jr. of Arthur D. Little, Inc., an engineer and former treasurer of the Polaroid Corporation; physicist Edward M. Purcell; and John W. Tukey of Princeton University and Bell. The group prepared a study "of various options that might provide means whether in peace or war, of conducting overhead strategic reconnaissance from the highest feasible altitude."[12]

After World War II, the nation's industries had begun focusing on new research, new products, and new production techniques in support of the private sector. American consumers wanted new cars, new refrigerators, and other long-denied luxuries. But the emergent Cold War also had to be a prime consideration. Private organizations willingly contributed their talents to the government. The question then became, Could these new industrial products and techniques be applied to intelligence pursuits?

Inventive insights and a profusion of new materials were creating new products for Americans. Jimmy Doolittle, who saw that technological developments would be the result of teamwork, remarked, "The curve of technological progress is not slowing down; it is exponential."[13] Doolittle also understood that technologically driven innovations would require organizational changes to keep pace in the fast and shifting industrial environment. The 1950s was a period of transition, and both Doolittle and Land were advocates of internal incentives to encourage innovation. Doolittle searched for a way to cut through the maze of politics and personal opinions to create the atmosphere necessary for teamwork.

Dr. Land was an intuitive and brilliant scientist with the intellectual capacity to overcome the burdens of preconceptions and a mind always working at top speed. His capacity for curiosity and research set the standard for his profession. Lundahl, who knew him well, called him an idea man of the first order and "the most spontaneously brilliant scientist at any sophisticated level. His trademark—

enthusiasm, energy, insatiable curiosity and breadth of knowledge—were applied to scientific discovery." Land scorned small ideas and conventional thinking. With his intellectual curiosity and energy, he enjoyed challenging people to reexamine their preconceived notions, and his panel was guided by his personal credo: "Select things that are manifestly important and nearly impossible."[14] He maintained that "discoveries are made by some individual who has freed himself from a way of thinking that is held by friends and associates who may be more intelligent, better educated, better disciplined, but who have not mastered the art of a fresh, clean look at old, old knowledge."[15] Lundahl recalled that Land had a lifelong fascination with light and color, and that he enjoyed working on horseback. He would stop, sweep the dust off his saddlebag, and say, "Let's go this way." He opposed having all research and development under a centralized command and detested the regulations, infringements, boards, panels, and red tape that characterized government research and development. He also detested people who sat around playing bureaucratic and turf protection games. He told Lundahl never to separate research and development from the functioning people; bootleg it, if necessary.

In the fall of 1952 Maj. John Seaberg at the Wright Development Command began to develop specifications for a high-altitude reconnaissance aircraft that was enthusiastically endorsed not only by the Air Force but also by the CIA. On March 27, 1953, the Air Force released a design study for such a plane. The design called for a single-seat subsonic aircraft with an operational radius of 1,500 statute miles. It would fly at altitudes above 70,000 feet and be capable of carrying a variety of cameras. Solicitations were forwarded to Bell, Fairchild, and Martin aircraft companies. Although large companies such as Douglas, Boeing, and Lockheed were deliberately excluded from the solicitation, Clarence L. "Kelly" Johnson of Lockheed, a talented designer, had been leaked details of the Seaberg competition and drafted an unsolicited proposal. Johnson, the chief of Lockheed's Advanced Project Development group, had designed the P-38, the P-80 Shooting Star, the Constellation airliner, and the F-104 Starfighter. The Air Research and Development Command (ARDC) was responsible for selecting the aircraft. About the time the ARDC selected the X-16, Lockheed sent Johnson's proposal for the CL-282 reconnaissance aircraft to Brig. Gen. Bernard Schriever. The proposal was forwarded to Major Seaberg, who rejected it because "it did not offer any serious advantages over the designs already reviewed."[16]

Fairchild submitted a design for the M-195, which had an altitude potential of 67,200 feet. Bell's entry was the Model 67. Later designated the X-16, it had a maximum altitude of 69,500 feet. Martin's entry was a large-wing version of the Canberra bomber, later designated the RB-57D. All three planes represented a radical departure from the quirks and prejudices that usually were apparent when fighters and bombers were converted for reconnaissance purposes.

In late March 1954 the ARDC selected the X-16. Meanwhile, Schriever remained interested in Johnson's CL-282 proposal, which featured a single jet engine, an unpressurized cabin, and high-aspect wings designed to fly at 70,000 feet for 2,000 miles. Schriever invited Johnson to Washington to brief him in April 1954, immediately recognized the reconnaissance potential of the CL-282, and arranged a briefing for Trevor Gardner, special assistant for research and development to Air Force Secretary Harold Talbott. Gardner also became an ardent supporter of the CL-282. Word of the CL-282 reached the Technological Capabilities Panel, and Land's Project Three committee became very interested in the aircraft.

General LeMay was briefed on the CL-282 and saw it as an immediate threat to the role of the Air Force in reconnaissance. Further, the Air Force was convinced that any spy plane the United States put in the air had to have twin engines. With typical abrasiveness LeMay called the CL-282 "a pile of bull shit" and said, "I can do all of that stuff with my B-36." The reconnaissance version of the B-36, the RB-36, was a far cry from the single-seat high-altitude design the Air Force had solicited back in March. It could carry a crew of eighteen, fourteen cameras, and eighty flash bombs. While a specially equipped B-36 could reach 50,000 feet, the new Soviet MiG-15 could also reach that altitude. In fact, the military service practice of converting bomber or fighter aircraft for reconnaissance purposes during World War II and in the postwar period had become so institutionalized that it was difficult to inject new proposals into the process. Land called SAC and the U.S. Air Force an "arena of fixed ideas." William Baker charitably characterized LeMay as not having much sympathy for space technology: "He had a deep suspicion of the CIA and he thought scientists were interfering with his business."[17]

The ARDC rejected the CL-282, as did the Air Force, which decided to develop the RB-57 reconnaissance bomber. The CIA, on the other hand, maintained interest in the craft. Land and the Project Three study group visited Lockheed and saw the CL-282 as a viable reconnaissance vehicle, and drafted a program for overhead reconnaissance based on the aircraft. In late October 1954 Land and his panel briefed Allen Dulles on the CL-282.

Initially, Dulles was not enthusiastic about involving the Agency in the technical phases of gathering intelligence. He believed that the CIA's mission lay in human operatives and communications intelligence. Certainly Dulles had institutional prejudices. The nucleus of the Agency had been formed from a cadre of wartime OSS agents, and his preference for former OSS officers established a form of elitism and self-righteousness that resulted in a bias against scientific and technical intelligence. Many of these agents had been recruited from Ivy League and other prestigious universities, and many ranking CIA officials were from prominent or wealthy eastern families. Nor could one overestimate the power of "the colonels," as they were called, to whom Dulles entrusted the "housekeeping of the Agency." They were staid and stern men not receptive to new ideas. Col. Matthew Baird headed all training for the Agency, Col. Sheffield Edwards was the director of the Office of Security, and Col. Lawrence K. "Red" White served first as deputy director for administration and later as the Agency's executive officer–comptroller. They, in turn, hired a number of men who had been with them in the service. These ex-OSS and former Army officers continued to foster the nexus between espionage, the "eastern establishment," and the academic community by recruiting individuals with backgrounds largely similar to theirs. They definitely favored the more traditional liberal arts-based "substantive intelligence" types.

TCP members felt that Allen Dulles "had to move from the old OSS-HUMINT approach of dropping agents out of airplanes with a backpack to suddenly employing technical collection systems that operated overhead."[18] Soviet security was efficient and ruthless. Attachés and their families were closely monitored. Any Soviet who ventured near Western embassies was immediately transported to a KGB station and questioned. Soviet strategic installations were protected by guards, multiple fences, and guard towers. Defectors produced little or no strategic information. Time after time, covert operations had been compromised when agents were captured or killed. But despite the enemy's apparent willingness to employ any and all methods to forestall intelligence gathering, Land had the impression that Dulles felt that that aerial reconnaissance was not fair play, in the idiom of intelligence.

The financial impact the CL-282 reconnaissance system would have on the CIA's budget was also causing consternation within the Agency, particularly in the covert Directorate of Plans, which had virtually a blank check from Dulles for its operations. When Colonel White suggested that the Agency should let the Defense Department do the photographic interpretation, Dulles pushed his glasses onto his forehead, as he often did, and said, "Red, you don't think that after I've taken all those photos I am going to let someone else interpret them."[19]

Well aware that Dulles had a preference for classical intelligence, Land emphasized that aerial intelligence would allow the pieces of fragmentary and indirect intelligence from covert sources to be melded. The idea pleased Dulles, who nevertheless left day-to-day decisions regarding technical intelligence to General Cabell, his deputy. Cabell was well qualified to make those decisions. His extensive background in Air Force intelligence, particularly reconnaissance, made him ideally qualified to oversee the CL-282 project. He also had valuable connections with members of Congress because his brother was a congressman.

Land pressed for action on the CL-282. When Lt. Gen. Donald L. Putt, the Air Force deputy chief of staff for development, saw the progress being made on the CL-282 project, he expressed fervent opposition, fearing the revolutionary craft would jeopardize the Air Force's X-16 and RB-57 projects. In fact, it did; the X-16 would be canceled when the CL-282 began flying, although the Air Force did continue with its purchase of twenty RB-57s. To mask its mission, the CL-282 was renamed the U-2, "U" for "utility aircraft" and "2" because the U-1 and U-3 designations had been taken.

On November 1, 1954, Kelly Johnson was invited back to Washington and questioned closely by Richard M. Bissell and Lawrence Houston, the Agency's general counsel, about getting the U-2 into production. The Agency had a special fund protected from the government's accountants that could be used to get the project under way. The CIA Act of 1949 gave the DCI the authority to spend monies "without regard to the provision of law and regulations relating to the expenditure of government funds . . . such expenditures to be accounted for solely on the certification of the director."[20] Dulles, however, had made it a practice to inform President Eisenhower about all such expenditures. Houston, who was told to keep track of these expenditures, remembered: "Kelly said . . . he would use his best people on the production line and that this would cost us a bit. I said we had twenty-two million [in the reserve fund] and Kelly said he thought this would do. He took our draft letter to Gross [Lockheed's president] and their comptroller thought twenty-two was too low and they wanted twenty-six outside."[21] Early in November 1954, Land and Killian met with the president. According to Killian, Eisenhower listened intently.

> Land described the U-2 system using an unarmed plane and recommended its development be undertaken. After listening to our proposal and asking many hard questions, Eisenhower approved the development of the U-2 system, but he stipulated that it should be handled in an unconventional way so that it would not become entangled in the bureaucracy of the Department of Defense or troubled by rivalries among the services. Consequently, a special management arrangement was devised that made it possible for the advisory group of scientists and engineers constantly to appraise and guide the development program and to permit quick decisions to be made.[22]

Land was very confident when he told the president that "this aircraft could and would find and photograph the Soviet Union's bomber fleet."[23]

Bissell was put in charge of the project, with Trevor Gardner, a high-ranking Air Force official, providing full Air Force support. Gardner was a dynamic, impatient individual who expressed his feelings strongly and, if need be, laced his words with profanity, a sure attention getter. Air Force officials who thought Gardner was being disloyal to the Air Force soon found out that once he made up his mind about something, he didn't give a damn what other people thought.

Houston recalled that Dr. Land had the "heebie jeebies" wanting to get the CL-292 project under way and paid for. As cost discussions continued, Land was concerned about the feuding between the Air Force and its contractors and the apparent lack of direction in the Department of Defense regarding reconnaissance. On November 5, 1954, Land sent a memorandum entitled "A Unique Opportunity for Comprehensive Intelligence" to Allen Dulles that bluntly suggested that the Agency assume the leadership role in the application of technical intelligence collection techniques: "We told you that this seems to us the kind of action and technique that is right for the contemporary version of CIA: a modern scientific way for the Agency that is always supposed to be looking, to do its looking. Quite strongly, we feel that you must assert your first right to pioneer in scientific techniques for collecting intelligence—and choosing such partners to assist you as may be needed. The present opportunity for aerial photography seems to us as a fine way to start."[24]

In November 1954 Allen Dulles, Secretary of State John Foster Dulles, Air Force chief of staff Nathan Twining, Donald Putt, and Defense chief Charles E. "Engine Charlie" Wilson met with Eisenhower to discuss funding for the U-2. There was concern about whether the Agency had enough funds to cover the project. Goodpaster recorded that "authorization was sought from the President to go ahead on a program to produce thirty special high performance aircraft at a cost of about $35 million."[25]

On November 23, 1954, Eisenhower assured Allen Dulles that the project was to be managed by the Agency and that the Air Force was going to provide any assistance needed to get it operational. That same day, Dulles answered Land's memorandum of November 5, stating that the Agency would be willing to take on the responsibility of both developing the U-2 and interpreting the photos it took.

Three days later, Dulles called Bissell into his office and told him that Eisenhower had approved the U-2 project and that he was assigning overall coordination both within and outside the CIA to Bissell. An economist by training and experience, Bissell possessed extraordinary innovative and organizational talents. More than any other individual, he was responsible for inaugurating the technical collection systems that became the mainstay of modern intelligence. Bissell was given the innocuous title of special assistant to the director for project control. In actuality, he would become the Agency's contact point with scientists, engineers, and scientific institutions. In essence, he would translate the TCP's suggestions into reality. Bissell's first office was in the brick building at 2430 E Street NW in Washington, D.C. Later, his office would occupy a large portion of the Matomic Building downtown. His headquarters was a beehive of activity. Bissell was a hard driver who surrounded himself with can-do people. His support staff was rated the best in Washington. His people could get a passport, a cover story, money, and plane tickets for overseas travel the same day they were requested.

President Eisenhower officially approved the proposal for the construction of the U-2s on December 4, 1954, and authorized Allen Dulles to use $35 million from the Agency's Contingency Reserve Fund to finance the project. Kelly Johnson said that Lockheed understood the fund limitations and that it could proceed using $22 million and would request additional funds if needed. Houston explained that the Agency needed the balance of the $35 million for cameras, life support gear, and support equipment. On December 9 the Agency and Lockheed signed a contract to construct twenty U-2 aircraft, the first to be delivered in July 1955 and the last in November 1956. Larry Houston would later laugh when he said that all the contracts and documents relating to the development of the U-2 would fit in one archive box. Lockheed agreed to deliver the twenty aircraft for about $19 million, less than $1 million per plane. And so a deal was struck that has since been described as the biggest intelligence bargain in history. Unlike the Air Force, which presented volumes of technical specifications when it wanted a new aircraft, the Agency gave Lockheed "performance" specifications and freed Johnson and his staff to follow their creative instincts. Basically, the specs called for an aircraft that would fly at 70,000 feet for extended periods and provide a stable camera platform; the rest was up to Johnson.

The 1950s was a period of prodigious invention: the computer, transistor, jet engine, and guided missile all appeared within that single decade. As happens rarely in scientific pursuits, five major breakthroughs applicable to intelligence gathering came together in the postwar period. Among the major developments in chemistry was a thin, tough plastic called Mylar developed by DuPont. Eastman Kodak scientists discovered that Mylar was an ideal supporter for photographic films. Eastman Kodak made a licensing agreement with DuPont to be the sole producer of the thin-based film known as Estar. Because Estar was so thin, enormous quantities of the film could be spooled onto a single film roll or film magazine. This technique in turn allowed reconnaissance missions to be expanded to cover large territorial areas over extended flight periods. Eastman scientists Joe Boone, Edgar Green, Al Soren, Raife Tarkington, Fordyce Tuttle, and Henry Yutzy worked not only on the development of the film but also on the machines that processed it.

Rocket developments during World War II had ushered in a new era of interest in atmospheric and space phenomena, both celestial and human-made. At Harvard University, the renowned astronomer and lens designer Dr. James Baker had designed revolutionary lenses of unprecedented efficiency for observing celestial bodies—lenses perfect for looking backward from space to the earth. Baker understood exactly what was needed for aerial reconnaissance: "Overhead reconnaissance from extreme altitude did indeed require some form of long focal length lenses of the highest precision. To obtain maximum results from isolated and hazardous missions, the equipment had to be capable of photographing large tracks of land in clear sunlight or through light haze, not only directly downward but [obliquely] as well."[26]

The invention of the transistor and the introduction of computers to control production lines opened new vistas in a number of highly technical areas. Before experiments revealed that computers could be applied to the precise work of driving lens grinding and polishing machines, the custom grinding of aerial camera lenses was a slow and laborious process. Baker was the first to consider using a computer to design lenses, and he used the large computer at nearby MIT to do it. The long optical experience of the Perkin-Elmer Corporation of Norwalk, Connecticut, under Dr. Roderick Scott was drawn on to produce the 24- and 36-inch lenses. Baker specified the focal length and format of the cameras to be designed by the Hycon Corporation of Monrovia, California, under the leadership of Grover Judy, Leroy A. Loftus, William McFadden, Richard H. Perley, and Wilton A. Stewart. Three cameras—the A, B, and C—were designed and produced. The design of the B panoramic camera, which weighed about 450 pounds, incorporated the Baker 36-inch lens and utilized the thin-base film, looked especially promising to Dr. Land.

It took a visionary such as Land to see that the U-2 used in conjunction with scientific advances in film, lenses, and camera development could constitute a valuable reconnaissance system. He likewise understood the need for efficient management to make the system work. Land had become disenchanted with the Air Force system of assigning specific tasks to a variety of offices in managing the research, development, and testing phases of an individual aircraft. Under this arrangement, each office incorporated hundreds of major and minor changes into an aircraft, thereby lengthening its testing and development time. Land wanted a single agency for the U-2 project, headed and staffed by technically qualified personnel and charged with a single purpose.

Dr. Albert "Bud" Wheelon, later the CIA's deputy director for science and technology, described Kelly Johnson as a man of "enormous self assurance. He was a towering personality. He knew all of aeronautical engineering and he drove his people hard, he expected a lot of them. He cursed like a sailor. He intimidated them, but he also led them and they loved him. He was an absolute patriot, he loved this country. He was headstrong, he was brilliant."[27]

Johnson applied his insatiable curiosity and drive to the design of the U-2. He picked a small staff and a team of twenty-nine engineers and technicians and moved them into Lockheed's Building 82, an aircraft assembly building left over from World War II situated next to the main runway at Burbank Airport. When Bissell insisted on complete security, the windows in the plant were blacked out, a control system was installed, and all employees were required to wear badges. Johnson moved at a calculated pace with calculated ends. The U-2 proceeded under Johnson's KISS design philosophy (Keep It Simple, Stupid). Al Capp's *L'il Abner* cartoon strip was popular at the time, and one of the strip's characters was responsible for the project's nickname. Hairless Joe would brew an alcoholic concoction called “kickapoo joy juice” from old shoes, dead skunks, and a variety of other things. People began to call Building 82 “the stink works” because of the smell of all the chemicals emanating from it. Lockheed changed the name to “Skunk Works” and registered the name and logo, a little standing skunk. People who worked on the U-2 project and those who later interpreted the film wore tiepins that featured a skunk with a shining eye.

Development of the U-2 commenced with the realistic assumption that it would be a short-term, high-risk operation. Though the chances of success were uncertain at best, the need was so urgent that the risk of failure was acceptable to President Eisenhower. The program faced one challenge after another as development and testing proceeded, but there was no flagging in the determination to make the system work—and in the shortest time possible. Johnson emphasized that development of the U-2 was like moving an aircraft directly from the design phase into combat. Risks were taken, bottlenecks broken, red tape minimized, new techniques developed, and feedback established. The U-2, by its inherent design and minimized weight and payload, achieved higher altitudes than previously thought possible. Exerting his ferocious will, Johnson drove his engineers to reduce the craft’s weight even further, telling them he would “trade his grandma” for several pounds. From that moment on, every pound saved was referred to as a “grandma.” “Simplicity, simplicity of design,” Johnson would extol his engineers at every morning meeting.

The close-knit design team achieved miracles. The wing was so superbly designed that it weighed only three pounds per square foot, one-third that of a normal aircraft, although its length posed stability problems on takeoff and landing. The landing gear likewise posed special problems. The gear had to be lightweight, and it had to be able to be moved forward to keep the aircraft from porpoising. The engineers placed the main landing gear inside the fuselage and installed tiny auxiliary landing gear called “pogos” near the wingtips. On takeoff, the pogos would be jettisoned; on landing, ground personnel would run alongside the aircraft as it lost momentum and reinsert the pogos into the wings. Skids were mounted on the wingtips as additional precautions. Tom Braden, an ex-CIA employee, summed up this phase of development when he remarked, “Only arrogant men would insist on building the U-2 spy plane within a time frame which experts said could not be done.”[28]

The plane’s distinguishing feature was its elongated, narrow wings, which had a span of seventy feet, eight inches. The wings held 1,350 gallons of fuel in four separate tanks. The fuselage was fifty feet long. The cameras were housed in the equipment bay, or Q bay, behind the pilot. The first U-2 camera system, designated the A-1, consisted of two modified Hycon K-38 24-inch-focal-length framing cameras. One was mounted vertically and the other was in a rocking assembly that would swing the camera to the left or right for oblique shots. Within a few months, a new camera system, the A-2, was employed. It consisted of three modified Hycon K-38 cameras mounted in a trimetrogon configuration (one looking down and two oblique) and a 3-inch Perkin-Elmer tracking camera that would produce a continuous strip of 70-mm film for the duration of the mission. James Baker, under subcontract to Perkin-Elmer, had substantially improved his original lens, and it was integrated into the A-2 K-38 cameras.[29] The A cameras could photograph objects about two and a half feet across.

The U-2's engine, the J-57, had to be modified to fly at 70,000 feet. But there were problems with the engine and the JP-4 fuel, which could freeze or boil off at high altitudes. Engine problems included flameouts at altitude, turbine blade failures, high oil consumption, and fumes in the cockpit.[30] It was obvious to engineers that long and complex reconnaissance missions required a better engine. The project acquired nine J-75-P-2 engines from the canceled Martin Seamaster flying boat program and modified them for use in the U-2. Johnson contacted General Doolittle, then a vice president at Shell Oil, and asked for help. Shell engineers developed special low-vapor kerosene for high altitudes. Designated LF-1A, it became known as "lighter fluid." Johnson referred to it as "cough syrup." The fuel was very similar in chemistry to Flit bug spray, which Shell Oil also produced. The company devoted so much of its bug spray to the production of LF-1A that consumers began to object because they could no longer find Flit on grocery shelves.

As the U-2 neared operational status, another question arose: Who was going to fly it? When President Eisenhower asked Allen Dulles about that, Dulles replied that pilots were being recruited from U.S. Air Force units thanks to the efforts of Lt. Gen. Emmett "Rosy" O'Donnell Jr. "You won't have many volunteers to fly over Russia," the president responded. Dulles assured the president that General O'Donnell had a number of potential recruits. The president frowned. "Are they down to recruiting soldiers of fortune?" Dulles replied that if recruiting soldiers of fortune became necessary, they would be Americans. Obviously disliking the idea of putting American military pilots in that position, the president frowned again. "It would seem that you would be able to recruit some Russians or pilots of other nationalities." Dulles said he would try.[31]

Dulles did try to recruit foreigners as U-2 pilots. Seven Greek pilots and an expatriate Polish flyer were added to the pool of U-2 trainees. (The United States had cordial relations with the hierarchy of the Greek Air Force because a number of its officers had been trained in the United States.) Two of the Greek pilots were subsequently allowed to train in the U-2, but their flight proficiency was poor and they were dropped from the program. The Polish pilot was never allowed to fly the U-2. Eisenhower also insisted that the pilot be a civilian who would identify himself, if captured, as a CIA employee. The pilot would make it clear that he was not working for any branch of the armed services and that his mission was solely to gather intelligence. The pilots were *not* to be briefed on the objectives of their mission.

Air Force pilots selected to fly the U-2 had to resign from the Air Force and assume civilian status. Pilots reluctant to leave the service and give up their seniority were assured by the Air Force that each could return at his former rank and seniority on completion of his CIA assignment. In the meantime, he would be considered for promotion along with his contemporaries who remained in the Air Force. Pilots soon realized that flying the U-2 required superior flying skills and a high degree of mental and physical stamina. Carmine Vito had his doubts at first; on looking in the cockpit and seeing the yoke used in bombers rather than the standard stick for fighters he remarked, "Oh, shit. It will be like flying a transport."

Bissell investigated a dry lake bed in Nevada located within the atomic testing area and adjacent to the Nellis AFB gunnery range as a site for flight-testing the U-2, and a runway and support facilities were hastily constructed. The site would come to be known by a number of names, among them Area 51, Groom Lake, Watertown Strip, Paradise Ranch, and Dreamland. On July 24, 1955, in the dark of night, a U-2 was loaded onto a C-124 and flown out of Burbank Airport to Area 51. The flight-test group piled into a DC-3 with its curtains drawn and followed. Air crews and technicians began arriving for training in the summer of 1955. On August 1, 1955, just eight months to the day after Kelly Johnson had gotten the go-ahead from the Agency, the U-2 was ready for its first test flight. Never in the field of aviation history had so much been achieved by so few so quickly. It remains a formidable achievement. Variations of the U-2 are still flying today. Tony LeVier, Lockheed's premier test pilot, took the plane up on August 4, with Kelly Johnson observing its performance from a T-33 chase plane that flew alongside. The flight went well, but LeVier had to use all his skill on the landing. Henry Combs, a structural engineer at Lockheed, was not surprised that the U-2 did not land easily. A craft with the U-2's enormous wing surface area wanted to fly, he said, not land.

The life of the U-2 pilot was, of course, of prime importance, and U-2 pilots wore specially designed flight suits. Each pilot had to travel to the David Clark Company in Worcester, Massachusetts, to be fitted with a custom-tailored pressure suit. The company, established in the 1930s, was primarily a manufacturer of quality bras and girdles. The ten-hour duration of U-2 flights presented special problems for pilots. During the early training flights, a catheter was inserted into the pilot's penis before he put on his flight suit so urine could be collected during the flight. Later, one of the pilots came in with a condom and a football bladder, which led to a new system. By the fall of 1955 the cockpit carried an external bladder that allowed the men to urinate during the flight, but there were still no provisions for defecating. Dietary adjustments took care of that. On the day before and the day of the flight, the pilot would eat a high-protein, low-residue meal consisting of bacon or steak, eggs, toast, and coffee. The pilot would feed himself and drink water during flights by inserting a plastic tube through the opening of the helmet faceplate. Charles Cravotta described the system to me as follows: "Liquids were stored in a plastic bottle and food (much like baby food) was stored in tooth-paste-like tubes and squeezed through the tube as desired. Commonly used foods were applesauce, peaches, beef and gravy. Liquids were water and fruit juices. The food and liquid were normally carried in a pocket of the leg of the pilot's coverall, which was worn over the partial pressure suit."[32]

Richard Bissell has received a great deal of the credit for developing the U-2, but others contributed as well to bringing the CIA's intelligence-collecting capability into the twentieth century. Robert Amory Jr., for instance, helped to modernize the Agency's photo intelligence capabilities. It was Amory who made the decision to detach the Photo Intelligence Division from the Office of Research and Reports and have it report directly to him. Highly intelligent and erudite, he was invariably gracious with his subordinates. Amory met with each of his office chiefs at least every two weeks. When he visited the Photo Intelligence Division, Lundahl would be ready with a list of accomplishments and an honest list of needs.

Amory listened well and took notes, especially of the needs. He was careful where funds were concerned, but the division never suffered for lack of money.

Amory maintained excellent relations with congressional leaders. He also had excellent relations with columnists, especially Joseph Alsop, and nationally known reporters, who often called him to check the authenticity of articles they were preparing. He was an avid hiker and mountain climber. During his visits to SAC, Air Force pilots would fly him to Colorado or Alaska to allow him to enjoy these pursuits. Although he knew that most of the people in his directorate wanted to stick with the old-fashioned "human" way of collecting intelligence, Amory saw technical intelligence as the only way to go.

Land agreed with Amory in that regard, and he was, of course, aware of the decade's significant advances in technology. In an era dominated by the doctrine of massive retaliation, he saw the problem as harnessing this technology to warn of an impending attack. Only knowledge, he told Bud Wheelon when explaining the goal of the TCP, made it possible to determine the source of a threat.[33] He once remarked that all government research and development activity eventually follows a well-worn path toward bigness, turf protection, security, inertia, and incompetence. He somehow managed to avoid that pitfall. Under Land's leadership, many learned men and women—leaders in academe, science, and industry—generously gave of their time and talents; research laboratories made their resources and facilities available; and industry displayed a willingness to cooperate in the manufacture of highly sophisticated hardware.[34]

Jimmy Doolittle, who knew the value of aerial reconnaissance in World War II, supported Land's view that every known reconnaissance technique should be used to meet the threat posed by the Soviet Union. President Eisenhower respected Doolittle for his reputation as a calm, dedicated, and resourceful scientist and aviator. William Baker called Doolittle "a tremendous patriot" and, along with the rest of the TCP, respected his vast knowledge of aircraft. Baker added that the panel members "had a high respect also for Jimmy's objectivity. Although he was very loyal to the Air Force, he didn't let it twist him, and so he became the last word as far as we were concerned on the margin of liability when we began to discuss the U-2. He gave the President very good information that the thing was going to be shot down, and, at some stage we all joined with that."[35]

TCP meetings were lively discussions that covered a wide range of topics. Land was a worthy leader. James G. Baker would later relate:

> Typically we would have a general meeting of the Killian group, and there would be about 40 to 50 people in the room. And Land would arrive somewhat sleepy from flying in, and being tired from not sleeping well and all of that. . . . [H]e would come in kind of sleepified, and he would listen to the discussion on whatever it was, and at some point he would start talking about his thoughts on the subject. Then he would get himself all worked up. And, a little bit later, he would be on his feet walking around the room, talking to the issue in the greatest of detail. Now he would be thoroughly active with his maximum IQ . . . entirely involved and . . . his blood pressure elevated. . . . It was a worthwhile demonstration. But Land was always interested in helping the government at every possible juncture, and using his good time.[36]

The TCP was not just another government panel whose members made recommendations and then retired back to their institutions. The intellectual accomplishments were made against a military mindset that wanted to do things the traditional way. The debt the country owes to these men is incalculable, and their accomplishments stand as a towering contribution to the security of the United States.

Like Amory, Land was a frequent visitor to the Photo Intelligence Division. Lundahl admired him, he told me, because "Land successfully fused the achievements of science with the needs of national security." In 1981 I was asked by Les Dirks, the Agency's deputy director for science and technology, to draft a recommendation for Land to receive the National Security Medal. I responded: "Whether in his Boston Office, in White House conferences, or in countless planning, budgeting and operational meetings, Dr. Land was always the motivator who provided the inspiration necessary to turn radical, innovative ideas from theory into reality. He also had that rare gift for inspiring others to achieve their own fullest potential. Perhaps his scientific and engineering resourcefulness was to be tested most in the faith and trust our national leaders placed in his judgments."[37] The medal was awarded to Dr. Land by President Ronald Reagan.

Land was a mild-mannered man with a shock of black hair, and he always appeared to be in a hurry on his visits to the PID. He had enormous self-discipline that enabled him to apply his multiple talents to the new and unique problems we were facing. He wore sport coats with leather patches on the sleeves and gabardine trousers somewhat like the "pinks" worn by officers during World War II. In meetings he would listen to what we had to say, then rise and with an astonishing profusion of detail tell us what had to be done. Land was a visionary of the application of science and technology to intelligence who helped to marshal the technical capabilities of U.S. industry for the PID. He would provide names of individuals and organizations we should contact. When Lundahl asked if he could use Land's name in making the connection, his reply was, "Of course." It was a sure way to get the person's attention.

In late October 1954 Land and Killian met with Eisenhower to discuss the various recommendations the TCP would make in its upcoming report. The formal report, "Meeting the Threat of Surprise Attack: The Report to the President by the Technological Capabilities Panel of the Science Advisory Panel," was issued on February 15, 1955. It would become the bible for scientific endeavors for the next three decades. The report noted the fundamental problem with U.S. intelligence efforts in the Soviet Union: "We obtain little significant information from classical covert operations inside Russia. We cannot hope to circumvent these elaborate [security] measures in an easy way. But we can use the ultimate in science and technology to improve our intelligence take." There was an admonition: "We conclude there is a real possibility that a surprise attack might strike us without useful, strategic early warning. We must find ways to increase the number of hard facts upon which our intelligence estimates are based, to provide better strategic warning, to minimize surprise in the kind of attack, and to reduce the danger of gross overestimation or gross underestimation of the threat. To this end, we recommend adoption of a vigorous program for the extensive use of the most advanced knowledge in science and technology."[38] The panel felt that highly motivated people with vision and determination could bring about the desired results. The president listened intently to the presentation but expressed his concern about leaks.

The TCP's report included the following footnote: "In order to keep this report out of a more restricted classification, the Panel has prepared for highly restricted classification two other reports on intelligence embodying recommendations and conclusions for transmittal directly to appropriate offices of the government."[39] It would have an important impact on U.S. government intelligence collection activities. Eisenhower, through a National Security Council Action, required all executive departments and agencies to comment on the TCP recommendations by June 6, 1955. Lundahl was given a copy of the document, and we prepared a lengthy statement of approval of the report.

Rehearsals for the 1955 Tushino air show lasted for several weeks. As had been the case for the 1954 May Day celebration, Bison bombers flew over the Kremlin in the rehearsals. Two Bisons flew one day, two the next, and two the following day, each bearing a different bort number. Each time they flew down the traditional Moscow parade route over the Kremlin, attachés with long-focal-length cameras on the roof of the U.S. embassy photographed them. On Aviation Day in July 1955, the Soviets staged a spectacular display of air power. The number of aircraft in the show was particularly impressive, but only one Bison flew over the reviewing stands. Instead, the Soviets displayed a second long-range bomber, the turboprop Tu-95 Bear.

The apparently large number of Bison bombers seen in the rehearsals led the Department of Defense, spurred by the Air Force, to call for an intelligence estimate on Soviet bomber production for the next five years. When completed, the report was rife with speculation and qualifying footnotes. The Air Force estimated that the Soviets' inventory would include more than thirty Bisons by the end of 1955 and about five hundred by mid-1959. When Eisenhower received the estimates, he ordered the secretary of defense to speed up B-52 bomber production. In testimony before Congress in 1956, Defense Secretary Neil H. McElroy testified that the Soviets would have six hundred to seven hundred Bisons in long-range operational units by 1959.

On November 15, 1954, Jimmy Doolittle had sent a report to President Eisenhower requesting the creation of a civilian group to oversee the CIA. Eisenhower did not act on the request, and Doolittle resurrected the suggestion in a 1955 letter to the president. This time, Eisenhower agreed. Executive Order 10656, effective January 12, 1956, established the President's Board of Consultants on Foreign Intelligence Activities (PBCFIA). The board was given oversight responsibilities for the CIA, the National Security Agency, and other intelligence units. The president considered the PBCFIA more than just a consulting body; it would make substantive recommendations on improving intelligence collection and analytical activities. The board was a permanent body. It first met on January 24, 1956, and was chaired by James Killian. On the board were James Doolittle; Robert Lovett, former secretary of defense and undersecretary of state; Benjamin Fairless and Edward L. Ryerson, who had headed major steel companies; Gen. John E. Hull, former commander in chief in the Far East; Vice Adm. Richard L. Connolly, former president of the Naval War College; Ambassador David E. Bruce; and

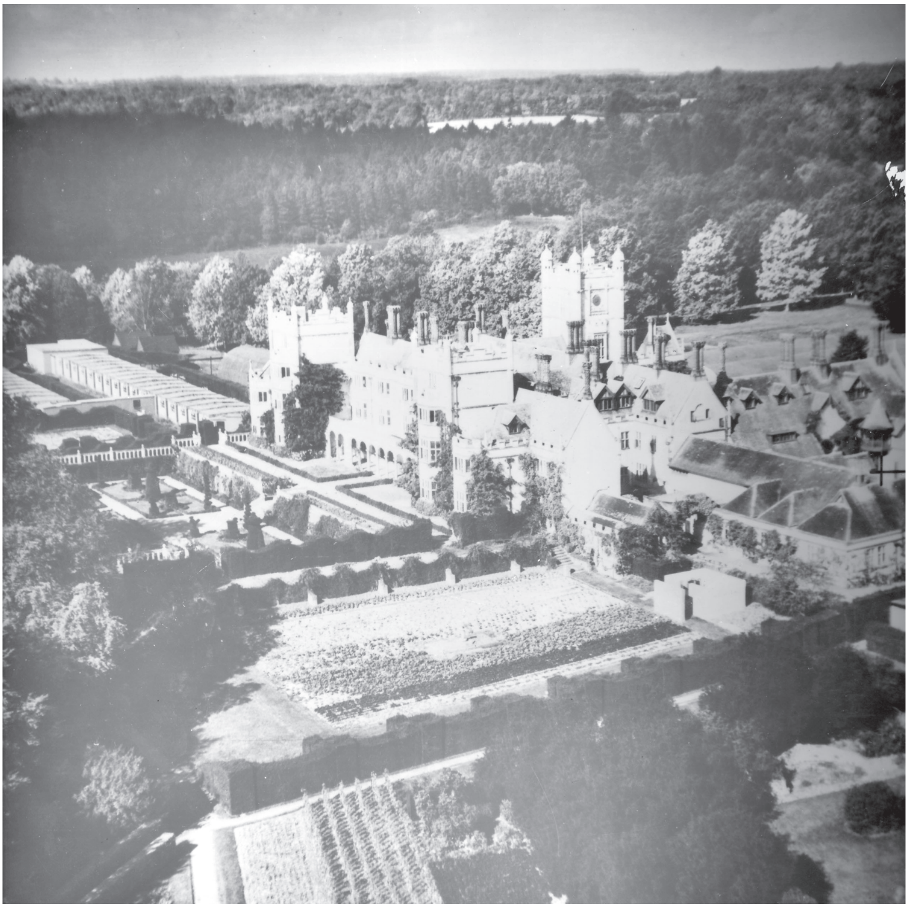
Colgate L. Darden, six-time representative in Congress from Virginia and former chancellor of the University of Virginia. Over the years, a series of distinguished scientists and renowned individuals served on the board, which reported to the president periodically on the work of intelligence organizations, particularly the CIA. It would later be renamed the President's Foreign Intelligence Advisory Board (PFIAB). The board instituted a thorough yearly review with visits to all U.S. intelligence-producing organizations, including the Photographic Intelligence Division. William Baker noted that the "PFIAB was very much a personal resource for the President. Killian met with him a lot of times. Killian had almost a daily interaction there. Killian had a very sensitive and perceptive view of what that group could do."[40]

No book has ever been written on the PFIAB's contributions to the intelligence community, but they are many. Baker commented: "We said during this whole PFIAB intelligence evolution—that industry, of course, is in a major mode: It's learning a lot of things. Because of the Soviet threat, we are going to see to it that the ordinary competitive restraints were not followed in the Intelligence Community. We're going to see to it that the Intelligence Community gets the knowledge it wants immediately, and we have confidence that it will respect it and not short circuit it."[41]

The author, holding a K-20 camera (right hand) and the camera carrying case, prepares a reconnaissance mission in Italy during World War II. (Author collection)

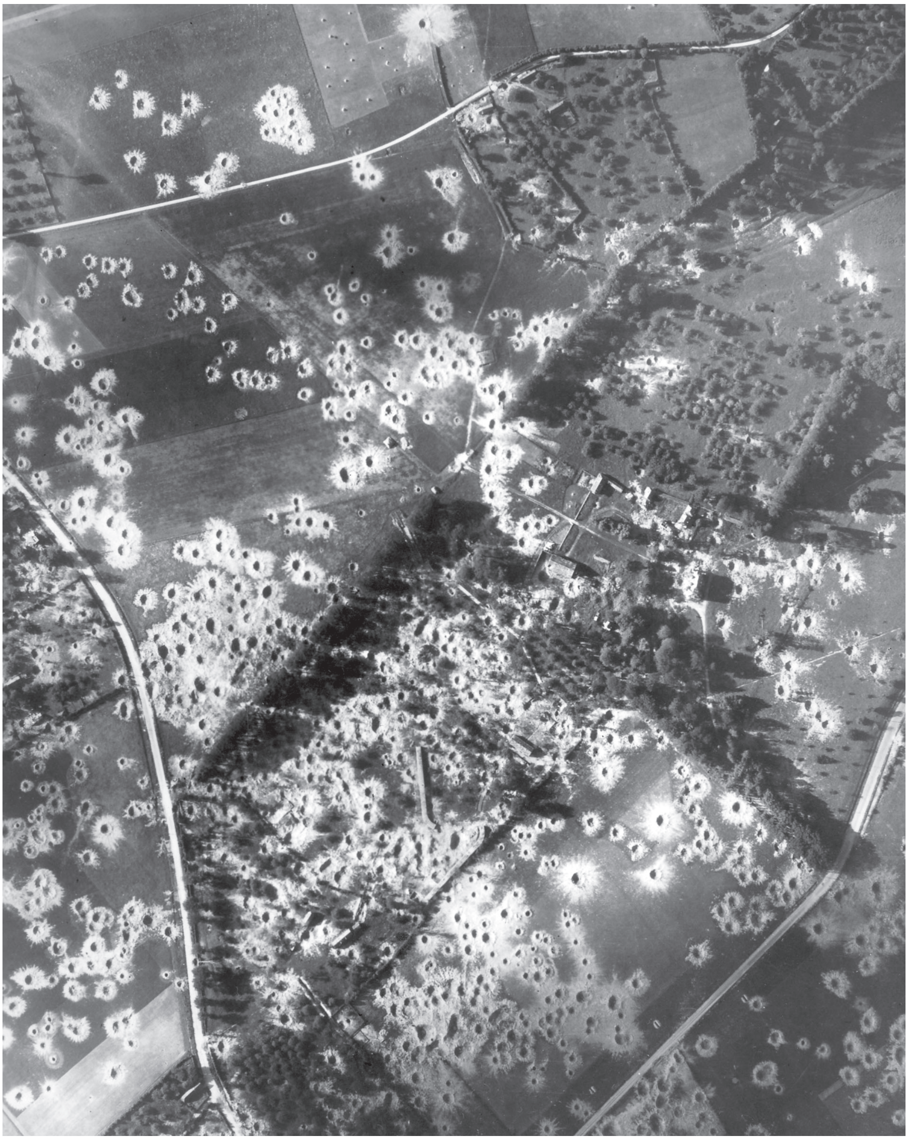
Maj. George Goddard shows President Franklin D. Roosevelt the finer points of photo interpretation during the president's visit to Wright-Patterson Air Base prior to the war. (U.S. Air Force)

Col. Elliott Roosevelt and General Eisenhower at the headquarters of the North African Photographic Reconnaissance Wing at La Marsa, Tunisia, in July 1943. (U.S. Air Force)



The palatial mansion at Medmenham, England, functioned as the main Allied Photographic Intelligence Unit during World War II. (Joint Air Reconnaissance Intelligence Centre–UK)

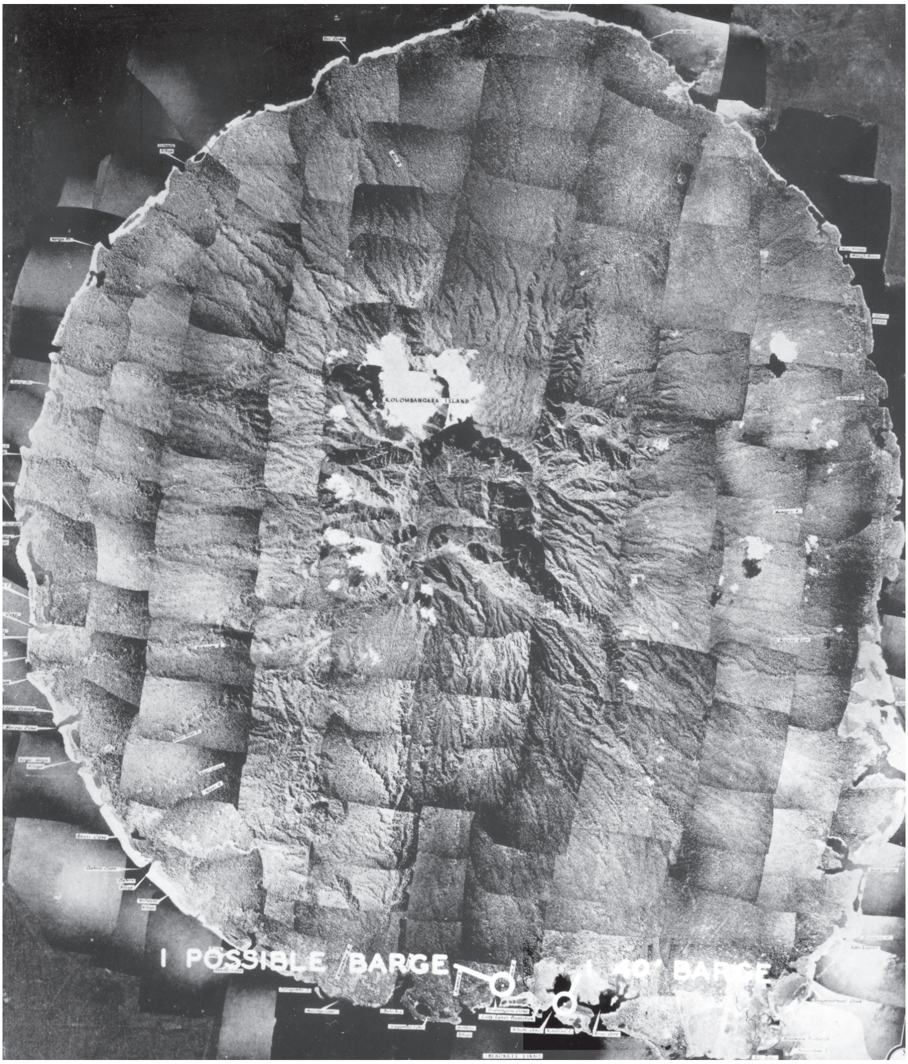
May 2, 1943, aerial photo shows V-2 launching pads at the German Peenemunde Guided Missile Test Center. The center was bombed by the RAF on August 14, 1943. (Joint Air Reconnaissance Intelligence Centre–UK)



Over 500 bomb craters are shown in this photo of the Les Hayon's V-1 site. Note that the launch rail and the control unit in the center of the photo were not struck. (U.S. Army)

The ramp of the Fresnoy V-1 site in France is heavily camouflaged, making it difficult for photo interpreters to find such hidden sites. (U.S. Air Force)

The most daring aerial photograph of World War II: an RAF reconnaissance pilot on July 21, 1944, dives his plane into a quarry to get details of the Wizernes V-2 assembly and launch site under construction. (Joint Air Reconnaissance Intelligence Centre–UK)

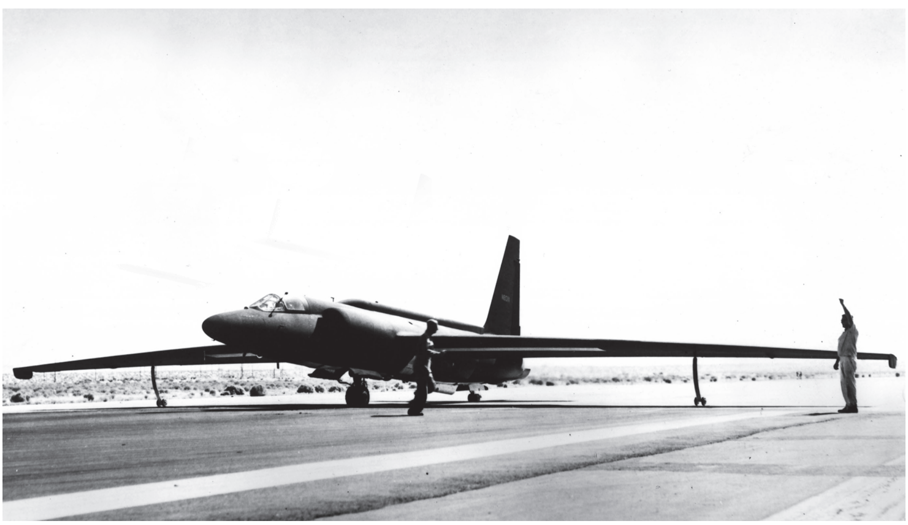


A mosaic made up from hundreds of aerial photos was used to both map and interpret areas where little other information was available in the South Pacific. (U.S. Navy)

An eight-week course was used to train hundreds of American World War II photo interpreters. (U.S. Air Force)

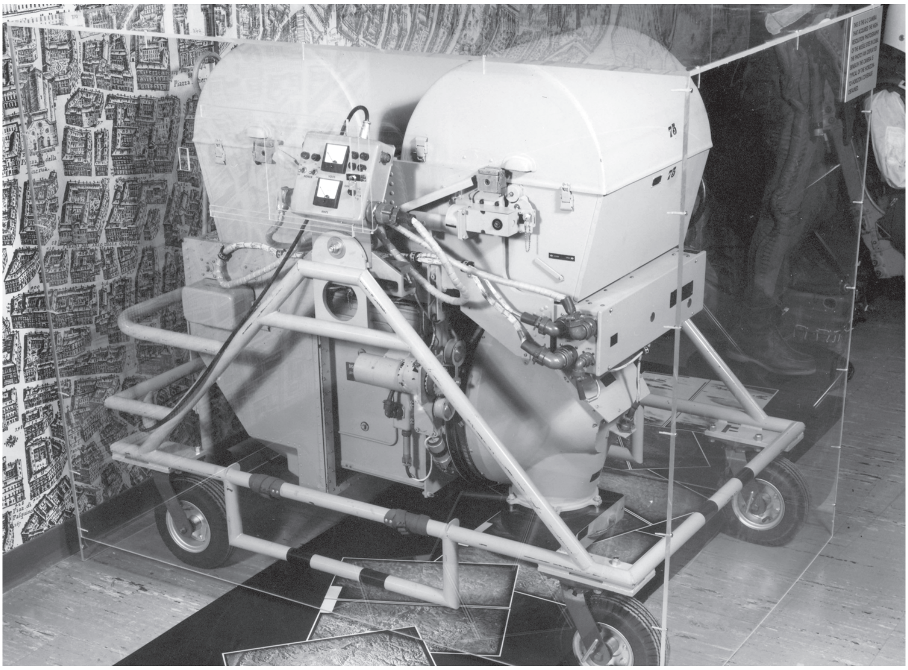
The World War II photo interpreter's tools would fit into an attaché case. (U.S. Navy)

The Steart Building at 5th and K Streets NW in Washington, D.C., was the first home of the Photographic Intelligence Division. (Central Intelligence Agency)

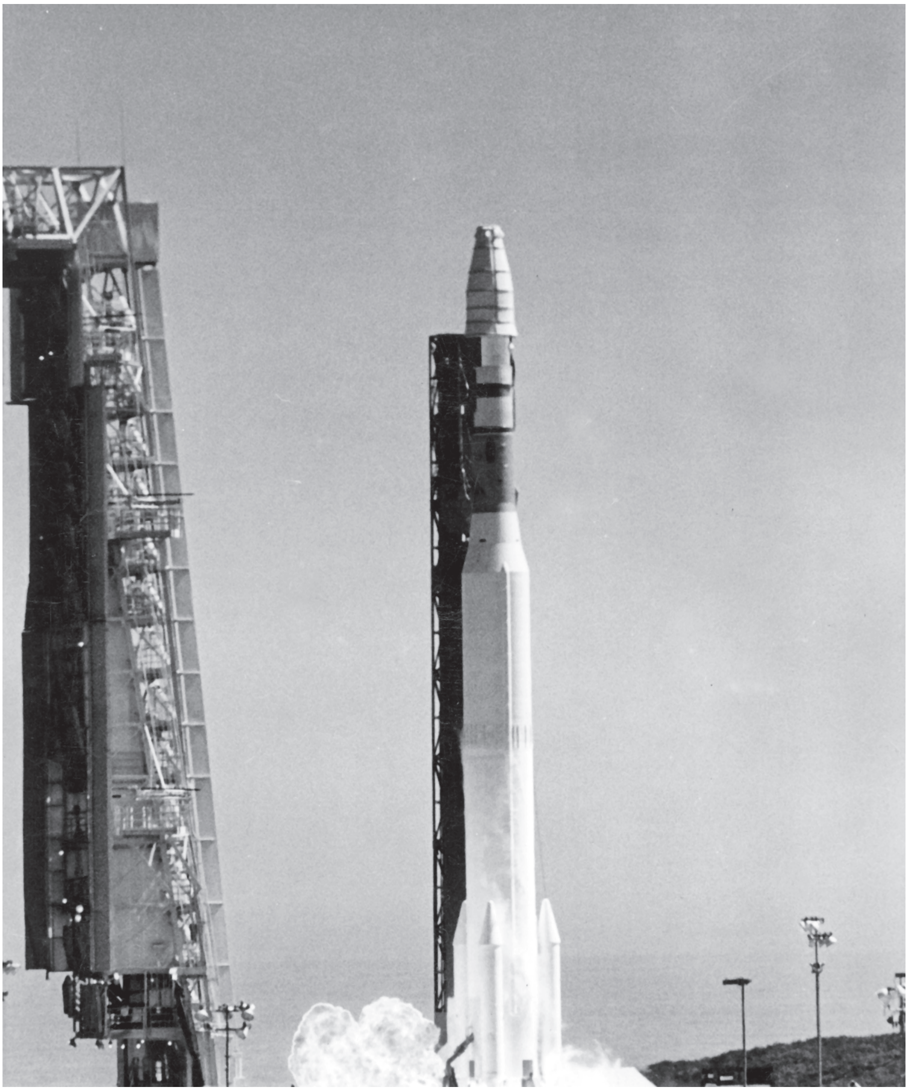


The Lockheed U-2, with an 80-foot wingspan, flew at over 70,000 feet and gathered not only information on Soviet strategic capabilities, but also data required in crisis situations. (Central Intelligence Agency)

U-2 pilot Francis Gary Powers, who was shot down on May 1, 1960, while flying a mission to determine Russian ICBM and nuclear capabilities, testifies before Congress. (Central Intelligence Agency)

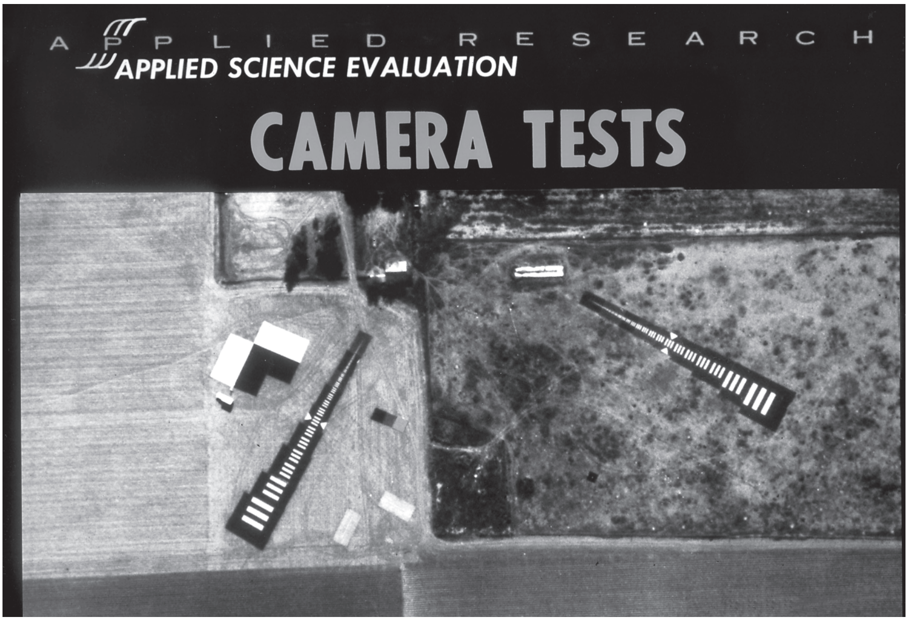


The B camera used in the U-2 was capable of photographing an area about 100 miles wide and over 2,000 miles long with a resolution of about two to three feet. (Central Intelligence Agency)

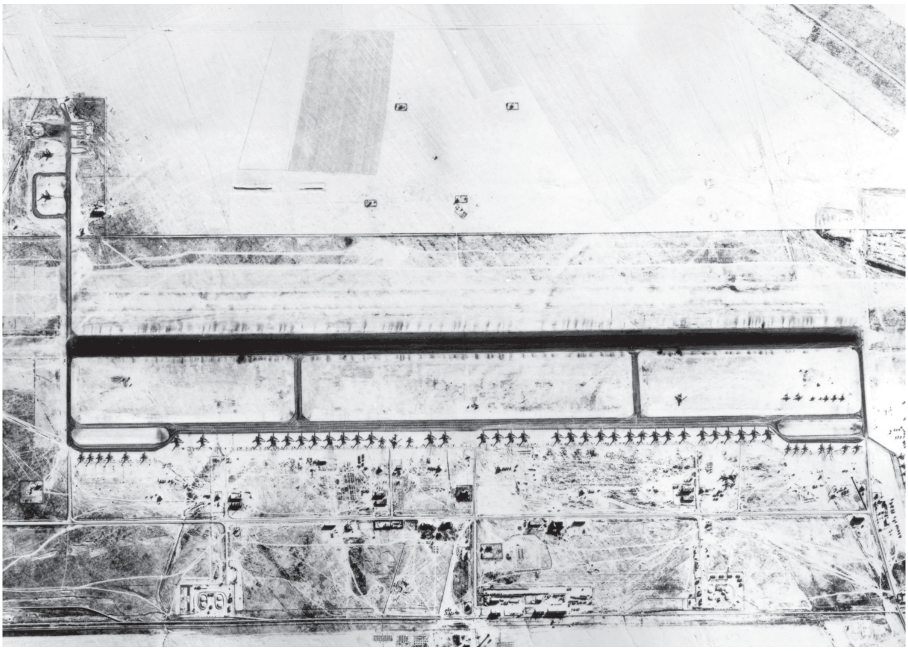


The Thor booster, adapted from the Thor nuclear missile, launching the Corona camera in the Agena spacecraft. (Central Intelligence Agency)

Eisenhower examines the *Discover XIII* capsule at the White House on August 15, 1960. (Dwight D. Eisenhower Library)



In order to gauge the accuracy of the Corona satellite camera, it had to be tested after launch. Here, a control range network panel displays known measured bar sizes used to test both satellite cameras and photogrammetric measuring capabilities. Here, a 5-ton multi-sensor truck, a 40'x 80'edge target, and two 51'-51' "T" Bar target legs are shown in a photo taken by a passing Corona satellite (Central Intelligence Agency)



Interpretation of U-2 photographs of Soviet long-range bomber fields revealed details and numbers of bombers in the Soviet arsenal. Photos like this one proved the bomber gap was a myth in the mid-1950s. (Central Intelligence Agency)

President Eisenhower and Dr. T. Keith Glennan on April 1, 1960, review meteorological photographs transmitted by the Tiros I satellite. (Dwight D. Eisenhower Library)

SIX
under way

The U-2 looked like a black vulture on crutches.
Arthur C. Lundahl

On December 13, 1954, Allen Dulles and Richard Bissell briefed Arthur Lundahl on Project Aquatone, the code name for the U-2 project. Bissell was extremely security conscious and incorporated a number of security procedures into the program, a practice often referred to in the intelligence community as "mouse-trapping your security." Bissell instructed Lundahl to prepare a detailed plan for the exploitation of the U-2 images, which would begin arriving in 1956, and gave Lundahl's staff clearance under Project Equine to begin setting up a photo intelligence center.

Lundahl vowed that photo intelligence would not revert to its prewar status as a "military stepchild." He envisioned his new organization as a wheel, with photo interpreters as the hub and other personnel with diverse talents and disciplines as the spokes helping to turn it. The other specialists would include experts in photogrammetry, printing and photo processing, editing, automatic data processing, graphic arts, collateral information support, technical analysis, three-dimensional model making, and mail and courier support.

In January 1955 Lundahl was given a free hand to select his personnel. He chose Bill Banfield, Norman Beckett, Jack Gardner, Myron Krueger, Zigmund Lenchert, Clifton Mullineaux, Hans Scheufele, Sid Stallings, W. Reece Walker, John Wilson, and me to be the cadre of the Photographic Intelligence Division (PID). Charles Frost Camp, the dean of men at Dartmouth, who had been a U.S. Marine Corps major in World War II, was selected as the division's executive officer and entrusted to hire the men and women who would be the heart of the division. Camp might talk to you as a dean, but more often he spoke as a major. I was given the role of preparing all of the briefing boards that would summarize the U-2 images and Lundahl's briefing notes to go with them. Camp said that he would get me all of the security clearances that Lundahl had. Then he added bluntly, "It's up to you that Lundahl is provided the proper information. If he gets his ass in a sling, I'll fire yours." That kind of Marine admonition gets attention.

The twelve officers selected for the cadre, facetiously labeled "Lundahl's apostles," began planning an organization to extract information from U-2 missions. The loyalty, enthusiasm, devotion, and total commitment engendered by and among his twelve apostles were remarkable. Lundahl had an office in Q Building in Foggy Bottom and a small interpretation shop in the basement of the CIA's North Building at 2430 E Street NW. We began assembling the equipment and support materials in Quarters I, an abandoned barracks that had housed a WAVES contingent during World War II.

Lundahl excited us with his promise that "we will have the opportunity to do something extraordinary and it will be one of the most challenging tasks we have ever undertaken. We will have a seat on the fifty-yard line of history." He then enunciated three primary goals: (1) provide the photo interpreter with all-source collateral intelligence to assist him and make most meaningful his interpretation of objects imaged on the photography; (2) provide the photo interpreter with all forms of support necessary to the proper performance of his job, including mensuration, editorial, graphical, and photographic laboratory, in order that his full attention may be devoted to the task of viewing and interpreting the photography; and (3) produce timely independent and unbiased photo interpretation reports to be uniformly disseminated to U.S. Intelligence Board member organizations as required.[1] We had a relatively small budget for salaries and new equipment.

The U-2 made its maiden flight on August 4, 1955, and its second flight on August 8. Bissell, who was present at the second flight, notified Allan Dulles, who passed the information on to President Eisenhower. A few months later, pilots were regularly reaching 70,000 feet and breaking altitude records. The U-2 was being tested in three ways. First and foremost were the aircraft and its engine. There was one problem that all involved worried about. If a flameout should occur over enemy territory, the pilot would have to descend to about 35,000 feet to restart the engine. The U-2 could glide about a thousand miles from its top altitude, but at low altitudes it would be vulnerable to both fighters and antiaircraft fire. Bissell liked to tell the story of a pilot on a training mission who had a flameout over Tennessee and glided to Albuquerque. Initial concern that contrails produced by the U-2 at operational altitudes could make the aircraft identifiable proved unfounded; planes flying above 55,000 feet did not produce them. The second test involved the physical and mental condition of the pilot after ten-hour training missions over the United States. The third was the cameras: Could they expose a six-thousand-foot reel of film properly without malfunctioning or tearing the film? The mission of all reconnaissance pilots is to fly the mission track as ordered and to get the prime target as close to nadir as possible.* At nadir, interpretation and measurements of the photo are the most precise. The pilot must know the technical capabilities and characteristics of the cameras. The cameras were preset for proper exposure with the height and the speed of the aircraft. Weather conditions, of course, were also taken into consideration. The cameras were installed in the Q bay of the U-2.

At about this time Gen. Curtis LeMay made another move to take over the program. He met Bissell when both were visiting the Tactical Air Command in Colorado Springs and said in effect, "You fellows can't be serious in wanting to conduct these operations." A tactical air commander cautioned Bissell: "Don't let LeMay get his cotton-picking hands on this project."[2]

The initial missions were flown with the trimetrogon A camera, which consisted of three 24-inch-focal-length cameras, one vertical and two oblique. The A camera was a modification of existing cameras that was used because it could be produced expeditiously. Parallel to designing and testing the A camera was the development of the B camera, which included a new 36-inch-focal-length Baker lens and a sophisticated image motion compensation. The camera imaged two 9.5-inch-wide frames of film through a single lens. The B camera was a high-altitude panoramic camera designed to take pictures of an extremely large area of the earth's surface. It could operate in a number of different ways, with each mode providing a different look at the ground. On most missions the camera took pictures in seven discreet positions, from horizon to horizon. The camera stopped momentarily at each position, took a picture, and then proceeded to the next position until it had photographed the entire area from the horizon on the right to the horizon on the left. The split field allowed the aircraft to remain relatively level and balanced, because one of the two six-thousand-foot film rolls would go aft

* Nadir is the point on a photograph that is directly below the camera when the photo is taken. This can be visualized by imagining a plumb line attached from the optical center of the lens to the center of a designated target.

while the other went forward. But there was a problem with the B camera. When each frame was on the platen for exposure, the frames could not be touching and a thin metal strip kept them apart. This gap meant a loss of imagery of about five hundred feet at nadir. When a pilot flew precisely over a target, there would be an imagery gap exactly where the image was most important. Pilots were later instructed to fly slightly right or left of a target to prevent a gap over a prime target. The camera was also star-field calibrated for distortion. This provided the photogrammetrist with precise ground dimensions.

The film from all the test missions was delivered to the Photo Intelligence Division, where Lou Franceschini, Clifton Mullineaux, Hilton Oglesby, and I would examine it and prepare a report with special emphasis on malfunctions or anomalies. We often compared the photography with maps of installations in the United States.

Both Bissell and Lundahl wanted to make sure that the president and the select members of Congress allowed to see the photos could appreciate the quality of the photography from the test missions. Drawing on his training and experience, Eisenhower relied on oral briefings, shunning copious documents; he also appreciated a terse memorandum. PID graphics officer John Pagenstetcher, Cliff Mullineaux, and I met with Lundahl to decide how best to show the results of these and subsequent missions. We decided on a twenty-by-twenty-two-inch briefing board format with rounded corners to preclude catching in people's clothes. It would be an enlargement with sufficient detail to be easily recognized by the naked eye. The classification, location, name, coordinates, and annotations would be added on a black background in white lettering. Initially I prepared three-by-five-inch briefing notes for Lundahl. After we got started, I met with Chick Camp and Lundahl and suggested that it might be a good idea to have briefing notes accompany each of our briefing boards so there would be no confusion or ad-libbing on the part of briefers from other organizations that received them. They agreed, so the briefing board and notes became the fast method to move information to our superiors. Eisenhower was familiar with various briefing aids from his stay at SHAPE and liked our idea. We made Vu-Graphs of the briefing boards to serve large audiences.

The U-2 test program commenced in earnest in 1955. Lundahl visited Area 51 and said that witnessing U-2 takeoffs and landings was akin to watching a Keystone Kops comedy. The frail-looking aircraft reminded him of a "black vulture on crutches." To properly test the cameras, film, pilots, and even the U-2 itself, long missions were flown from the West Coast all over the United States. A routine training flight would begin at Area 51 in Nevada and range all over the country, covering a two-thousand-mile radius and a four-thousand-mile range. Several missions were flown from bases in the East. Eisenhower was kept fully informed, and Bissell and Lundahl periodically showed him briefing boards of these test flights. On one such mission we asked that the U-2 be flown over the president's home at Gettysburg. A glassed-in porch added to the house in 1955 served as the main recreational area with a television set, poker table, bar, and comfortable chairs for friendly chats with guests. Outside the house was the president's putting green. Nearby was a large barn. The U-2 obtained a clear picture of Eisenhower's farm, and we created a briefing board for the president. Lundahl pointed out the new porch addition, then Eisenhower grabbed the board and began a literal tour of the area. He took great delight in identifying objects about the farm, particularly his prized Angus cattle; he even pointed out a bull. He commented on the photos in his memoirs. "Proof of the [U-2's] capacity to produce photography of excellent quality was striking. I was shown photography, taken from an altitude of 70,000 feet, of some of our important cities. Of these we could easily count the automobiles in the street, even lines marking the parking area for individual cars. There was no doubt about the quality of the information to be obtained."[3]

We also had U-2 photos of Senator Richard Russell's birthplace in Winder, Georgia, along with Washington and New York. On an enlargement of the Capitol, Lundahl pointed out the stripes delineating parking places. We could even identify specific car models. Bissell was pleased. "I saw photographs of our own Capitol," he recalled in his memoir, "in which the photo analysis not only counted the number of cars but identified their makes—all this from about thirteen miles up."[4]

As the U-2 program progressed, Bissell maintained tight control on security clearances. Still, he realized he had to have an organization to recommend targets for the U-2 flights. Toward this end he created an informal Ad Hoc Requirements Committee (ARC) to select the highest-priority targets. Initially comprising representatives of the CIA, Army, Navy, and Air Force, ARC was an open forum where the representatives could present, discuss, and debate the prioritization of intelligence targets. James Q. Reber, who had a great deal of experience managing interagency conflicts, was the first chair. Subsequently, representatives of the State Department, Joint Chiefs of Staff, and NSA were included. At the first

ARC meeting it was generally agreed that the number-one issue was the so-called "bomber gap," and the majority of targets selected were Soviet long-range bomber bases and large urban areas in the western USSR. For subsequent missions, each service representative would argue vociferously for targets of specific concern to that service. Reber would listen patiently to the arguments, reflect on them, and then decide which flight track would be the most efficacious in satisfying intelligence needs relative to the national estimate.

After target selection, a group of CIA staffers would meet in Reber's office to help draft a request for presidential approval. These sessions usually occurred in late afternoon or early evening. Sidney Graybeal would write the portion delineating the intelligence a particular mission was expected to produce relative to missile estimates; Herb Bowers focused on intelligence relative to strategic bombers; and Henry "Hank" Lowenhaupt focused on nuclear weapons. After a flight line was drawn connecting the targets, James Cunningham, a former Marine Corps pilot, and I would try to bend it to pick up bonus targets such as industrial installations, military camps, and fighter airfields along the way. We thus attempted to maximize the intelligence take from each mission. I would recommend the tracks and Cunningham would compute the fuel required. Each proposed mission would have four to eight priority targets. I would mark the track on a World Aeronautical Chart (WAC) in red and indicate the prime targets with a large red symbol that became facetiously known as a "meatball." The U-2 pilots had virtually no freedom to deviate from their assigned course because the aircraft carried just enough fuel for the assigned mission. When we finished, I would report to Reber the number of lesser priority targets that could be covered. After the mission was completed, I would brief the intelligence community using the WAC.

When the mission's flight plan was complete, Reber composed a brief justification memo for Eisenhower's approval. One paragraph would cover the potential take for missile information; another, nuclear information; the third, bombers; and the fourth, the number and types of bonus targets that could be accrued. Undersecretary of State U. Alexis Johnson and the secretary of state also read it and made comments. Throughout this period, a pattern was established whereby Allen Dulles or Bissell would show the president the memo justifying the mission along with the proposed flight tract. Bissell noted that the president did not just rubber-stamp the memo: "On at least a couple of occasions he exercised his authority as commander in chief by suggesting the flight plan be altered. He was a cautious man who liked to have contingencies under his control."[5] Eisenhower did not make an immediate decision. He would reflect and discuss the mission with John Foster Dulles, and his decision would usually be transmitted by his aide, Col. Andrew Goodpaster, who returned the memo with a scribbled "DE" or "DDE."

U-2 missions had to be flown over areas free of clouds or bad weather, so weather conditions were a primary consideration in planning the missions. An Air Weather Service unit at Suitland, Maryland, provided forecast information. In 1958 the unit was transferred to Special Projects of Weather Forecast Central at SAC headquarters in Omaha. Ironically, the missions were flown primarily on information obtained from intercepted and decoded Soviet weather reports. Hyko Gayikian, a chief meteorologist, noted that

> weather data over the Soviet Union, while not classified, was sparse. The Soviets transmitted to the outside world only the absolute minimum of information required by the Meteorological Committee of the International Civil Aviation Organization (ICAO). However, their internal communications were so archaic that they used radio carrier waves to collect and transmit their weather data to Moscow. Both the United States and the United Kingdom surrounded the Soviet Union with radio listening sites and intercepted their data. It was transmitted to the United States by wire so that we had complete weather data for the U.S.S.R several hours before the Soviets did with their carrier wave communications. Retransmission across the USSR took a long time.[6]

Information from Weather Forecast Central was also used in planning presidential flights and peripheral flights around the Soviet Union.

Arthur Lundahl was the linchpin that held the PID together. He realized that the division had to keep pace with new developments, and that technology-driven innovations required a dramatic change in organization from the way things had been done during World War II. He surrounded himself with managers who could grasp the need for change and focus on the developments the new technologies would bring. The cadre he selected included people who could not only sustain constant efforts of innovation but also provide the necessary incentives for that innovation to take place.

I first met Lundahl in the early 1950s, when we each represented our organizations—he the Navy and I the CIA—in ground photo conferences held at the Aeronautical Chart and Information Center in the old Midway Building in

Washington, D.C. The Midway Building had been a temporary WACS barracks in World War II and was situated along the Anacostia River where RFK Stadium is now located. It contained a collection of World War II aerial film, aeronautical charts, and photographs. Lundahl and I had numerous discussions on photography. I was impressed with his technical knowledge, and he was impressed with my knowledge of Soviet targets. After the CIA hired him, he told me that he wanted me to be a part of his new organization.

Lundahl's lectures in Washington were classics. He frequently quoted Thomas Jefferson, particularly, "I like the dreams of the future more than the history of the past," and "A little rebellion now and then is a good thing." He would explain to his audience that the photograph had brought into existence a category of proof called "demonstrative evidence." The photo froze a moment in time and became a priceless historical record. In a lecture at the Cosmos Club in May 1955, he said: "Photography affords us a graphic record of an infinite variety of natural and cultural activity. The qualitative and quantitative analysis and interpretation of that record affords us a universal language of communication enabling us to view all things more accurately than vision itself."[7] He would later add that photo interpretation is a human skill that can be supported but not replaced by automation.

From the beginning, both Lundahl and I pledged that the division would use all-source intelligence in interpreting aerial photography. Some CIA analysts expressed concern that we lacked sufficient experience to handle communications intelligence and tried to keep us from getting clearances. Robert Amory, the deputy director for intelligence, quickly dispensed with that notion. Dr. Louis W. Tordella of the National Security Agency also believed in a synergetic approach to intelligence. "Dr. T," as he was known, met frequently with Lundahl and pledged the NSA's cooperation, not only to observe Soviet reactions to U.S. overflights but also to work together to solve mutual problems. Through his efforts, green (secure) telephone lines were approved for the PID for communication with headquarters analysts. An NSA liaison officer would meet with me every morning and brief me on new information on targets of interest. Lundahl's office had a red line, a secure line for communications with the deputy director for intelligence and the CIA director. Dr. T would become the NSA's deputy director in 1958 and served in that position until he retired in 1974.

As we began processing the first U-2 imagery, a search was being made for a permanent home for the division. One of the requirements was a plentiful supply of water for photo processing. The two most promising sites were the abandoned

Sunshine Arcade laundry and the upper floors of the Steuart Motor Car Company building. We settled on the latter. The nondescript Steuart Building was in a crime-ridden area of Washington at 5th and K streets, NW. The upper four floors would become the division's home; the lower floors would be occupied by the Steuart automobile sales and repair shops along with the Steuart Real Estate office. "The Steuart Building was not the finest building in the world to work in," Lundahl recalled. "There was no place to eat, no place to park, no air conditioning, our people were getting mugged on the streets before it was fashionable. I guess the best thing you could say is that it had wonderful security cover, because I am sure nobody would ever believe that anything of any importance to the United States could be taking place in a trashy neighborhood."[8] The efforts of a small group of dedicated, determined people working out of the equivalent of a garage in a "trashy neighborhood" would have a tremendous impact on history. The undaunted Lundahl quipped, "Where a choice be necessary, give me good men in poor ships rather than the converse." We were deeply committed to creating a photographic intelligence data center for the intelligence community, something that had never been attempted. Lundahl provided the inspiration, visionary zeal, and technical expertise that would revolutionize the photo interpretation process. His leadership motivated everyone and fostered a wonderful sense of collegiality.

The results from the U-2 test missions were astounding, but the division had only World War II stereoscopes and tube magnifiers with which to view the images. It is appropriate at this point to discuss photographic resolution—the size of an object that can be seen on a photograph; a two-foot resolution, for example, indicates that a two-foot-square object is visible. The most generally used technical measure of resolution is the number of lines per millimeter distinguishable on the film. A photographic line is actually a pair of lines, one black and one white, that can be seen and counted within one millimeter under magnification. The more lines per millimeter, the better the resolution and the larger the enlargement possible. During World War II, for example, cameras could obtain about 20 lines per millimeter. The U-2 film was resolving an astonishing 100 lines per millimeter. Advances in film technology later raised it to 125–150 lines. The U-2 missions were resolving about two and one-half feet at nadir. With that type of quality, mensuration of nuclear weapons loading pits, new aircraft, missiles, and the like was possible.

Lundahl loved to quote Amron H. Katz, the distinguished RAND scientist: "You take a multi-million dollar airplane, a hundred thousand dollars worth of cameras, take off on a hazardous, expensive mission, get back . . . run the film through comparably expensive processing machinery . . . and when the photo interpreter gets around to extracting the information on the photography he uses a ten cent magnifying glass."[9] Amron, as usual with a minimum of words, had underscored an important issue.

Ten years had elapsed since the war, and we were still using a 4-power stereoscope and 6-power tube magnifier to interpret aerial photos. We were also still using paper prints. We were losing precious intelligence. We soon realized that proper photographic interpretation required the development of new equipment. Gordon Heath, one of the division's interpreters, tried a medical binocular microscope to view some U-2 imagery and was surprised at the detail he saw—details missed using the tube magnifier. Unfortunately, he could not see the targets in stereo. With the addition of mirrors, he reasoned, he would be able to see stereo, and at the desired magnification. Taking small mirrors like those women normally carried in their purses, he created a prototype rhomboid, and thus the microstereoscope was born. It is still in use today. One change quickly made was to have duplicate positives rather than paper prints sent to the division. Another was to develop a light table whose light source could be controlled by the interpreter. The light table, duplicate positives, and microstereoscopes combined to increase photo interpreter efficiency one hundredfold. Lundahl reorganized his forces to concentrate on developing a "family" of equipment designed specifically to extract all the information captured on the film. He put senior division engineers Duane W. "Doc" Linker and Robert Neasham to work on developing new photo interpretation gear. Working with Bausch and Lomb and the Richards Corporation, they produced an encased light table for exploiting duplicate positives and a microscope with rhomboids for stereoscopic viewing of the film.

The exacting science of deriving dimensions from imagery—photogrammetry—was performed by professionals known as photogrammetrists. Lundahl was fond of quoting Lord Kelvin, the renowned British scientist, in that regard: "When you measure what you are speaking about and express it in numbers, you know something about it." He was determined to develop sophisticated mensuration techniques and to have an instrument facility second to none to employ them. To accomplish this he hired his friends Chris Mares and John Cain, who had spearheaded the U.S. Navy's photogrammetric effort.

When Lundahl attended the International Photogrammetric Society's convention in Stockholm in 1955, he saw no precision stereocomparators on display.

The only comparators displayed were 10-micron instruments with approximately 12-power magnification. He quickly realized that the division had to design its own instruments to properly measure U-2 images. Before any mensuration effort could proceed, the photogrammetrist had to understand the technical characteristics of the cameras, lenses, film emulsions, and processing techniques. Analytical and mathematical models had to be developed including mensuration parameters and ephemeral data files. Accuracy also required a domestic and later a foreign ground truth program—installations whose dimensions were known—in order to establish how well photogrammetrists could measure overhead reconnaissance photography.

But all that lay in the future. In 1955 the only equipment the photogrammetrists had was a scale and a tube magnifier with etched reticules. Calculations were done with slide rules, and Marchand and Friden desk calculators were used for computation. Shortly after the move into the Steuart Building, the photogrammetrists began using a Mann Comparator Type 621, generally used in mapmaking, to determine measurements, primarily of installations. A monocomparator measures X and Y coordinates of a single photographic image. A stereocomparator permits two overlapping frames of photography to be viewed, thereby presenting the object in three dimensions, measuring the X and Y coordinates of both frames and facilitating a more accurate analysis.

Along with better equipment we needed faster and better methods for producing dimensions. In 1957 the division received the CIA's first computer to use for data management, an ALWAC 3E. It employed radio tubes, and the temperature and humidity of the room that housed it had to be precisely controlled. Each morning a technician equipped with a mail carrier-like pouch would bring each stage of the computer up. If the voltage did not reach the proper level, he would test the tubes and remove and replace the low-performing tube. This process often took several hours. Then several trials were made to determine if the results were as they should be. The ALWAC was a total-batch process system, which meant that operators could load data in and get data out.

Two years later we got the Nistri Stereocomparator TA-3, designed by Italian optical designer Geno Parenti and manufactured by Ottica Mechanica Italiana of Rome. It was specifically designed for aerial and spatial photography. Dr. Parenti accompanied the TA-3 to Washington and helped install and test it. It arrived just in time. The Air Force Foreign Technology Division was clamoring for measurements to determine the capability of Russian aircraft and missiles, and the Navy was asking for dimensions of Soviet naval vessels, especially submarines.

My unit was responsible for procuring all the maps, charts, and collateral materials required for flights over the Soviet Union and Eastern European countries—a job that had to be done with the utmost secrecy. I knew about Soviet targets from my experience in the CIA Industrial Register. We were also responsible for processing the photos the missions returned. Since most photo interpreters had little or no knowledge of Soviet targets, we had to create a new information-processing system. But I was ever mindful that the information-processing system I was creating would be for the exploitation of photography obtained by reconnaissance methods of the highest sensitivity. Because of the unique characteristics of the system, we knew we could create the most efficient data-processing system in the intelligence community.

Three reproduction options were available at the time: thermofax, microfilm, and an early Xerox process that involved charging each plate before attempting to reproduce information. These simply would not do. The information we would be gathering would have to be transmitted rapidly to our customers, who demanded current and relevant data.

We started from scratch with a target header that contained the name of the city or town, the installation name, the country, coordinates to minutes and seconds, a Bombing Encyclopedia number if one was available, and the number of the WAC on which the target was located, followed by a Photo Intelligence Division (PID) number. An overlay showed the location of targets of interest on each WAC. We wrote briefs of each target and included intelligence requirements for military and strategic targets from ARC. The workhorse for our new processing system was an IBM 407. It was basically a punch card "lister" and required batch processing to generate target briefs and an accompanying worksheet. We progressed to the IBM 1401, which had 16K of memory and had to be programmed with keypunch cards, and later purchased one of the first IBM 1410 computers, which further helped to speed up our reporting. The system was flexible and easily expandable when we began overflying countries during crisis periods.

Interpretation was a time-consuming and laborious process. When photography from a mission was received, a photo interpreter would be issued a can of film. The interpreter would use a WAC with the targets indicated to locate a position on the film, and would then read the target brief that had already been written along with the requirements for information. After interpreting the film, the interpreter would write observations on a worksheet, list the location (X and Y coordinates) of the target on the film, and rate the interpretability of the imagery. The worksheet next went to a team leader for review. An editor reviewed the worksheet for style, grammar, and completeness and gave it to the mission coordinator for approval. After that step, worksheets went to the keypunch operator, who punched one card for each line of text. The cards were then fed into a computer processor, which printed out a proof run in subject order (missiles, airfields, etc.) for final editing and review. Each evening, a corrected proof would be run, and the final version of the latest Situation Summary (SITSUM) would be ready for transmittal by cable and hard copy to the intelligence community. The database would then be updated and preparations would begin for incoming missions. To better cope with the increasing size of the target brief file, a UNIVAC 490 real-time computer was installed in the 1960s.

New ideas for processing and viewing imagery were always welcomed; some panned out and some did not. For example, Dr. Land saw a need to miniaturize the data we would be receiving from the U-2 and future collection vehicles to reduce storage space. He was the principal driver of a project called Minicard. Developed by Eastman Kodak, Minicard was a major advancement for its day that succeeded in reducing page-size documents or aerial photos onto a chip about the size of a thumbnail. The chips would be sorted by subject and held on devices called shishkebabs, and they could be searched for information. The idea was a good one, but the technology for rapid scanning was just not there. The electronic scanning of the coded chips was a slow and cumbersome process. My unit was the first in the intelligence community to receive the machines, and we were responsible for coding the scanned data. SAC was the only other organization to use the Minicard system. Not only was the response time slow, but the system could not be integrated with any future computer data system. After a few years, both the CIA and the Air Force dropped the Minicard as a means of processing information from airborne data-collection systems.

SEVEN
1955: year of transition to technology

Nyet! Nyet! Nyet!

Nikita Khrushchev

Nineteen fifty-five was for President Eisenhower a year of reflection on the sobering thought of an atomic war, assessment of technological capabilities for intelligence collection, and advancement of ideas for better relations with the Soviet Union.

Operation Alert

Alarmed by the awesome power of the H-bomb, Eisenhower early in his first term commissioned a study and test of how the United States could function in the event of a surprise Soviet atomic attack. He decided to test that ability with Operation Alert, 1955. The exercise called for the president, cabinet members, and more than six thousand very knowledgeable federal officials to be relocated from the Washington, D.C., area. The president and cabinet members were moved to a remote site from which they would continue to run the country.

I was one of about sixty members of a CIA contingent that took part in the exercise. About a week before the alert, which ran from June 15 to June 17, 1955, we had taken operational files to the CIA's relocation site. I had transported five filing cabinets of target information on seventy Russian cities that were of prime interest to the U.S. military as part of the Single Integrated Operational Plan (SIOP). When the sirens wailed on June 15, the selected government officials went to their respective relocation sites. I began driving along with other Agency personnel to the CIA's site. Rather than taking highways that would be blocked in an attack, we took predetermined side roads. When we arrived, we discovered that the Agency's medical staff had set up a decontamination tent. Medical technicians checked our medical records and administered shots to those lacking up-to-date vaccinations. We were then checked in and began considering various scenarios. We quickly established communications with the remote site where the president was, and we began fairly active communications with the Department of Defense, the military services, and the Atomic Energy Commission. At the same time, an interim assembly consisting of the president and cabinet members was considering other scenarios. Most were predetermined; the remainder grew out of the exercise.

In one of our scenarios, New York had been bombed and a Soviet bomber had been shot down. We alerted the Joint Factory Markings Center, as would have been done in an actual situation, to obtain information from the downed bomber. Because there were no aircraft at the CIA's relocation site, the Markings Center people went into a maintenance shed and prepared to analyze the lawnmowers. They had started photographing the lawnmowers' labels and tags when a guard at the site came running up and demanded to know what in the hell they were doing. He was threatening to arrest them when his supervisor arrived to straighten things out.

One of our other scenarios involved retaliation. SAC's long-range bombers were designed to survive even an all-out surprise attack in numbers sufficient to deliver a devastating retaliatory attack on the Soviet Union. The military services called for folders on Moscow, Leningrad, and Soviet long-range air bases for possible retaliation. Among the folders called for was the Kirov plant—the GE of the Soviet Union—in Leningrad. That request interested me because I thought that President Eisenhower had visited the plant after the war. The imposition of martial law—declared as part of the exercise—made it impossible to consider the many requirements that would have been levied if the request had gone through normal avenues.

The exercise exposed serious problems. The biggest problems were in communications, particularly with agencies that had little or no experience communicating outside their offices. The Bureau of the Budget, for example, was housed in tents and relied on a military field telephone system. One agency was housed in a college, and another was in a hotel with only telephone service. Sometimes car telephones were used in interagency communications, creating a major security issue. Communication and cooperation with state governors posed another significant problem, especially in the mobilization of the National Guard for civil defense, bomb damage estimates, and rehabilitation purposes. While the CIA and the military services had someone in charge around the clock to classify and transmit information, a number of civilian agencies did not.

Interagency power struggles also emerged. Early in the exercise there was some concern as to whether the Office of Defense Mobilization, which controlled all executive branch mobilization activities, had the appropriate power to act in an emergency. Commerce and Interior bickered over which would be responsible for fuels and metals. Air, sea, rail, and road communications were concerns. Was the Department of Agriculture or the Office of Defense Mobilization in charge of food distribution? There was general agreement that food and fuel rationing would be instituted and that ration books would have to be printed. We were shocked to learn that the Government Printing Office required more than five months to produce ration books and planned to subcontract the printing to four other printers![1] When President Eisenhower heard that, he threw his hands in the air and said, "Oh, shit," in exasperation.

None of the president's cabinet leaders was conversant on estimates or the consequences of an atomic war. Each was looking at his own area of responsibility and failing to see the larger picture. But it was not just the cabinet officers. The performance of governmental agencies at all levels was abysmal. My roommate during the exercise was William Bundy, who later would become a high-ranking Defense official. One evening we were discussing what our seniors were regarding as a rather successful session. He looked at me and said. "Man, the whole day we were whistling past a cemetery."

On the last evening of the exercise, Allen Dulles profusely thanked us for our efforts. Dulles had felt right at home out in the field. Part of the appeal of clandestine operations was the matching of wits with an opponent. He regaled us with stories of his wartime efforts as head of the OSS network in Switzerland and told us about unmasking "Cicero," a German spy who was the valet to the British ambassador to Turkey.

Operation Alert revealed that the entire nation was unprepared in many ways to respond to an atomic attack. As a result of the exercise, underground installations were built to shield executive and legislative branch leaders, and all federal agencies were ordered to establish relocation sites.

Eisenhower later emphasized the ramifications of nuclear war to a legislative group:

> What do you think would happen if this city was hit today by an H-bomb? Do you think you would vote or ask me to send the troops at Fort Meade overseas—or would you be knocking on my door to get me to bring them in to try to pick up the pieces here in Washington? We have to do that. All our military plans are based really on two things—one, to destroy the enemy's production and two, protect [our] own. To do that we need not just more than men. We need more equipment, an expanded air force and an expanded warning system.
>
> "As the president was talking," notes the account of the speech, "you could hear a pin drop."[2]

Eisenhower's wartime experience had taught him that no nation, regardless of its resiliency and determination, could long continue in a nuclear war after its important industries and cities had been pulverized. He had seen that happen in key cities in Germany where an average of 40 percent of the dwelling units were destroyed or seriously damaged, with attendant psychological effects. People who must expend all their energy on survival have little desire for war.

At an expanded cabinet meeting held on July 25, 1955, cabinet officials involved in Operation Alert congratulated themselves on the success of the exercise. The president's comments were in part complimentary and in part disparaging. In response to Secretary of Commerce Sinclair Weeks' comment that he had sent 450 people to a relocation site and everything had gone rather smoothly, Eisenhower shot back, "In a real situation there would not be normal people—they will be scared, will be hysterical, and will be 'absolutely nuts.'" The president added that "the plans for work at relocation sites should be drawn up on the simplest possible lines, in order to enable a man who will be beside himself with grief and apprehension about his family and country to carry on and do something that will be of use. . . . We must not assume that we are going to handle these problems with calmness. Any such assumptions would be completely unrealistic."[3]

The idea of a surprise attack continued to bother the president, and near the end of his first term, in 1956, he asked the Department of Defense to prepare guidelines authorizing the use of nuclear weapons by "predelegated" senior military commanders in the event of a surprise attack. The authority to launch nuclear weapons was only to be used "when the urgency of the time and circumstances clearly does not permit a specific decision by the president, or other person empowered to act in his stead."[4]

The president gave the chief of staff of the Army authority to use nuclear warheads in shooting down attacking bombers. He also predelegated authority to the commander of the Air Force Strategic Air Command "in circumstances where communication between the President and the Commander of SAC is impossible because of the result of atomic attack." A civil defense program was developed to designate and stock a nationwide system of blast and fallout shelters. A top secret relocation center, code-named "Casper," was constructed for Congress beneath the Greenbrier Hotel in White Sulphur Springs, West Virginia. An airborne command post, code-named "Looking Glass," stood by along with specially equipped communications ships to take the president and his advisers aboard in the event of an emergency.

Open Skies Proposal

President Eisenhower realized that the nature of war had changed forever. He had witnessed the suffering and losses that conventional war brought; nuclear war would expand the losses and suffering one thousandfold. If both the United States and the Soviet Union were to survive, they had to avoid nuclear war and gain a better understanding of each other's capabilities. An improved intelligence and reconnaissance system would reveal just what those capabilities were. Eisenhower did not accept the inevitability of an endless, dangerous confrontation with the Soviet Union. He believed that if he could engage the Soviet leaders in a constructive dialogue, it would lay the foundation for further talks—and perhaps someday peace—between the two countries.

The president was also well aware that overflight of another state without authorization was an illegal and hostile act. He decided to try to legitimize aerial reconnaissance, hoping to gain Soviet acceptance, and commissioned a report that would examine every phase of aerial reconnaissance. He was also receptive to the idea of using aerial reconnaissance as the vehicle for inspection and compliance with a proposed disarmament agreement. The idea became known as "Open Skies."

Four groups submitted ideas and proposals to Nelson Rockefeller, who was drafting a disarmament proposal for the president to present at a summit conference to be held in Geneva in July 1955: (1) the "Quantico group," headed by Prof. Max Millikan of MIT, the former head of the CIA's Office of Research and Reports; (2) an Air Force group comprising specialists from SAC and the Air Research and Development Command; (3) specialists from the Office of the

Secretary of the Air Force; and (4) a CIA group. Information from these four groups was eventually melded into the Stassen-Rockefeller arms control and disarmament group's report. The groups produced reports full of details, but full of qualifiers as well because they did not know what the president had in mind. Lundahl, for example, who headed the CIA group, said he did not know what kind of enticements the president thought might get the Soviets to agree to Open Skies.

The president asked an old Army colleague and confidant, Gen. Lucian K. Truscott, currently a senior DCI representative in West Germany, to return to Washington and apprise him of the pros and cons of a disarmament proposal involving aerial reconnaissance. On his arrival Truscott was made a deputy director to Allen Dulles. My superior, James M. Andrews, chief of the Office of Collection and Dissemination, asked me to meet with General Truscott and show him the types of information that we had on Russian plants. Truscott asked what information the CIA would want in addition to aerial photos for verification. He was rather surprised when I told him blueprints. I then showed him detailed blueprints the American Austin Engineering Company had created when it built the large Stalinsk steel combine. Because they were to scale, the blueprints could also be used for verifying our measuring efforts. Truscott thanked me and said that aerial photos and blueprints would indeed help solve problems relating to industrial and military installations.

The day after our meeting, Truscott asked me to accompany him to the White House. We met with Nelson Rockefeller, who was most impressed by what could be done with a combination of blueprints and aerial photography. Rockefeller presented a draft proposal on Open Skies to Secretary of State Dulles, who promptly rejected it. We learned later that the two men had engaged in several heated discussions on the proposal in Eisenhower's office. The proposal was not dead, though.

Eisenhower also wanted a publication that could be used to inform the media about the photo reconnaissance and interpretation processes, and could also be made available abroad. Arthur Lundahl worked with Air Force officials, who provided photos while he worked on the text. The result, a slick magazine-sized publication entitled *Mutual Inspection for Peace* that was printed by the CIA, became a classic description of the aerial reconnaissance, photo interpretation, and inspection processes. It focused on the value of enlargements, how reconnaissance was conducted, photo interpretation, different scales, day and night photography, three-dimensional vision, camouflage detection, and photo mosaics. A later version included photos of Eisenhower at the summit meeting along with the text of his address there.

Eisenhower discussed his Open Skies proposal with British Prime Minister Anthony Eden, who was most enthusiastic. On July 21, 1955, at the Geneva Four-Power Summit, President Eisenhower revealed his proposal. "I've been searching my heart and mind for something that I could say here that would convince everyone of the great sincerity of the United States in approaching this problem of disarmament," he told the assembled delegates. The United States and the Soviet Union, he said, should

> give each other a complete blueprint of our military establishments, from beginning to end, from one end of our countries to the other; lay out the establishments and provide the blueprints to each other. Next to provide within our countries facilities for aerial reconnaissance, to the other country—we to provide you with the facilities within our country, ample facilities for aerial reconnaissance, where you can make all the pictures you choose and take them to your country to study, you to provide exactly the same facilities for us and we to make these examinations, and by this step to convince the world that we are providing as between ourselves against the possibility of great surprise attack, thus lessening danger and relaxing tension. Likewise, we will make more easily attainable a comprehensive and effective system of inspection and disarmament, because what I propose, I assure you, would only be the beginning.[5]

The prime minister of Britain and the premier of France spoke "in highly approving terms of the proposal. They declared themselves ready to cooperate and to open up their territories to aerial inspection, provided only that all present were in agreement."[6] Nikolai Bulganin, who was serving as co-chair of the USSR delegation with General Secretary Nikita Khrushchev, gave an evasive answer, stating that it was something to be studied.

After the meeting, Khrushchev categorically rejected the proposal, claiming that the plan was a bald espionage plot to use reconnaissance against the USSR. Khrushchev was obviously aware of some of the U.S. SENSINT overflights of the Soviet Union. Col. Andrew Goodpaster, who was present, recalled that "after a tea break, Khrushchev came up to Eisenhower, put his wagging finger out and said over and over '*Nyet, nyet, nyet*.' The translator cleaned up his next remark a bit, but it translated roughly as 'You're simply trying to look into our bedrooms.' We knew then and there that the open skies proposal was rejected."[7] The Soviets were unalterably hostile to aerial inspection of any sort.

Khrushchev's son Sergei later wrote that his father's greatest concern was "concealing Soviet weakness. That was one thing he wished above all to hide from the Americans. He thought that if they knew how badly off Russia was, it would encourage the United States to attack while the balance of forces was in its favor."[8] J. M. Spaight, an expert on the Soviet Union, agreed: "Their policy of insulating themselves from the western world, of building up a cushioning layer of friendly States on their borders, of keeping the unfriendly states at arm's length, of making themselves difficult to deal with in relations with nearly all countries—all this has been due at bottom to one cause: fear."[9]

Secrecy was an integral part of all facets of Soviet life. Expert Peter Goren noted:

> Excessive secrecy was an important tool in the hands of the Soviet leadership. If people are deprived of the free flow of information, they are prone to believe whatever is provided by official propaganda. Hence, society could be controlled more easily. The Soviet system of secrecy always was double-folded. On the one hand, the system served its purpose—preventing disclosure of state and military secrets to the assumed enemy. On the other hand, it concealed not only just secrets but "undesirable" facts from the public creating false impressions and perceptions in the interests of the ruling elite. In that sense, the Soviet system of secrecy was an instrument of psychological warfare.[10]

Sergei Khrushchev recalled that his father, who "was interested in new things," brought home a yellow brochure from the Geneva summit that included photographs produced by U.S. aerial reconnaissance. Khrushchev told his son that President Eisenhower had given him the brochure. "I just remember that it had photographs of some small town, then of the streets, then photographs of a building and grounds, and at last it was a person there sitting in an armchair reading a newspaper. He told me these photographs were made from an altitude of 10,000 meters."[11] The publication that Eisenhower gave Khrushchev was *Mutual Inspection for Peace*.

Although Khrushchev knew that the United States was far ahead of the Soviet Union with regard to armaments, he was also aware that the United States had little targeting information, especially on installations deep in the Urals and Siberia. When Sergei asked his father what he thought about Open Skies, he replied, "It was not possible because the Americans are really looking for targets for a war against the USSR. When they understand that we are defenseless against aerial attack, it will push the Americans to begin the war earlier." Sergei added that his father "thought that if in this fear of each other the Americans realized that the Soviet Union would become stronger and stronger, but was weak now, this might push America into a preventive war."[12]

Speaking to the Supreme Soviet on August 4, Bulganin stated that aerial photography could not provide the expected results because both countries stretched over vast territories in which one could conceal anything. Ambassador Anatoly Dobrynin, in an address at Georgetown University in November 1989, said Khrushchev initially favored accepting the Open Skies proposal but was voted down by the Politburo for fear it would legitimize spying against the Soviet Union.

In a conversation with Gen. George Goddard, Eisenhower said that he was willing to make a two-way agreement with the Russians. "I told them we would do it any way they wanted to. I was willing to do anything to get them to agree with it, but they would have no part of it. After all, they could come to this country and to the town library and probably find aerial photos of every town in the United States, but we couldn't get anything from them."[13] On returning from Geneva, Eisenhower "decided that more intelligence about their war-making capabilities was a necessity. So I directed that we would begin aerial reconnaissance, making use of the then relatively invulnerable, high flying U-2 aircraft. It had been making some weather flights, but from 1956 onward its basic mission was to provide us with current information on the status of the Soviet missile and armaments program."[14] Eisenhower supposedly said to Lundahl, "Well, if we can't have mutual inspection for peace, let us have unilateral inspection for peace." Lundahl considered that "a very dangerous, very gutsy move. In those days, prehostility reconnaissance by any country over another was a very likely inducement for war."

Eisenhower had been looking forward to a vacation of fishing and rest in Colorado after the Geneva conference, and after cleaning up urgent matters in Washington he headed for Denver. Office space for a summer White House was established at Lowry AFB in the old headquarters building, originally the main building of the Phillips Sanitarium. On the night of September 23, 1955, the president had a heart attack. He was taken to Fitzsimons General Hospital in Denver and placed under an oxygen tent. When the tent was removed, he met with Foster Dulles and his chief of staff, Sherman Adams. Dulles suggested that Sherman Adams stay at Fitzsimons to assist with matters that had to be brought to Eisenhower's attention for decisions, and Adams met almost daily with the president to discuss domestic and international affairs. Vice President Nixon traveled to Denver, where he was briefed on international affairs and asked to chair the regularly scheduled National Security Council (NSC) meetings. The president returned to Washington on November 11 to continue his recuperation. At the end of February 1956 he announced his intention to run for reelection.

The International Geophysical Year

A few weeks before the Geneva summit, Eisenhower, in a press release, had announced plans for launching small, earth-circling satellites as part of the International Geophysical Year (IGY) activities sponsored by the International Council of Scientific Unions. The Soviets announced that they too intended to launch scientific satellites during the IGY, which would extend from July 1, 1957, through December 31, 1959. In the spring of 1955 the CIA had presented evidence to the NSC indicating that the Soviets were serious about launching a satellite during the IGY. The NSC took up the matter of space and space policy that same spring and produced a paper (no. 5520) in May. The paper declared a national commitment to the idea of "freedom of space" and insisted that the United States had the right to develop a spacecraft for "peaceful and scientific purposes."

Donald Quarles, then assistant secretary for research and development in the Department of Defense, created an Ad Hoc Advisory Group on Special Capabilities to be chaired by Dr. Homer J. Stewart, chair of the Jet Propulsion Laboratory at the California Institute of Technology. The ten distinguished scientists constituting the group were briefed by the various services on their space capabilities. The Air Force had the Atlas—the nation's largest booster rocket—under development. The Army, at the urging of Wernher von Braun, proposed using the Redstone rocket. The Navy promoted a program based on the development of a new booster to be based on its Viking rocket. The group agreed that an American satellite launch was possible during the IGY, and the majority recommended the Navy program that later became known as Project Vanguard. A number in the group, however, voted for von Braun and the Redstone rocket and later claimed that the United States could have been first in space if the Redstone had been used. The Redstone was called on later to launch the first U.S. satellite.[15]

The Yo Yo Story

Shortly after World War II, Joseph Stalin became convinced that war with the United States was inevitable and began to build an air defense around Moscow, the obvious U.S. target in the event of war. In addition to batteries of antiaircraft guns the Soviets deployed a system of surface-to-air missiles (SAMs) using SA-1 Guild missiles. The first major project involving covert photography in the early 1950s was to photograph that system. U.S. attachés and foreign travelers managed to take some photos of some of the SA-1 sites from aircraft windows using hand-held cameras, but it was a risky proposition. On one occasion a KGB agent seized a camera from a U.S. attaché.

SAC commander Curtis LeMay's solution to any and all Cold War problems was the same: send a thousand planes to bomb Moscow. The Russians were well aware that the United States had built a web of bases ringing the Soviet Union, and were accustomed to LeMay's threats of a devastating nuclear response to any attack. "In the event of war," he warned, "the long range bomber and the nuclear weapon enable us to carry to an enemy's heartland the greatest destructive power the world has ever known. The airplane can reach over and beyond the masses of manpower the communist world has mobilized behind the Iron Curtain. It is the only means by which we can bring our full power to bear directly against his muscle and heart."[16] So it was no surprise to the intelligence community when the Soviets began to establish a massive air defense system to protect Moscow from such an attack.

By the end of 1954, aerial photos revealed an unusual pattern of two rings of roads around Moscow. The inner ring road would eventually have twenty-one SA-1 launch sites, and the outer would have thirty-two sites, each covering fifteen degrees of azimuth. Each missile site consisted of a series of parallel roads in a herringbone pattern. That configuration gave seventy-two launch positions at each site, for a total launch capability of more than 1,700 missiles. Each missile site had a control bunker housing radar that would direct the missiles to specific points in the sky to intercept incoming bombers. This deployment was an enormous undertaking. The intelligence community estimated that the cost for the research and development of the system, the construction of the sites, and the production of thousands of missiles was about $2.5 billion. The critical issue the intelligence community faced was finding out about the missiles' guidance and control radars, which were given the code name "Yo Yo."

A covert source managed to get a poor photograph of one of the Yo Yos. Determining the dimensions of the radar was critical, but the only object in the foreground that could be used for comparison was a cow. Ever inventive, the photogrammetrists determined the breed of cow and spent hours measuring cows of the same breed at the U.S. Department of Agriculture research station at Beltsville, Maryland. Chris Mares told me that the cows' measurements were in turn used to estimate some of the radar's parameters.

Personnel in U.S. transports delivering food to the U.S. embassy in Moscow managed to photograph some SA-1 sites using hand-held cameras, but the quality left a lot to be desired. The CIA used the spacing and dimensions of those sites to postulate the locations of others. LeMay was clamoring for information on the sites and wanted to know how the radars could be jammed should his bombers be sent to Moscow.

Early in August 1955 the CIA received better photos of the Yo Yo radar. Lundahl computed Yo Yo's measurements at the Naval Photographic Intelligence Center, and the film was further analyzed by Air Force photo interpreters along with Sylvania engineers at the Fort Monmouth Signal Corps research laboratory in New Jersey. The CIA published a provisional scientific SENSINT report on October 28, 1955, that was brought before the Technical Advisory Committee of the assistant secretary of defense for research and development.[17] Another SENSINT report on the SA-2 sites was prepared in April 1956.[18] By that time we had managed to obtain detailed dimensions not only of the Yo Yo radar but of all the facilities at a typical SA-1 site as well. The Diamond Ordinance Fuse Laboratories in Maryland built a mockup of the Yo Yo radar that was tested at the Army Air Force Proving Ground Command at Eglin AFB in Florida.

Project Genetrix

Balloons had been in use as camera platforms as early as the Civil War and continued in use during World War I. The Cold War era saw their resurgence. Advances in chemistry, especially in plastics, during and after World War II produced a superior-quality lightweight polyethylene film as well as a thin Mylar film, which, when laminated with reinforcing scrim or a mesh of Dacron thread, provided a strong, lightweight material for balloons. These plastic films could easily be fused and were capable of withstanding the rigorous environment of the upper atmosphere. The polyethylene balloon was the lighter and cheaper of the two, and when filled with helium or hydrogen could carry a larger payload. The Office of Naval Research began using polyethylene materials in Project Skyhook, which was designed to gather information on the upper atmosphere for future space flights. The first Skyhook balloon, released on September 25, 1947, carried a payload of sixty-three pounds to an altitude of nineteen miles. The Navy continued to release ever-larger balloons, including some launched from ships at sea.

The first postwar balloon project to fly over Soviet bloc countries was sponsored by the Free Europe Committee, a covert Agency group based in West Germany. The committee released small balloons filled with dry ice that floated at low altitudes and released propaganda leaflets imploring the satellite countries to resist communist domination.

Dr. Edwin Land, always a strong advocate of unorthodox approaches to aerial reconnaissance, repeatedly prodded the Air Force to evaluate radical suggestions to improve reconnaissance techniques. The U.S. Army Air Force had instituted Project RAND as its own think tank in late 1946 "to support the United States Army Air Force with scientific studies to help the Service in its designated roles for national security and national well-being."[19] RAND, later the RAND Corporation, was charged to identify new technologies and concepts that would be useful to the Air Force in a space program. These studies underscored the value of wartime rocket technology and its enormous applications for peacetime space activities. RAND scientists concluded that military satellites should be for observation rather than aggressive warfare and would later collaborate with the Batelle Institute in studies of missiles and spacecraft. Responsibility for the U.S. satellite program was assigned to the Air Force in 1948. Early in 1950 the RAND Corporation, viewing the spectacular results of the Navy's Skyhook program, realized that balloons provided a stable platform from which aerial photos could be taken and proposed that the Air Force consider using large balloons as photo reconnaissance platforms. The idea was referred to the Air Force Scientific Board, which called for further research by RAND and a more detailed concept of the balloon's camera systems.

The CIA learned of the Air Force's interest in a balloon reconnaissance system from Philip Strong, the chief of the Operations Staff of the Agency's Office of Scientific Intelligence, who served on several Air Force advisory staffs. Amron Katz, a leading RAND researcher, told Lundahl that RAND's interest was piqued when one of the Skyhook balloons escaped and traveled around the world, including over parts of the Soviet Union, without being detected. RAND provided a detailed concept of the balloon camera system, the cost, and the potential benefits to be derived from such a program in late 1950 and updated it in late 1952. Lt. Gen. Charles P. Cabell was briefed on the project shortly after he became deputy director of the CIA in February 1953. He later met with the director of Air Force Intelligence, who proposed that the project be implemented for photographic penetration of the Soviet Union. The Air Force referred to the project as Weapons Systems 119L and gave it the code name "Moby Dick." Moby Dick prompted the development of the Genetrix reconnaissance balloon. Weather research connected with the International Geophysical Year was its cover story.

The Genetrix balloon, which was up to sixty feet in diameter and fourteen stories tall when filled, was of the so-called zero pressure type. It rose to the height of the jet stream, where it literally ballooned, attained buoyant equilibrium, and floated in the prevailing westerly airstream of the upper atmosphere. The balloon floated at altitudes of 40,000–60,000 feet and traveled at speeds of 75–125 miles per hour. It maintained its equilibrium by venting excess gas or releasing ballast. The balloon was fueled with hydrogen gas and was capable of lifting a 1,500-pound payload that consisted of a camera, film, parachute and recovery devices, a battery, command and control instruments, ballast, and rigging. The Fairchild Camera Company built the camera, which had a 6-inch-focal-length lens designed by the Boston University Optical Research Laboratory and sufficient film to acquire about five hundred photographs. An ingenious light-sensing device activated the camera in response to daylight and turned it off in the evening. When the balloon reached the Pacific Ocean, usually during the fourth or fifth day of flight, the transmitter would begin emitting a distinctive signal. The flight was ended by a signal sent from a transmitter aboard an aircraft that detonated an explosive charge that destroyed the balloon. The camera and film were held aloft by a parachute. If the parachute was not recovered in midair by C-119 cargo aircraft near Japan and fell into the ocean, the camera package would float; an emergency battery-operated transmitter would be activated by the effects of saltwater and would send out signals until the package was recovered or the battery went dead.

To forestall any claim that the balloons were a hazard to aircraft in flight, each balloon was equipped with an aneroid barometer that would destroy it if it failed to rise above 30,000 feet within thirty-five minutes of launch. If the balloon leaked gas or dropped to 30,000 feet, it would be destroyed automatically. During darkness the balloon flashed standard aircraft red warning lights. There were also contingency plans to explain the safety measures to Moscow if necessary.

Cabell realized that technical problems were not the only ones to be solved, and he was skeptical about the whole project. It would need White House approval, and the flights were certain to generate protests from the Soviets. The planners recognized that the balloons were vulnerable to stormy weather and turbulence and knew that some balloons would rupture, be shot down, or otherwise fall into Soviet hands. The big question in Cabell's mind was whether President Eisenhower would approve the project knowing the risks and possible Soviet reaction.

During the winter of 1954–55 the U.S. Air Force conducted both domestic and foreign tests, the latter in England. A number of balloons carrying instruments and released over Europe successfully penetrated the Soviet Union. The results of the tests were of sufficient importance as an intelligence-gathering tool that Land and Killian briefed President Eisenhower on Project Genetrix in mid-March 1955. Eisenhower raised the issue of balloons endangering aircraft in flight or someone on the ground who might inadvertently recover the camera package, which included an explosive charge. In the end, however, he approved the project on December 17, 1955.[20]

The cover story finally agreed on was that Genetrix was a high-altitude, world-encircling meteorological research and survey project of several years' duration. Thousands of balloons would be launched worldwide for the purpose of weather research. The balloons supposedly would chart the track of the then-little known jet stream. All nations would benefit from the information gathered by the project, which would be freely published. The Air Force would also acknowledge that each balloon carried two cameras, one to read the instrument panel to record readings of barometric pressure, time, altitude, and other data; the other to record cloud information and weather front phenomena. Recording equipment kept track of the speed and direction of the jet stream. As soon as the president gave his approval, frantic efforts were under way to position the launch and recovery crews. The first balloon was launched on January 10, 1956; other launches followed from Turkey, Germany, Norway, Scotland, and from the afterdeck of aircraft carriers.

The project went generally as planned. The prevailing winds carried the balloons eastward across the Soviet Union to the Pacific Ocean afterward and were recovered in midair by C-119s near Japan. The Air Force later admitted launching 200 balloons from Scotland and at first denied that any were launched from West Germany or Turkey, although the latter statement was at variance with statements made by U.S. officers in West Germany. Later, the Air Force would state that 200 balloons had been launched from Scotland "and other places in Europe." Of the 516 Genetrix balloons launched, only 47 were recovered.[21]

A photo interpretation unit was established to plot and interpret the processed film at the Aeronautical Chart and Information Center (ACIC) in St. Louis. The photo interpreters had two jobs: to plot the area the balloons had photographed, and to analyze the photos for strategic industries. Maj. Frederick Sager, USAF, was placed in charge of the ACIC with the authority to recruit interpreters from various organizations. Roger Wildbrandt, a senior photo interpreter, was sent to the center to help out, as was an RAF interpreter. A loft in one of the buildings was used to lay out the prints of each mission. A space that size was necessary: the balloons photographed more than a million square miles of the Soviet Union. Unfortunately, most of the coverage was over Siberian forests and mountainous and desert regions.

On February 5, 1956, the Soviets strongly protested the balloon incursions into their airspace as "inadmissible" and claimed the overflights violated the sovereignty and territorial integrity of the Soviet Union. They accused the United States of going to the "brink of war" (a reference to statements made by John Foster Dulles) by sending espionage balloons over the Soviet Union. The Soviets also charged that the balloons threatened the lives of passengers and crew aboard Soviet aircraft. The Air Force cover story—that the balloons were for weather research as part of the IGY—was exploded when the Soviets put the balloons on display. The publicity that followed produced a storm of protests and threatened the very credibility of the U.S. government. Hanson W. Baldwin noted in the *New York Times* that "the integrity of the Government is one of the most precious assets of a free people and the confidence of the people in the word of their government is beyond price. The feeling among many experts here is that if the Government, for various reasons, cannot present a balanced picture, it should say nothing."[22]

When asked about the Soviets' charges, John Foster Dulles explained on February 7 that the recording equipment carried in the gondola of the balloon kept track of the speed and direction of the jet stream and recorded cloud formations below the balloon. He explained, "It would be quite accidental if the camera picked up anything significant on the ground."[23] Few people believed Dulles' statement, but it could not be disproved.

A State Department spokesman attempted to defuse the situation by suggesting that the Soviets were referring "to large weather balloons launched by the Air Force from various parts of the Northern Hemisphere." The spokesman assured the world "that the United States did not launch propaganda balloons of the type referred to by Moscow."[24] The Soviets placed forty balloons and copies of the aerial photos they contained on display to prove their case. The media were invited to attend a press conference at which Col. A. V. Tarantsov explained that the camera and film "permits the taking of photographs at a height of 30–35 kilometers where it is possible to distinguish easily separate objects on the terrain, for example, aircraft on an airfield."[25] Instructions on the camera package in English, French, Japanese, Arabic, and Urdu read as follows: "This box comes from the sky. It is harmless. It has weather information in it. Notify the authorities. You will receive a valuable reward when you turn it in to us."[26]

In concert with the Soviet Union, the governments of Albania, Czechoslovakia, Hungary, and Rumania formally protested the balloon incursions to the United Nations but did not request any formal actions. The Chinese also protested and placed some of the Genetrix balloons on display in Beijing. Eisenhower initially attempted to minimize the whole balloon incident. He read the Soviets' protest note and snapped, "If they don't want them tell them to return them back to us. Better still, demand it."[27] Eventually, Eisenhower told Foster Dulles that the intelligence obtained from the balloons was not worth the legitimate grounds for irritation they were providing to the Soviet bloc. They also threatened the credibility of the U.S. government. He stated his intention to continue exchanging personal letters with Nikolai Bulganin in efforts to improve East-West relations. On February 7, 1956, Secretary of State Dulles informed the Soviet Union that no more "weather balloons" would be released, but he did not offer an apology for the overflights. His note read in part:

> The Soviet Government has not returned the scientific property which rightfully belongs to the United States and which the Soviet Government has endeavored to convert to propaganda uses of its own. In reviewing its request for the return of the equipment in question, the United States Government states its willingness to return the Soviet equipment that has come into its possession. Any legitimate concern of the Soviet Government regarding

> the United States balloon operation has been satisfied by the United States Government's decision convened in the note of February 8, provisionally to suspend the release of balloons which could transit the Soviet territory.[28]

The Soviets were not appeased. The Soviet government sent a second note on February 18, 1956, further protesting the reconnaissance balloons and offered to show the balloons and equipment in New York, Washington, London, or Paris to prove they were reconnaissance and not meteorological balloons.

Some people in the Agency feared that Eisenhower's anger over the balloon project might sour the U-2 project. General Cabell asked General Twining in February 1956 to forgo further Genetrix flights because of the "additional political pressures being generated against all balloon operations and overflights, thus increasing the difficulties of policy decisions which would permit such operations in the future."[29]

The Genetrix project was a dismal failure. The balloons produced information on only two strategic installations, and not a single long-range bomber base was imaged. Perhaps worse, the political repercussions hampered Eisenhower's quest to improve U.S.-Soviet relations. He terminated the project in March 1956. The Air Force was not willing to give up so easily, however. Only five weeks later General Twining proposed a new balloon project in which the balloons would fly at even higher altitudes. It could be ready in eighteen months. President Eisenhower responded that he was no longer interested in balloons. The need for intelligence, however, had not lessened. Several installations were demanding further attention.

The bit of information that Genetrix did provide was quite useful. The U.S. intelligence community had known for some time that a secret installation was being constructed on the Yenisey River north of Krasnoyarsk. A defector reported that trainloads of mining equipment from Wismut, A.G., the vast Russian mining enterprise in East Germany, had been sent to Krasnoyarsk. We thought the new enterprise was involved with uranium mining, but geological charts did not show uranium-bearing ores in the area. Finding the truth was not an easy prospect. The city of Krasnoyarsk was off limits to all foreigners, and attachés were forbidden to leave the train when traveling on the Trans-Siberian Railroad. A town named Dodonovo, north of Krasnoyarsk and thirty-five miles downstream on the Yenisey River, was a major focus of interest. Hundreds of German POWs working in a large armament plant in Krasnoyarsk heard rumors of an "atomic city" being built north of Krasnoyarsk. A German POW, despite Soviet rules and regulations keeping foreigners away from their atomic installations, had actually worked at the site. He reported hearsay that many kilometers of tunnels lined with concrete were being built.

Although the Genetrix program had by that time been canceled, some of the balloon images helped answer the question. In early 1957, images from a Genetrix balloon recovered from the Aleutian Islands revealed a large complex under construction at Dodonovo. A rail line from Krasnoyarsk terminated at an underground tunnel where a spoil pile revealed extensive digging. The images also revealed a new city consisting of apartment houses, laboratories, warehouses, and machine shops. Heavy transmission lines terminated at the tunnel. The site was targeted as the Dodonove Underground Nuclear Energy Complex; the Soviets called it Krasnoyarsk 26.

One of the balloons strayed south into northwestern China before dropping its film over the Pacific. When the photography was processed, we found a unique circular road, 13,120 feet in diameter, at Lop Nor in the Taklimakan Desert in western China. Lundahl immediately asked me to research what it might be. Postulations ranged from a locomotive testing area to a direction-finding station to an archaeological dig. Because nations building nuclear weapons and long-range missiles frequently test them in desert proving grounds, Lop Nur became immediately suspect as a nuclear site. The road's location and dimensions made it a likely part of a planned nuclear test site; the area encompassed by the road was large enough to enclose an above-ground nuclear test site while leaving the road intact. Airfield, barracks, and support facilities showed up in subsequent intelligence. Lundahl asked if any Westerner had ever visited the area, and I asked our researchers to go to the Library of Congress and bring back any books they could find on the area. They discovered three sources. Archaeologist Sir Marc Aural Stein had visited the area and explored some of the sand-covered villages that abounded in the Takla Makan. He described his findings in his 1904 book, *Sand-Buried Ruins of Khotan.* Swedish explorer Sven Hedin explored the area in 1934 and described it in his books *The Wandering Lake* and *My Life as an Explorer*. Hedin's descriptive text, sketches, and ground photographs made it possible for us to follow his archaeological discoveries on aerial photography. Lundahl read the passages I had marked and asked if I had more. I said I had a good Italian source and handed him Marco Polo's description of the area. The books and images portrayed a relatively flat land buffeted by vicious sandstorms that alternately revealed and hid the remains of a civilization long lost. Hedin and Polo told of stories of spirits that inhabited the area and often called travelers by name. Those who dared venture into the desert heard incantations and musical instruments—particularly the commanding beat of drums.[30]

There is a postscript to the balloon story. Whether by accident or design, the camera-lifting apparatus consisted of a steel bar whose length and width stimulated an enhanced radar return from the newly deployed Soviet Token early warning radars. The Soviets could easily track balloons along their border, but their radar capability deep inside the motherland left much to be desired. This knowledge of Soviet tracking abilities of high-altitude vehicles proved invaluable in planning U-2 missions over the Soviet Union. When the United States later acquired a Token radar unit to examine, I was in a group that was sent to observe it in operation. We were amazed that the radar contained numerous vacuum tubes instead of transistors and yet functioned for hours without breakdowns.

EIGHT
the U-2 missions begin

Damn it, we did it.
Clarence L. "Kelly" Johnson

Preparations to deploy U-2s to overseas bases began soon after the test flights started. Richard Bissell had met with Prime Minister Anthony Eden and received his permission to base a squadron of three U-2s at Lakenheath Air Base, a World War II field that had a hangar to accommodate the aircraft. The U-2s were deployed at Lakenheath in May 1956. Shortly afterward Bissell and Cabell briefed Chancellor Konrad Adenauer of West Germany on the program, and the chancellor gave his permission to operate out of German airfields. President Charles de Gaulle of France, on the other hand, wanted no part of the operation.

Eisenhower grilled Bissell on every detail of the planned operation, including ramifications if things went wrong and whether every option had been considered. Bissell used the existing presidential permission for Air Force overflights of East European satellite countries as his authority to plan a U-2 mission over Poland and East Germany. Allen Dulles informed the president, and Eisenhower agreed. The president also wanted to be certain that Adenauer was informed in advance of our plans to overfly the Soviet Union from bases in West Germany.

In early June 1956 Bissell decided to move the U-2s from Lakenheath to Wiesbaden Airfield in West Germany for operational reasons. But Wiesbaden was a very busy spot; it was no place to keep the U-2 secret. Bissell wanted a more secure airfield. Eventually, an old Luftwaffe base at Giebelstadt, about fifty miles west of Wiesbaden near the border between East and West Germany, was chosen. The Giebelstadt runway needed repairs, however, so the initial U-2 operations took place from Wiesbaden. After Lundahl and Bissell briefed the prime minister of Turkey, Adnan Menderes, in Washington, he approved the use of Incirlik Airfield near Adana for U-2 operations.

Eisenhower, who knew from experience the value of security, stressed to Bissell and others that secrecy was of the essence. Any leak of information, either at home or abroad, could imperil the entire program. Bissell was a fanatic about security as well. With the president's concurrence, he insisted that the program be kept within a small, autonomous organization to help safeguard its security. A secure communications system was devised to handle photography from U-2 flights. The imagery would be classified "Top Secret Chess," and the intelligence obtained would be handled in the Talent control system. At the outset of the U-2 program in 1955, only one hundred people were given clearance for the entire program—the plane, camera, proposed missions, and so on. James Reber decided who received clearance. When the time came for the first overflights, there were so many complaints, especially from the military, that the number was increased to five hundred. All of the personnel of the CIA's Photographic Intelligence Division (PID) were cleared. At the White House, only President Eisenhower; his son, John Eisenhower; his aide, Col. Andrew Goodpaster; and Robert Cutler, his special assistant for national security affairs, were cleared. Cutler was a brilliant man who understood the value of intelligence and frequently requested reports from the PID. Even he, however, was sometimes exasperated with all the compartmentalization and caveats of the Top Secret classification.

Reber conducted an informal but highly secret meeting with representatives of the Army, Navy, and Air Force to select targets for imaging in Soviet satellite countries. The highest priority was given to Soviet-occupied airfields to detect any deployment of Bison or Badger bombers. Soviet armored and mechanized divisions and their state of readiness were second-priority targets. At ports and naval bases, Soviet combatants—especially submarines—were of interest. The capital cities of all satellite countries were targets, and there was a high-priority requirement to look for new or heavily secured bunkers at Soviet installations where atomic weapons might be stored.

When Bissell informed Lundahl that he was about to ask permission from the president to overfly the Soviet bloc countries, Lundahl called me in to ask if we were ready. I replied that we were operating out of archive boxes, and that Quarters I, a former WAVES barracks, was not the best place to conduct photographic operations. But I also said that Lou Franceschini, Earl Kniebiebly, Cliff

Mullineaux, and I would certainly try. At that, he handed me Reber's list of priority targets.

On May 31, 1956, Allen Dulles and Air Force chief of staff Gen. Nathan Twining sent the president "Aquatone Operational Plans" calling for preliminary U-2 flights over Eastern Europe; once these were completed, missions over the Soviet Union would follow. But everything came to a temporary halt when the president was rushed to Walter Reed on June 7 because of a "digestive upset." There was concern that it was another heart attack, and apprehension grew within the CIA about its impact on the U-2 program. Although it was not a heart attack, the president was diagnosed with ileitis, an inflammation of the intestines that required surgery. The president's physician estimated that he would be back on the job in four to six weeks. Taking advantage of presidential authority and approval of Air Force flights over Eastern Europe, Bissell ordered the first U-2 mission, using the A-2 camera, to fly over Poland and East Germany on June 20, 1956. The A-2 cameras performed well, and the mission was a deemed a major success.

The exposed film was rushed to Eastman Kodak in Rochester, New York. Herb Miller, Bissell's assistant, hurried to Eastman's film-processing plant, selected a number of duplicate positives at random, and brought them back to Washington, where he asked us to make briefing boards from them. Although we were still in Quarters I, the equipment that was destined for installation in the Steuart Building had been made operational. Cliff Mullineaux and I had the difficult task of attempting to identify each photo. The airfields were relatively easy because we had the Air Force reference books on airports and seaports of the world. One target that Miller claimed was a Russian automobile plant turned out to be the Volkswagen plant in West Germany, the pilot having turned on his camera too early. Some of the first prints were made with LogEtronic printers and washed in the mop washstands of the former WAVES barracks. Bissell and Cabell showed our briefing boards to the president, and Bissell said that Eisenhower was pleased with the results. Afterward, the three men discussed the proposed overflights of the Soviet Union. The topics were the yield to be expected, altitudes and other operating conditions, mission control and direction, the weather, and thoughts and preparations regarding malfunctions. Above all else the president demanded that the flights "be designed to cover all that was vital quickly."[1]

The paper prints of the first mission that arrived at the PID for interpretation in late June 1956 left a lot to be desired. A photo interpreter showed how easy it was to miss an aircraft at an airfield because of printing problems. After a call to

Eastman Kodak we soon received a duplicate positive. We purchased desk light tables and 6-power tube magnifiers to use in interpreting the film. Fortunately, we had an abundance of World War II targeting materials over the same targets for comparison. We also had Berlin corridor photographs for comparison in identifying military hardware. We did not find Bison or Badger bombers at any of the bloc country airfields. Activity at Soviet armor and mechanized forces was normal, but the images revealed a large number of MiG fighters at both Soviet and satellite airfields.

The PID moved into the Steuart Building on July 1, 1956, but the building was not fully operational until a water chiller was installed on July 9. The building was a nondescript seven-story structure at 5th and K streets, NW, built during World War II. We occupied a total of 50,000 square feet on the fourth through seventh floors, which had not been occupied since the war and required a thorough cleaning. The building was not air conditioned, and personnel sweltered during the summer. Conditions were no better in the winter. The winter chill seeped right through the single-pane windows. When it was cold, people would move their desks away from the windows and out into the rooms. The ceilings were made of pressed seaweed and shed a constant stream of particles onto desks and floors. In the photo lab, a plastic curtain was placed over the developing trays to keep the particles from contaminating the priceless photography. There was no cafeteria or food facility in the building. Food service was a particular problem for people working at night because the building was in one of the most notorious areas in Washington's Second Police Precinct. Most of the parking spaces were near buildings or in alleyways. Broken bottles, abandoned autos, and trash littered the area. Frequently car pool members had to get out and remove obstacles before a car could be parked.

Lundahl had invited the Army, Navy, and Air Force to send contingents to the PID. The Army and Navy accepted; the Air Force refused, and regretted it later when Air Force staff realized that they were being left out of discussions at the Joint Chiefs of Staff because they were unaware of what was happening at the Steuart Building. The Air Force finally reversed its decision and sent a small contingent headed by an Air Force colonel. The heads of the service contingents were allowed to sit in on all meetings that Lundahl conducted on mission planning and mission exploitation. Lundahl maintained that all information was to be shared and that photo interpreters from all contingents were to be involved in interpreting the photography. It was not long before we realized that the Air Force colonel, who took copious notes, was virtually a spy in our midst. We learned later that he was reporting directly to General LeMay, who was by then Air Force chief of staff. Clearly, he was reporting on our weaknesses and helping LeMay in his unending efforts to take over the photographic reconnaissance program. Lundahl later recalled that

> the Air Force liaison officer would run into the building, up and down the lanes where materials were being worked on, lean over a photo interpreter's shoulder, and copy down the name of an airfield or new discovery, mark it on a piece of scratch paper, run out the building, jump into a taxi, and hurry over to the Pentagon, with some hot bit of information for the afternoon edition. We had to take them aside and say, look, we have a system for moving papers around. You can move anything you want, but you have to catalogue, mark it carefully, put it in a sealed envelope, tell us where you want it to go, and our couriers will carry it to whatever legitimate office is going to get it. The Air Force was unhappy that they couldn't run rampant, they were under some serious control.[2]

The main criterion for launching a U-2 mission over the Soviet Union was clear weather. Weather Central had indicated that the best weather in western Russia in 1956 would be between June 20 and July 10. There was a hitch, however, to the planning for the first U-2 mission over the Soviet Union. General Twining and twenty-eight foreign delegates had been invited to attend an air show in the Soviet Union during this period. Eisenhower, Twining, Allen Dulles, Admiral Radford, and Colonel Goodpaster met on May 28 to decide whether Twining should attend. President Eisenhower saw no reason why he should not go. Goodpaster's notes of the meeting indicate that "the President said that General Twining could say while there that if the Soviets wanted to trade military visits, and go around and really see what the other country had in a military sense, they might invite our chiefs, who would be prepared to visit the Soviet Union providing the Soviets were willing to have their chiefs visit us. The President repeated that he is very anxious to see how far the Soviets are ready to go in making offers and working for better relationships."[3]

Twining attended the air show, arriving in Moscow on June 23, 1956, and no U-2 missions were staged until he had left the Soviet Union. The air show, as usual, was held at the Tushino Airfield northwest of Moscow. It was one of the more spectacular air shows ever staged there. A formation of fifty-four Tu-16 Badger medium jet bombers accompanied by new fighters zoomed overhead. The flyby included three Bisons and a Tu-95 Bear turboprop strategic bomber. The Tu-95 would add additional fuel to the "bomber-gap" controversy. The Soviet defense minister, Marshal G. K. Zhukov, hosted a reception afterward in a park at which Khrushchev made an appearance. The premier went straight for Twining. Clearly, he had been informed of the U-2 mission over East Germany and Poland. He admonished Twining that the Soviets would shoot down all intruding aircraft, specifically mentioning Canberras, which he called "flying coffins." Either he was referring to the British Canberra overflight in 1953 or the Soviets had completely misread the U-2 overflight.

During the Eisenhower years, Allan Dulles regularly briefed the National Security Council, usually every Thursday at 10 AM. At the briefings he gave "the latest information on issues that were currently in the forefront of attention and [brought] up matters which he believed members should be informed about. He was good at this; he had the mechanism for preparing for himself briefings well organized and responsive to his wishes and style of action."[4] The Office of Current Intelligence provided the data. While Dulles had set the standard for clandestine tradecraft, however, he knew little about aerial photography and photo interpretation. As the Agency entered the technical area, Dulles often took experts with him—usually Cabell, Bissell, or Lundahl—who could answer the detailed questions that Eisenhower was likely to ask.

Some NSC members were not privy to the latest efforts in the scientific community or to covert intelligence activities, so Dulles, Bissell, or Lundahl briefed the president on covert or sensitive photographic information before the NSC meetings began. These informal premeeting sessions were usually held in the Oval Office, and no minutes were kept. I am drawing on memories—primarily those of Lundahl and Bissell—for information on the photographic intelligence presented. Lundahl was a charismatic speaker who made the science of photo interpretation fascinating and understandable. Bissell, like Lundahl, could absorb and retain enormous amounts of information and was gifted with the uncanny ability to reduce highly technical terms to the layperson's level.

The president began his day with an intelligence briefing from Colonel Goodpaster, who recalled that "these updates were based on the presidential summary that we received during the night from the Central Intelligence Agency . . . but also included the gist of messages exchanged with the State Department as well as important communications and actions from the Department of Defense."[5] Bissell noted that "the president would form and reform his views on the basis of new intelligence. If something was of particular interest to him, he would call for more intelligence on the subject. He would then take this information and fit it into a worldwide view that had been shaped by years of reviewing and studying and pondering."[6]

The Office of Current Intelligence was the domain of Huntington D. "Ting" Sheldon, who had served as an Air Force photo intelligence officer during World War II. His wife, Alice Bradley Davey, also a wartime photo interpreter, would later work at the PID. (Alice is better known to the public by her pseudonym, James Tiptree Jr., under which she wrote award-winning science fiction.) Ting was an opinionated, irascible individual who insisted on complete control of communications intelligence. One of his principal functions was to keep Robert Amory Jr., the deputy director of intelligence, informed on intelligence matters. Sheldon often briefed Amory, who in addition to creating the presidential summaries was responsible for prepping Dulles for the NSC meetings.

Amory and Shelton would meet with Dulles several days in advance of an NSC meeting. Lundahl was sometimes present to brief Dulles on new photo interpretation finds. Dulles knew that Eisenhower was a good photo interpreter from his wartime experiences and that he understood and appreciated the analysis of aerial photography. If it were a complex subject, Dulles would ask Lundahl to accompany him for a separate meeting with Eisenhower.

According to Lundahl, one never knew what to expect when briefing Dulles in his cluttered office. Sometimes he would say, "You know the subject, so let's go on." At other times Dulles would say, "Do you think you can reduce it to few words that I could understand?" The briefings tended to be more complicated during baseball season. Dulles often kept a radio tuned to Washington Senators baseball games, and it was not always clear to Lundahl whether Dulles had understood a particular point. At one briefing, Dulles, giving one ear to the radio and one to Lundahl, became miffed when one of the Senators' batters struck out. "He couldn't hit a bull in the ass with a banjo," he said, then told Lundahl to proceed with the briefing.

Eisenhower expected Dulles to provide both the latest intelligence on the crisis of the moment and, more important, the intelligence background for whatever larger or longer-term planning issue was on the agenda. Most of the briefing materials the DCI used for the latter were prepared by the Office of National

Estimates. Goodpaster said the president often asked in NSC preparation sessions, “How solid is the information? Where did it come from?”[7]

Before Eisenhower approved reconnaissance flights over the Soviet Union, he had to consider five factors: (1) Was the information that would be gleaned from the flight an absolute necessity for U.S. national security? (2) Would the mission be worth the political costs that would be occasioned if it should fail? (3) Would the mission precipitate a crisis in which the adversary could institute measures detrimental to the United States? (4) Would such a mission poison discussions or negotiations on other issues, possibly further dividing the countries? (5) If the mission was brought down, what would be the consequences if the pilot were captured? Eisenhower, Goodpaster would relate, introduced a much more rigorous and thorough control of these flights—flight dates, the time span authorized, the targets, and so on—than his much more perfunctory and less formal approach to the SENSINT flights had been. Eisenhower made it clear to Allen Dulles that obtaining hard information on the Soviet bomber force was the most urgent priority of the planned U-2 missions.

Before a U-2 mission, Dulles or—more often—Bissell would bring the flight target maps to the president with the targets outlined by large red circles. Eisenhower would read the justification for the mission and then look at the proposed flight track, sometimes making corrections or eliminating portions of the track. These tracks were top secret, and only when a mission was approved would Lundahl receive a copy of the proposed track. He would give it to me so we could prepare to interpret the mission when the film was received.

Two more overflights of Eastern Europe satellite countries were made on July 2, 1956. The first mission covered Czechoslovakia, Hungary, and Bulgaria; the second was over East Germany, Poland, Hungary, and Rumania. On that day, Bissell and Cabell gave the president a detailed briefing on the results of the first U-2 mission, showing him a number of mission briefing boards. The president found the mission “very interesting, very positive.” He wanted to know if the U-2 had been tracked. Cabell replied that Eastern European radars had picked up the flight but had misread the altitude as being only 42,000 feet. Cabell said that he would report to the president the results of the two flights being flown that day.

Although these missions did not reveal any Bison or Badger bombers, we reaped a bonanza of up-to-date information on the Soviets and their Eastern European satellites: almost simultaneous coverage of all the airfields, naval bases, and ground units in the area. We updated our files on army, navy, and air force orders of battle, giving special attention to the Soviet tank and motorized divisions in these countries because they posed a threat to our European allies. (Within three months, some of these divisions would be putting down the Hungarian rebellion.) Of particular interest were structures to house new tanks and armored personnel carriers. Since these were first-line divisions, we gained information on the alignments of the various components. We also received valuable information on the Soviet service units and saw the new armaments the Soviets were supplying to Eastern European countries. The images revealed that many of the industries in the bloc countries that had been bombed in World War II were still in shambles or were being reconstructed at a very slow pace compared with industries of U.S. allies.

When Allen Dulles asked what we had on Budapest, Lundahl showed him a large briefing board of the city. Dulles did not ask any questions but asked if he could keep the briefing board for a while. We never knew what his interest was, but Dulles was said to have been a Lothario in his younger days, and Lundahl facetiously remarked that he might be feeling nostalgic about an old love affair.

The initial findings from these missions were disseminated in "Oak reports," a term Lundahl coined to signify that from a small acorn a large tree of information would grow. Lundahl told us that he wanted the PID to function like the well-known Automat self-serve restaurant in New York: open twenty-four hours a day, seven days a weeks, with a variety of products available around the clock and at a moment's notice. At a staff meeting he told us: "Find out what the hell it is they want, give it to them, if possible before they ask for it; that's how you get the reputation of a can-do outfit." When Henry Thomas, the Aquatone security officer, attempted to record the name "Automat" for our unit, he found that there was another project named "Automagic." To prevent possible conflict, Thomas added his initials to "Automat" and the program became known under the code name "HTAutomat."

With the Eastern Europe overflights under our belt, we were ready to move on to the Soviet Union. On July 2, 1956, Bissell met with Colonel Goodpaster and "indicated readiness and desire to extend operations." Eisenhower had mixed feelings about this next step. While the missions could provide him with the intelligence on the Soviet Union he needed to make accurate decisions, he realized that such overflights "were close to an act of war and . . . must be very hard for the Soviets to swallow." On the other hand, he commented, "no one wants another

Pearl Harbor. This means that we must have knowledge of military forces and preparations around the world." After agreeing to approve the mission he added, "But I'll tell you one thing. Some day one of these machines is going to be caught and then we'll have a storm."[8] The president suggested that a ten-day period of operations should be followed by a report. He also wanted a report on how much time was needed to cover each of the five major areas delineated. Eisenhower wanted the missions flown at a maximum rate until the first evidence of tracking was received. At that point, the operations would be suspended until he had discussed the matter with the Dulles brothers.[9] Goodpaster relayed to Bissell on July 3 that the operation was to begin on July 4 and end on July 14. Bissell, a bargainer, asked if he had ten good-weather days. "Absolutely not," Goodpaster replied. "It's ten calendar days. You have to take your chances with the weather."[10] Bissell intended to fly as many missions as he could in that ten-day period.

The weather remained clear, and Hervey Stockman flew the first U-2 mission over the Soviet Union on July 4, 1956. He overflew Poznań, Poland, where rioting between June 28 and June 30 had been put down by the Soviet army; headed for the long-range bomber base at Minsk/Machulische in Byelorussia, which had Badger bombers and a nuclear weapons loading pit; and then flew north to Leningrad. The main targets in Leningrad were the Admiralty, Baltic, and Sudomech shipyards; two were producing fleet units and Sudomech submarines. During Stockman's flight, Soviet MiG-17 and MiG-19 fighters made more than twenty interception attempts. His cameras photographed the MiGs desperately trying to reach the U-2, only to fall back to an altitude where they could restart their flamed-out engines.

Specialists from the PID's Special Projects Branch went to the Eastman processing facility to take a "first look" at the imagery and dove headlong into the project. One Eastman official told them they were working "like a bunch of tigers," and from that day forward they were known as the "Tiger Team." Team members reported on the presence of clouds over priority targets, on flight path integrity, and on camera operations. They worked with the processing site engineers in resolving titling and film reproduction concerns. On the early U-2 missions about 15 percent of the imagery was obscured by clouds. Tiger Team members reviewed each negative as it came off the processors; if the image was completely obscured by clouds, it was not duplicated or reproduced. Their work saved a considerable amount of money and time because only useful images were copied and distributed to other intelligence organizations.

After each U-2 mission was flown, but before we had received the film, I would conduct a "pre-Oak" mission briefing for cleared members of the intelligence community, giving them their first indication of what to expect. A typical briefing, as described by Lundahl, went as follows:

> On a huge map, 20 feet long Dino would show the whole Soviet Union and the tracks made by the U-2 on a mission were laid out. And as Dino would track the route, he would tell them what would likely be seen on the location, based on communication intelligence and other sources. In the Pre-Oak briefings, we told all these people what we were expecting or hoped to find. They all took furious notes. Dino would do several of these. If you didn't have the tickets, the security clearances, to get into these briefings, you were a no one in Washington. It was a sign of prestige to be able to come in and get these stories. And it was very helpful. The services, when they got their film, they knew what part they would be after.[11]

We made a number of briefing boards on the long-range bomber airfield and the Leningrad shipyards, one of a Token radar station, and one of a MiG-19 that was flying below the U-2. A spectacular briefing board of Leningrad pinpointed only the Winter Palace and the Peter and Paul Fortress. Allen Dulles thought so much of it that he asked us to make a duplicate copy that he used to illustrate the quality of U-2 photography for distinguished visitors.

When the U-2 took off, the pilot would reach an altitude of about 68,000 feet and maintain a 400-knot true airspeed. As the plane expended fuel, its altitude would rise; at the end of a mission the altitude often reached 70,000 feet. U-2 pilots had a device known as a drift sight that allowed them to observe objects below them such as Token radar installations and MiG interceptors. The sight was an upside down periscope that had four levels of magnification and could be swiveled 360 degrees in azimuth and elevated almost to the horizontal position. Stockman and other U-2 pilots would observe interception attempts with their heart in their throat. Stockman photographed one of the Token radars tracking him, yet his U-2 flew over Soviet territory without incident.

Carmine Vito flew the second U-2 mission, on July 5, 1956. He also flew first over Poland, but then turned to the Baranovichi and Orsha SW long-range bomber bases; after that he went to Moscow and beyond to a long-range bomber base at Ivanovo. Although two concentric rings of SA-1 SAM sites totaling some 3,600 launchers defended Moscow, the Soviets were caught completely by surprise and for some reason did not activate the missile sites when Vito flew over them. Vito had four targets of interest in the Moscow area: the Moscow/Khimki missile engine plant; Korolov's Kaliningrad missile center, where large missiles were being assembled; the Moscow/Fili aircraft plant, which produced the Myasischev-4 Bison bomber; and the Ramenskoye flight test center, where Bison bombers had been spotted.

Vito's mission solved one long-standing puzzle. We had wondered how the Soviets could get a Bison bomber out of the Fili plant because the runway was far too short for such a large plane to take off. We got our answer when the images showed a large barge on the Moscow River next to the plant. The Bisons were placed on the barge and ferried to the Ramenskoye test field. The Kaliningrad and Moscow/Khimki plants were obscured by clouds, as was the Ramenskoye test center. Vita proceeded on to Ivanovo, 130 miles northwest of Moscow, where his images revealed Bull bombers but no Bisons or Badgers. On his return, Vito penetrated the SA-1 sites again, and again they were not activated. We would learn years later that Khrushchev severely reprimanded the head of the homeland defense bureau, or PVO, for that lapse.

The Russians were indeed surprised by the Fourth of July flight. Soviet leaders in Moscow had been invited to the American embassy's Independence Day celebration. Khrushchev, who attended, had been informed that an American plane was overflying Soviet territory on that very day, but he said nothing to the ambassador. According to Sergei Khrushchev, his father "believed, after receiving the American generals at the Moscow Air Show that they wanted to show that Americans can do anything they want. When he attended the reception at the American Embassy, he carried this strong feeling, but did not speak of it to anybody."[12]

After Vito's flight, the president asked if Allen Dulles had received any information that day about the flights being discovered or tracked, and was informed that there was a thirty-six-hour delay in receiving that kind of information.[13] Eisenhower responded that he urgently needed to know if the flights were tracked and told Goodpaster to advise Allen Dulles that the operation would be suspended if he learned that any flights had been discovered or tracked.

At that point the weather intervened. Bissell called Goodpaster and said there would be no flights on July 6 and probably not on July 7 either.[14]

The president authorized three more U-2 flights over the Soviet Union during the ten-day period: two missions covered most of Byelorussia and the Ukraine, and the third was flown over Moldavia and to the Crimea. One of the three A cameras stopped operating on the Crimea mission, confirming our doubts about them, and we lost a lot of strategic intelligence. This gave further impetus to use the B camera on future missions.

The PID photo interpreters looked at the U-2 images with total fascination. It was an exciting time—a new age of discovery. Much to our surprise, the Russians had made no attempts to camouflage or conceal their installations. For the first time we had the capability to derive precise, irrefutable, up-to-date data on the vast land mass and physical installations of our principal adversary. The U-2 missions were a learning and collaborative experience between the policy makers, intelligence analysts, and photo interpreters. The analyst literally stood at the photo interpreter's shoulder and was acutely aware of the exploitation process and of the photo interpreter's nuances and jargon. The policy makers, meanwhile, could compare the information derived from the U-2 with information from other sources.

As the images from each mission arrived, we made a series of spectacular briefing boards with annotated details and descriptive captions. Bissell and Dulles could not contain their delight at what they were seeing. Bissell later recalled: "I remember vividly standing around a long table with Dulles next to me, both of us chuckling with amazement at the clarity of those incredible black-and-white photos. From seventy thousand feet you could not only count the airplanes lined up on the ramps, but tell what they were without a magnifying glass."[15]

The president was a bit more subdued when Bissell and Lundahl showed the mission briefing boards to him. Lundahl explained the intelligence significance of each board as Eisenhower listened intently and asked questions about specific targets that were of great national interest. He was impressed with the interpretability of the photography and asked about the altitude at which the pictures were taken. He also asked questions about intercept attempts. Bissell showed him the briefing board of a MiG-19 below the U-2. Lundahl described the president as being "warm from satisfaction." The president made a gesture of praise for a job well done.

On July 10 the Soviets issued a strong protest of the July 4, 5, and 9 overflights.[16] The Soviets clearly had tracked all of the U-2 missions, although they thought the aircraft was a modified RB-47 Canberra bomber. The protest indicated that "a twin-engine medium bomber of the United States Air Force" had penetrated Soviet territory. Most of the cities the protest mentioned were in the former Baltic States; the protest did not mention Leningrad or Moscow. There were meetings between CIA analysts analyzing the Soviet tracking of the U-2s and those of us at the division. A multicode document was prepared by the CIA. It was apparent, too, that the Soviets knew the U-2's altitude and radar cross section.

Eisenhower was upset to learn that the missions had been tracked and said that he wanted knowledge of the U-2 project kept inside the executive branch and confined to "those who directly need to know of the operation, as distinguished from output derived from it." At that point, Goodpaster noted, "the President seemed very close to a decision not to continue."[17] The president and his advisers were concerned that the Russians might bring the U-2 flights up before the UN Security Council. At the UN Disarmament Commission meeting on July 12, 1956, Ambassador Henry Cabot Lodge promised "that the charges would be thoroughly investigated and that a report will be made when all the facts are ascertained."[18] The Soviets did not bring the matter before the UN, but threatened that they might be compelled to do so if there were "a reoccurrence of such impermissible actions."[19]

Khrushchev's son and upper-level Soviet defectors later explained that the Soviets faced a conundrum. They protested the flights to the United States privately but kept them a secret from the Soviet people and even from some high-ranking officers. Publishing the information would be tantamount to admitting that the United States was overflying the Soviet Union with impunity. Khrushchev would not reveal this big weakness in Soviet defenses.

The first five U-2 missions covered Soviet long-range bomber airfields in Minsk/Machulische, Stryy, Gomel/Pribyki, Baranovichi, Uzin/Chapelevka, Poltava, Priluki, Orsha SW, Soltsy, Ostrov Gorkhovaya, Ivanovo, and Belaya Tserkov. Only one Bison bomber was found—at Belaya Tserkov, an aircraft modification and repair base. When we finished interpreting the five missions, we realized that the Air Force was either misinformed or just wrong; the so-called bomber gap did not exist. Colonel Rinehart, an extremely able intelligence officer attached to the Army contingent in the PID, came down to my unit and checked all of our statistics before he was willing to report to his superiors that the "bomber gap" was a myth and that Air Force intelligence to the contrary (80 Bisons operational by July 1, 1956; 470 Bisons and Bears by mid-1958; and 800 by mid-1960) should be challenged at the highest levels.

Colonel Goodpaster wrote that the U-2 flights gave the United States "confidence, a great deal of confidence about our estimates of Soviet military capabilities and their state of readiness, especially as it related to whether they were massing forces in a way that suggested a possible surprise attack."[20] Eisenhower was pleased. His subordinates knew that his eyes reflected his mood: they could be "icy with anger, warm with satisfaction, sharp with concern, glazed with boredom. And always, somehow, they created a sense of—strength."[21] When the president was told that there was no bomber gap, his eyes were warm with both satisfaction and strength. When he learned from the Soviets' protest that they had been tracking all of the U-2 flights, Eisenhower's eyes were sharp with concern. He became cautious at that point and ordered a stop to the missions over Russia. Although all the missions had been successful, Eisenhower was not willing to proceed knowing that the Soviet Token radars had spotted all of the aircraft.

The U-2 flights were a source of irritation and embarrassment to the Kremlin, which never allowed the Russian people to learn of them. Sergei Khrushchev remembered that his father said, "I can see the Americans laughing there when they are reading our protest, knowing that we can do nothing more except this."[22] Elsewhere Sergei recalled: "Father summoned everybody who might be able to do something: Artyom Mikoyan, Pyotr Crushin, Andrey Tupolev, Pavel Sukhoi, and other designers of interceptors and anti-aircraft missiles. What most worried Father was the possibility that the intruder could carry an atomic bomb. The specialists categorically rejected the idea." Aircraft designers such as Tupolev believed that a twin-engine aircraft such as the Canberra would be too heavy to rise to that altitude and said that it must have one engine and very thin, long wings.[23] Khrushchev prodded the Soviet military-industrial complex to provide a solution. Among the aircraft considered for intercepting the U-2 were the MiG-21 and the Su-9. The SA-2 surface-to-air missile was not yet ready to deploy.

Sherman Kent, the director of the Office of National Estimates, called Lundahl to ask if we had completed our interpretation of all the airfields. When he was told that we had, Kent said he was going to call for a new estimate to downgrade the estimate of the number of Bison bombers in the Soviet Air Force. The Office of National Estimates did indeed publish a new estimate stating that as of July 1956 the Soviets had only approximately thirty-five Bisons in operational units. Allen Dulles informed Goodpaster, noting that the downward revision was based on an attaché's observation of the Moscow/Fili aircraft plant, which produced the

Bison. He added that "sensitive data on known Soviet Long Range Aviation bases supported the revised estimate of Bison strength."

The White House was not yet satisfied. The president wanted to find out more about the number, location, and readiness of the Bisons.[24] We had not yet overflown Saratov/Engels or Ukraina Airfield, for example, where Bison bombers were known to be stationed.

The U-2 missions were generating accurate, current information in greater quantities than had ever been contemplated. The information we were reporting was dispelling existing notions and intelligence estimates, and we took vicarious pleasure in proving the value of aerial photography over other intelligence sources. The U-2 came to symbolize the rising power of technical intelligence challenging the Ivy League traditionalists and the OSS holdovers in the Agency. Lundahl called us all together to thank us and praise our efforts. In just two months of operations we had dispelled the bomber gap myth. With only one hundred people we had solved a puzzle that thousands in the intelligence community had been working on for months. The Air Force looked at our accomplishments with amazement and envy. Our success was "like a miserable dream, because reconnaissance had always been the life blood of the Air Force. . . . An economics professor from MIT, a geologist from the University of Chicago running a major reconnaissance program for the United States?"[25]

SAC commander Curtis LeMay was not one to take the blow lightly. Still chafing that the project had not been entrusted to his command, he had demanded that the interpretation function be given over to the Air Force. When the president refused, LeMay demanded thousands of billets for his reconnaissance technical squadrons to construct charts on Russia for his bomber force.

Allen Dulles sent Henry Thomas, the Aquatone security officer, and me to Omaha to see what LeMay was bellowing about. LeMay was known for his outbursts of crude language and for deliberately circumventing the chain of command. It was all part of his image as a rough, tough general. We had heard that he was a profane, insufferable bastard determined to have things his way, even if it meant alienating everyone around him. We listened to his blustering and his demeaning comments about the CIA, but Thomas was immovable. SAC would not be given the security billets LeMay was demanding. Nor would Thomas agree to release any additional U-2 film unless SAC met certain security conditions. LeMay blustered on, insisting that only the Air Force knew anything about photo interpretation, until finally Thomas informed him that the decision had been made by the president and that he was free to call and complain.

Fortunately, Brig. Gen. James H. Walsh, SAC's intelligence chief, was present. He saw that nothing productive was likely to come out of our meeting with LeMay and invited us to his office for further conversation. The CIA did not dispute SAC's need for detailed and up-to-date intelligence. It was SAC's job to produce bombing charts and to carry out bombing missions should the United States come under attack. But we could not release highly sensitive documents until the Air Force units that were to see them had been brought up to CIA standards of security. Thomas told Walsh that anyone with a can opener could get into SAC headquarters, which was situated in a former World War II bomber plant. A specially designed cinderblock room would have to be built, and it would have to be under security control around the clock. Walsh picked up the phone, called the base provost marshal, and told him that he wanted such a room constructed, beginning the next day, and security provided around the clock. Thomas said it was a good start, but he would have to inspect the building when it was completed and approve the security procedures. He went back about a week later and approved a cell of fifteen people to be fully aware of the U-2 project, to be under the control of Col. Robert Smith, Walsh's deputy.

The Air Force set up four reconnaissance technical squadrons (RTSs) to receive the materials necessary to produce bombing charts. Thomas insisted that all would have to meet the same security standards that had been established at SAC headquarters and that each facility would have to pass inspection before receiving sensitive materials. The 544th RTS Wing, established in 1950 as a subordinate unit of Air Force Intelligence, was moved to Offutt AFB near Omaha in June 1952 in support of SAC operations. SAC was granted the necessary billets, but then a question arose about the security of the four Air Force reconnaissance technical squadrons to receive the materials needed to produce bombing charts. Thomas and I were sent to the Second Air Force headquarters at Barksdale, Louisiana, to inspect the construction of a special area and approve their cell, which consisted of about ten officers and enlisted men. Thomas also inspected the cells at March AFB in California and at Westover AFB in Massachusetts. The RTS in England was denied access to the photography until additional security measures could be taken because it employed British photo interpreters.

I visited SAC on several occasions. As Cold War tensions mounted, SAC swelled in importance. The command moved into an underground combat control center near Omaha where target information could be displayed on multiple screens. The morale at SAC headquarters and at the various bases was high. Personnel realized that SAC had an important role in the Single Integrated Operation Plan (SIOP) and a role to play in creating the Basic Intelligence Planning Guide (often referred to as the "Big Pig"), which listed military targets of interest to SAC. Crews were assigned to one or more aiming points called designated ground zeros to practice on radar ultrasonic trainers. The use of U-2 photography helped tremendously in these efforts.

It soon became obvious that the Soviets had some knowledge about the activities going on in the Steuart Building. The building was across the street from the Center Market, a large red brick structure with vendors who specialized in foods served at embassy parties and society functions. A limousine began parking across the street from the Steuart Building, and its driver was spotted taking pictures of the building. Lundahl brought his Questar telescope to bear on the limo. He photographed not only the driver but also the car's license plates. The driver was a Russian agent, and the car was registered to the Soviet embassy. Whenever the limousine parked in front of the Steuart Building, Henry Thomas would have the courier van park alongside it and take pictures of the occupants.

After the first five U-2 missions were flown, it was important to create a feedback loop on the successes and problems encountered on each mission. Bissell invited those responsible for the mission to visit the PID. Kelly Johnson was the first shown. Johnson, with his bulbous nose, slicked-down hair, and duck waddle, was always welcome at the division. Lundahl showed him the flight tracks for the missions and the briefing boards showing Soviet long-range bomber bases along with a number of industrial installations. Johnson looked at Lundahl with some pride and said, "Damn it, we did it, Art." Johnson was surprised, however, when he learned that the Soviet PVO not only had detected the U-2s but had also tracked them on all of the missions, and on several occasions had tracked them accurately and continuously.

Lou Franceschini and Carroll Lucas, division technical specialists, served as hosts to the scientists and engineers who arrived to analyze the products from test and operational missions and to monitor the evolutionary effects of multiple cameras and film modifications. Among these visitors were Bill McFadden and Bob Fulton from Hycon, Dr. Rod Scott from Perkin-Elmer, and Ed Green and several of the film and processing experts from Eastman Kodak. Of special concern to them was aircraft performance that could affect the resolution of the photography, such as changes in altitude, vibration from internal operating equipment, camera window problems, and the radius of recorded aircraft turns. Photo interpreters were present to provide opinions on the interpretability of the photos.

On June 19, 1956, Allen Dulles met with the president to review the U-2 program. Dulles indicated that two units were being deployed to the Mediterranean for possible reconnoitering. The president "thought that this might be very interesting." Eisenhower also saw merit in establishing a base in the western Pacific region to reconnoiter the Asian mainland. But he told Dulles that he "had lost enthusiasm for the U-2 overflights over the Soviet Union, and reiterated that if we were on the receiving end the reaction would be drastic. While Soviet protests are one thing, any loss of confidence by our own people would be quite another."[26] The president had been assured that only a small percentage of the flights would be detected and was upset that he had been misinformed.

The key ingredient in the U-2 program—and any aerial reconnaissance—was the proficiency of the photo interpreters and the presentation of the data. President Eisenhower said that photo interpretation required the patience of Job and the skill of a good darner of socks. Antoine de Saint-Exupéry, the noted French aviator and writer, likened photo interpreters to bacteriologists because they examined images under a microscope. James Barnes, a World War I photo interpreter, said that photo interpretation demands a peculiar mind—a type that enjoys chess problems or crossword puzzles. Fundamentally, photo interpretation is an operation of human judgment, and every conceivable method has to be applied to enhance the interpreter's performance and efficiency.

Lundahl would frequently address his new interpreters with this analogy. Scribe a twenty-five-mile circle on a map in most areas of the world, and a man is born, lives, and dies within that circle. Carefully analyze the aerial photo of that circle and you will be able to determine what he eats, what he wears, his source of water, what he cooks with, where and how he is educated, his customs, how he lives, how he makes a living, his religion, the home he lives in, his interaction with nature, and finally where he lies buried. The skills one brings to photo interpretation are imagination, intuition, nonconcrete thinking, and attention to detail. A 1943 publication Lundahl helped produce on the duties of an interpreter notes that "a photo interpreter must have knowledge in what he is looking for, its appearance and how it works. He must know the enemy's country economically and physically, its industries, communications, terrain, etc. He is drilled in the characteristics of the various industries, airfields, railways and other inland transportation, warships, shipbuilding, general shipping, radio, camouflage, gun installations and armored vehicles, bomb damage assessment, decoys and dummies. He must be sure of what he reports."[27]

The imagery analysis process is complex, painstaking, and often tedious. First, the photo interpreter must determine which images have intelligence value. Image resolution varies greatly, and images situated in topographically simple areas are easier to exploit than those in topographically complex ones. Photo interpretation in the missile and nuclear age grew in complexity and sophistication. It was largely cognitive and was based on the recognition of features or patterns. For example, the SA-2 SAM site displays a Star of David pattern. An armored unit can always be identified by a series of bowling alley-like lanes that are actually tank-firing ranges. A Soviet SS-4 intermediate-range ballistic missile (IRBM) site in its initial stages of construction displays unique "slash marks" for the missile pads.

Today's photo interpreter develops a unique combination of traits, skills, and knowledge. Inherent traits include attention to detail, curiosity, inquisitiveness, diligence, deductive and inductive reasoning, and, above all, good eyesight. The collateral information necessary for interpretation is available from many sources. Without computer information continually at hand, the photo interpreter would be seriously handicapped. Computer services are more than a reporting mechanism; they provide historical target descriptions and specific exploitation testing. Should dimensions of objects be required, photogrammetrists using sophisticated machines called comparators can provide the needed data.

Photo interpreters can focus either on the geographic or the substantive. An analyst assigned a geographic area becomes acutely familiar not only with the terrain but with all the military and industrial activity within the assigned area, and with its environmental details. The substantive analyst knows a subject—say, missiles—and becomes very familiar with all the various research and development, construction, testing, and deployment phases that pertain to the subject.

Only about 25 percent of the world had been mapped by the mid-1950s. The low percentage became acute when the era of missile and nuclear testing dawned, when deserts and remote areas became nuclear and missile proving grounds. These were easy to identify but required constant monitoring. When a flight was completed, preparations would immediately get under way to exploit the results of the mission. Maps, charts, and reference materials would be assembled and placed on collateral support carts that could be moved to the area where the photo interpreters worked.

Over many years, an experienced interpreter catalogues hundreds of ways and techniques to outfox the enemy. For example, the Soviet penchant for horizontal security immensely aided our interpretation efforts. To prevent ground observations, sensitive strategic installations were ringed not by one but by several fences or board walls that were easily detected on imagery. Interpreters looking down from above could see between electrified fences, minefields, or paths for sentries with dogs. The Soviets also applied natural security to an abnormal degree. Sensitive installations were built in deep forests. But the Soviets were heavily dependent on rail lines, and the interpreters would look for rail spurs, which often led to a sensitive installation. All sensitive installations required further analysis.

An interpreter becomes acutely aware that each day, month, and season presents its own exploitation possibilities. Snowmelt on the roofs of buildings, for example, allowed an observer to discern which buildings are heated and probably occupied. Snow-clearing efforts at military installations gave an idea of the importance of each building. It was my experience that headquarters buildings and paths to latrines were always cleared first. Microwave towers, which beamed radio waves on a line of sight, used relay towers that were usually perched atop hills about twenty-five miles apart. These tall, slender towers were often difficult to discern on clear days, but their long, dark shadows showed up well on photos taken early in the morning against a backdrop of snow. Knowledge of the latitude, day, and time allowed photogrammetrists to compute the tower's height, and often its orientation. Each tower radiated energy detectable five to ten miles away. Military vehicles, such as tanks, left unique tracks visible in the snow or in training areas. Arid areas were easily identified not only by vehicle tracks but also by the dust vehicles stirred up.

The best intelligence about military order of battle was obtained on Sunday mornings and during holidays, when most military equipment was in garrison, parked, or stowed. Paths and activities in forests were best observed in the spring before the trees began to leaf out. Capabilities of ground forces were best observed during spring training exercises. The elite units invariably had the most modern military equipment. Monitoring activities such as these took up much of the photo interpreter's time.

Even the best photo interpreter has made one call that he would like to forget. I am no exception. It happened during the Battle of Anzio in the summer of

1944. The Allies had control of the air by that time, and German troops moved at night, stopping at streams for water and to wash their clothes, usually spreading the items on bushes or tall grass nearby. The Germans never adopted khaki or green underwear such as American forces wore, and the presence of white underwear was a dead giveaway that a German unit was near. One day we were told that a German division was moving down from Udine to Anzio in Italy. I flew on a photographic mission with the group's commanding officer. Looking down at a stream, I spotted splotches of white on the grass and photographed the area. I called up to the colonel that I wanted to photograph the area again because I was convinced that I had spotted the telltale white underwear of a German unit on the move. He complied, and I got another round of photos. When we returned to our base I told our intelligence officer I had spotted a German unit. The film was quickly developed and I was asked why I had photographed the same area twice. I replied that I wanted to make sure I got the picture. The intelligence officer said, "You shouldn't have done that because your skivvies moved." I had filmed a flock of sheep quenching their thirst. A large photo of a sheep went up on the squadron's briefing board with the note, "Dino's private army on the move." Subsequently, when I entered the briefing room for other missions someone would invariably call out, "Baa baa baa."

Even Arthur Lundahl missed a call from time to time. After Pearl Harbor, the Japanese occupied Kiska Island in Alaska's Aleutian chain and constructed an airfield for fighter planes that were quite a nuisance to U.S. naval forces. Lundahl was a photo interpreter at the Navy's Attu Island Photo Interpretation Center. The U.S. Navy blockaded the harbor to cut off the fuel supply, and still Japanese planes from the airfield were coming out and attacking. "Where in the hell are they getting their fuel?" an admiral demanded to know. Lundahl thoroughly analyzed the aerial photos and could not find any storage tanks or barrels. He had seen the answer, in fact, but did not realize it. When aerial photos showed Japanese planes on a spit of land about a mile from the airfield, he quickly identified the planes as dummies; they were weatherbeaten, their wings drooped, and they never moved. The Navy staged an aerial attack on the airfield holding the real planes, hoping to wipe out the pests. One pilot completely missed the airfield and dropped his bombs on the dummy planes about a mile away. An enormous explosion occurred, and the puzzle was solved. The gasoline tanks were beneath the dummy planes.

Lundahl never forgot to look for camouflage after that. He had a number of Russian books on camouflage, concealment, and deception translated and was well aware of the Soviets' proclivity for secrecy, concealment, and deception. The Russians had developed a *dezinformatsiya* (disinformation) system with the intent of misleading or throwing the enemy off balance. Lundahl kept pressing the PID for information on such activity. He wanted to know if we had seen any "Potemkin" schemes that were meant to deceive. We had not.

In fact, the Soviet Union was wide open to observers looking down from above. Eisenhower too was surprised when photos of strategic installations showed no sign of camouflage or concealment activities, and that gave him pause. He asked Lundahl, "Are we doing any camouflaging of our missile and nuclear installations?" No, he was told, we were not. He thought for a moment and said, "I guess it would very difficult to conceal such large installations." After another pause, "We camouflaged our aircraft plants out west, didn't we?" The reply was in the affirmative. Then he said, "But that was during wartime."

Although there was a temporary stand-down in U-2 missions because of the Soviet protest, we continued analyzing the film from the first five missions. We discovered our first enigma on images from Vito's July 5 flight. Near Mozhaysk, about fifty miles southwest of Moscow, there was a new strongly constructed and heavily secured installation. Security consisted of three fences with guard towers and guard dogs. In addition to a secured housing area and several bunkers the images showed a large domed building under construction that reminded Lundahl of the National Gallery of Art in Washington, D.C. The top of the dome had a circular opening. Initially, there was some speculation that it might be a diorama display marking the spot where Napoleon's and later Hitler's forces were stopped on their way to Moscow. But the heavy security and heavy concrete construction nominated it to be a structure in the Soviet atomic energy or missile program, or both. There was absolutely no collateral information available about the site. Fred Lowery, a very competent Army photo interpreter, was given the task of thoroughly analyzing and measuring all the structures.

Someone hypothesized that a missile could be fired through the opening of the dome. Lundahl wanted a missile specialist's opinion on that. The best there was in those days was Wernher von Braun at the Army Missile Command in Alabama. Von Braun, however, was not cleared to see the photos. Lundahl had the photo lab skew the photo to make it appear oblique. The cover story was that the photo was of an unknown installation taken from a commercial airliner. Lundahl asked Maj. Gen. John Medaris, the head of the Army Missile Command, to bring von Braun to Washington. Von Braun was impressed with the quality of the photo and tried to learn more about how we had come by it. He looked at the photo with a magnifying glass for a considerable period and finally said that he could see no reason for such heavy construction for a missile launch, unless it was for a nuclear missile.

After some dithering by U.S. intelligence officials, a senior official from the Atomic Energy Commission was cleared to view the photos of the installation. He in turn requested clearance for a scientist from the Sandia Corporation. That scientist immediately identified the site as a nuclear weapons assembly plant. Sandia scientists had designed a similar structure—a reinforced dome that would have a fifteen-foot gravel covering instead of a solid roof. Steel cables strung from the reinforced concrete dome would support the gravel, and layers of steel wire mesh would further contain the gravel. Sandia called the structure "Gravel Gertie," after a character in a *Dick Tracy* comic strip, because it resembled the character's curly gray hair. Gravel Gertie was designed to prevent release of radioactive materials into the atmosphere if an explosion should occur in the structure. If an accidental explosion did occur, the gravel roof would expand and then fall back, filtering out the radioactive particles. The Sandia Corporation had successfully tested high-explosive uranium devices. The U.S. Gravel Gerties were later covered over with soil.[28]

Even weapons experts can be wrong. When we saw the completed Soviet installation some five years later, the dome had been sealed, indicating that it was not a Gravel Gertie but rather a nuclear storage installation. This and other such installations were designated SOCs (sensitive operations complexes). With additional data and better resolution, they would be designated NNWSSs (national nuclear weapons storage sites).

The Cold War brought other new weapons and related complexes as well. Lundahl realized that these new weapons systems demanded certain facilities, practices, operations, and safety standards. Secrecy, essential to protect our national security, did not permit photo interpretation keys or guides of these nuclear and missile installations. Lundahl's solution was to send photo interpreters into the field to develop their abilities to correlate ground features at weapons installations with their photographic appearance. The Department of Defense allowed photo interpreters to visit these sites on "plant trips." Top officials at the plants knew our identity and provided guides to point out the salient interpretation points of each type of installation. Each installation had unique signatures that allowed the PID to establish keys or "signatures" to facilitate interpretation. Excavations, foundations, heavy military equipment, and security became signatures that photo interpreters invariably looked for. The tours of SAC and Tactical Command airfields and naval and submarine bases helped immensely in defining signatures. We would later discover that the designs of these systems were in most cases practically the same in the Soviet Union as in the United States.

Another unique installation turned up on images from the July 1956 U-2 flight over Odessa, Kerch, Simferopol, Sevastopol, and Balaklava. Because of its rather humanistic appearance, the installation at Balaklava was given the name "Twin Eyes." It was immediately placed in the missile category because the images showed two launchers constructed on two large concrete platforms. Subsequently identified as a coastal and shipboard cruise missile testing site, it was the first missile site we detected.

There began a practice that I would continue throughout my years with the PID and later the Photographic Intelligence Center (PIC)—adding historical or humorous items captured on aerial or satellite photos to the briefing boards (Richard Helms would call the humorous ones "funnies"). I was fascinated with the Balaklava area and its role in the Crimean War.

Since Balaclava was near the Black Sea, Lundahl identified a site there to Eisenhower as a probable naval cruise missile test site. On a large print that included both Sevastopol and Balaklava, he showed the Sevastopol naval base and the naval order of battle of the Black Sea Fleet. Eisenhower looked on in interest as Lundahl pointed out the area between Balaklava and Sevastopol where the charge of the Light Brigade had occurred. Eisenhower pored over the print and pointed out the defenses at Sevastopol. He seemed so enthralled that Lundahl added, "I am sure you are aware that Secretary of War Jefferson Davis sent Captain George McClellan as the American observer of the war." Eisenhower looked up and smiled, "He didn't learn much, did he?"

We shared the U-2 intelligence information on the Soviet Union with the British. An air commodore from London and his aide regularly visited the PID to receive a sheaf of briefing boards we had prepared for them. Lundahl would meet with the air commodore to go over each board and the notes I had prepared, because he wanted to make sure there would be no confusion. The briefing boards were then packaged and sent back with the British officers. When the boards reached London, the air marshal was briefed, then the prime minister and other high-ranking British intelligence officials. Henry Thomas, our security officer, told the aide who carried the boards from the first mission not to surrender them to anyone—even if it meant his life. The aide turned white as a sheet. Eager to play a more active role, the British began to revamp their photo interpretation facility and to procure American photo interpretation and photogrammetric equipment. Robert Abbott, an RAF officer, was assigned to our division.

Eisenhower would face three crises in October–November 1956, in Suez, Little Rock, and Hungary. Of that period he would later write: "October 20, 1956 was the start of the most crowded and demanding three weeks of my Presidency. The drama of those weeks is still so fresh in my memory that I can recite its principal events and our decisions without a pause."[29]

NINE

suez, little rock, hungary, and the black knight flights

I'll G-2 my friends if I have to.
Dwight D. Eisenhower

The world seemed about to explode in violence during President Eisenhower's last term. Crises in the Middle East and Europe demanded his attention.

The Suez War

The Egyptian army coup that overthrew the corrupt regime of King Farouk brought thirty-year-old Col. Gamal Abdel Nasser to power. A spellbinding orator, Nasser championed Egypt's independence from Great Britain. His call for Arab nationalism frightened both the British and the French. Nasser also called for Egyptian domination of the neighboring Sudan and asked the United States and Britain for military aid. The United States was on the verge of granting both military and economic aid to Egypt throughout 1953–54, but was always held back by the British. The CIA's covert service was active behind the scenes, with Kermit Roosevelt and Miles Copeland trying to lure Nasser away from his radical ideas. Eisenhower, meanwhile, was attempting to maintain a policy of neutrality between Arabs and Jews.

During 1955, relations between Israel and Egypt, always strained, worsened. Border skirmishes and fedayeen raids from Egypt and Jordan increased in frequency and magnitude. In July 1956 the scuffling in the Middle East flared dramatically into an international crisis. Although his campaign against the Baghdad Pact intensified in the latter half of July, Nasser announced Egypt's readiness to accept help from the United Kingdom and the United States to build the Aswan

Dam, a large water and electrical project to be constructed across the Nile River. The dam, estimated to cost $1.35 billion, would expand Egypt's arable land by 30 percent. After prolonged negotiations, Secretary of State Dulles announced that the United States was no longer willing to help finance the project because the scheme was not economically sound. Similar announcements followed from Britain and the International Bank for Reconstruction and Development. Smarting from his rebuff by the West, Nasser announced, on July 26, 1956, that the Egyptian government would nationalize the Suez Canal Company and would use revenues from the canal to build the dam. Nasser then turned to the Soviet Union for help, and Premier Nikita Khrushchev promised that the Soviets would construct the dam.

The Soviet Union was already supplying arms to Egypt under a September 27, 1955, agreement with Czechoslovakia. It was clear that the Soviet Union was using its Eastern European proxy to become an important influence in the Middle East by abetting Nasser's anticolonial policies. This struck a sensitive point with the British because the British Empire still encompassed large areas of Africa.

When Russian-made arms began arriving at Alexandria, the CIA gave cameras to foreign nationals to photograph the military equipment arriving at the port. Security at the port was lax, and the CIA began receiving abundant photos. Crates holding MiG-15 jet fighters, Il-28 bombers, and Il-14 transports were followed by T-34 and JS tanks, armored personnel carriers, and field and antiaircraft guns. The Soviets also delivered two destroyers, four minesweepers, and 12 Komar and Osa guided-missile patrol boats.

The Israelis became increasingly concerned that the infusion of Soviet military equipment and advisers posed a severe threat to their security. Nasser had never hidden his intent to conquer Israel. The Soviet arms would be an enormous help in that endeavor. The Israelis approached the United States and asked for military aid. At that point the Israeli Defense Forces were a motley lot. Through a series of war surplus purchases the Israelis had assembled a number of British and U.S. World War II propeller-driven bombers and fighters. The French had supplied thirty-six earlier-model jets (Ouragans) to Israel in 1954. When the United States and Britain stonewalled their requests for arms, the Israelis found a more favorable atmosphere in Paris. France notified the United States that it had agreed to send the Israelis twelve Dassault Mystère IV fighters. The United States approved this shipment as well as an additional twelve Mystères.

Although the U-2 missions had been planned to gain strategic information about communist countries, and the organizational structure and databases of the Photo Intelligence Division were predicated on such overflights, events in the Middle East were approaching the point at which tactical use of U-2s was being considered. Political tensions between Egypt and Britain, France, and Israel over Egypt's nationalization of the Suez Canal were causing apprehension at the White House, particularly when it became apparent that those three nations might be conspiring to attack Egypt. Eisenhower made his disapproval very clear to the British and French. When the British did not heed the warning and seemed to be masking their military operations, Eisenhower convened a meeting of House and Senate leaders in mid-August 1956 to discuss the situation. He told the attendees, "I don't like to do this but I will G-2 [use intelligence on] them if I have to."[1]

Shortly afterward, Arthur Lundahl called me into his office after a meeting with Allen Dulles and said that President Eisenhower had authorized U-2 flights over the Middle East and that we must get ready at once to exploit the film. Many in the intelligence community surmised that Eisenhower had received advance notice—probably from a high-ranking British official—that the British might attack Egypt. The most frequently mentioned possibilities were Lord Louis Mountbatten, who openly voiced his disapproval of attacking Egypt, and Minister of Defense Walter Monckton, who would resign from Eden's cabinet to protest Eden's decision to attack Egypt.

In a staff meeting Lundahl emphasized that we were entering a new reconnaissance phase and told us to call our shots as we saw them. Dulles told us essentially the same thing: "We've got to keep our absolute integrity. Keep out of politics. Be absolutely fearless. Report the facts as we see them regardless of whether they're palatable or unpalatable to the policy makers. If we ever lose that objective, then we are finished."[2]

Preparing to exploit Middle East U-2 missions meant a round-the-clock effort by my branch to procure the maps, charts, reference materials, and other paraphernalia necessary to support a U-2 interpretation effort in Washington and also, if necessary, in the field. Initially, the missions were to be flown out of Wiesbaden, West Germany, and the film processed and interpreted in the United States.

The first mission, on August 29, 1956, was flown over Egypt, Jordan, Lebanon, Israel, and Syria; missions over Malta and Cyprus followed. When we interpreted the images we were surprised to find more than sixty Mystère IV fighters along with Sud Vautour fighters and Ouragan bombers at Ramat David and other

Israeli airfields. Eisenhower was furious when he saw the photos. He felt that the Israelis had betrayed him. In a memorandum for the record Eisenhower added the following note: "Our high-flying reconnaissance planes have shown that Israel has obtained some 60 French Mystère pursuit planes, when there had been reported the transfer of only 24." He wrote in his memoirs that "a blackout of communications had been imposed. From that time on, we had the uneasy feeling we were cut off from our allies."[3] Eisenhower ordered the U-2 missions over the area to be stepped up. In an NSC briefing General Cabell stated that the additional Mystères had given the Israelis air superiority over the Arab states.[4]

Eisenhower knew that sophisticated modern reconnaissance methods would be able to determine the capability, limitations, and to some extent the intentions of the enemy. But even the best reconnaissance cannot forecast the intentions of foreign leaders or military officials. So he tried a different tack. The British were not aware of the U-2 flights. After the initial U-2 missions over the Middle East, Eisenhower decided to share some of the intelligence gained with the British and Germans. We created a series of briefing boards and notes on Egyptian, Israeli, Syrian, and Jordanian military installations for Lundahl and Jim Reber, chair of the Ad Hoc Requirements Committee, to take to London on September 7, 1956. On arrival they briefed the air marshal along with a number of senior military and Foreign Service personnel, without mentioning that the U-2s were overflying British bases on Cyprus and Malta as well. In a way it was a warning that the Middle East was under careful U.S. surveillance. The high-ranking British officers listened to the briefings but, according to Lundahl, seemed disinterested. The air marshal, a loquacious man whom Lundahl had met before, surprised Lundahl by asking few questions. The briefing materials remained with the British.

Lundahl and Reber went on to Wiesbaden, and on September 12 briefed Chancellor Konrad Adenauer. Always gracious, Adenauer thanked Lundahl and Reber for the update and said he hoped there would not be war. He also said that the situation did not look good, implying that he, too, had information that the British, French, and Israelis were conspiring to invade Egypt.

The deteriorating situation continued to concern President Eisenhower, Secretary of State Dulles, and DCI Dulles. It was clear to all three that the British, French, and Israelis were systematically trying to deceive Eisenhower about their preparations for war.

Determined to conduct a speedy readout of the missions so that the president could have the freshest information possible, Lundahl decided to send a photo interpretation team to the field to interpret the film as it came off the processors. The Ad Hoc Requirements Committee approved it as a national mission. A photo interpretation team from the PID, led by Clifton Mullineaux, was sent to the USAFE 497th Reconnaissance Technical Squadron in Wiesbaden. Earle Kniebiebly, the PID's senior laboratory chief, met with Eastman Kodak officials to learn what processors and chemicals would be required to process the U-2 film and to arrange for their prompt shipment to Germany. Collateral supporting materials, along with viewing and interpretation gear, were crated and sent to Wiesbaden. Division interpreters on ninety-day tours quickly set up shop in a specially secured area in the 497th.

When the 497th's officers protested their lab being taken over by the CIA and a stranger telling their personnel how to process the U-2 film, the Air Force was quickly and emphatically told that this was a national mission ordered by the president. The Air Force did not like it, but cooler heads prevailed. As soon as U-2s landed at Wiesbaden the film was removed and processed, the photo interpreters read out significant targets, and the information was cabled to Washington. The original negative and a duplicate positive were sent by courier to the PID.

Lundahl anticipated turf battles in other world spots where rapid interpretation might be needed and suggested to Reber that cleared Overseas Photo Interpretation Centers (OPICs) be established for use in future emergencies. The Ad Hoc Requirements Committee agreed that such centers would be established at overseas Air Force bases and, if needed, on Navy aircraft carriers. Each OPIC would be headed by a senior CIA officer, and his deputy would be an Air Force or Navy officer. This was later modified to make the Air Force officer the senior at the OPIC and the CIA officer his deputy. OPICs were established at bases in Eielson, Alaska; Hickam, Hawaii; Wiesbaden, West Germany; Yokota, Japan; Clark, Philippines; Incirlik, Turkey; and on the Navy carrier *Ranger*.

On September 12, 1956, the Intelligence Advisory Committee created the Paramount Committee to handle all-source crisis reporting on a round-the-clock basis. The committee was chaired by Fritz Voight of the CIA and included representatives from the CIA, Air Force, Navy, NSA, and State Department. Enno H. "Hank" Knoche, also from the CIA, served as the executive secretary. The Paramount Committee met daily in a secure room on the seventh floor of the Steuart Building where photo interpretation operations were conducted. The committee received and integrated six distinct types of information: (1) intelligence from U-2 missions; (2) COMINT reports; (3) ground observer reports by three American military officers, identified by the code name "Thoptic," whose services were acquired by the CIA to conduct clandestine observations of British and French forces in Cyprus; (4) information from the Sixth Fleet and from a Navy air reconnaissance unit at Sigonella, Sicily; (5) State Department cables; and (6) press reports. This was the intelligence community's first all-source shop using U-2 imagery.

A large map of the Middle East dominated one wall of the committee's meeting room. Overlays of the tracks of each U-2 mission were posted over the map. Clipboards attached to another wall gave the latest information from the six sources. The committee prepared a daily situation report that was classified in the Talent and communications category, and transmitted to the Watch Committee and the White House.

The U-2 overflights began producing interesting information. Detailed analysis of U-2 film of Cyprus showed roadblocks on a number of roads and tent encampments. Sentry posts were spotted in several areas on Malta. An overflight of Toulon, France, on September 11, 1956, clearly showed extensive military activity and possibly troop loading. Overflights of Syria and Rhodes showed no suspicious activity.

U-2 imagery over Malta indicated that the Royal Navy was beginning to assemble at the British naval base at Valetta. The buildup included heavy units of the British fleet along with a number of troop transports. Ground intelligence supported British military activity. The British navy, when in port, was known for its parties; yet the wife of an admiral was bemoaning that her "dear Chauncey" would not be attending parties for the next few weeks because he would be exceptionally busy. Other high-ranking Royal Navy officers were missing from London. Fighters, bombers, and transports began arriving at the RAF Luqa Air Base in Malta.

The U-2 missions continued to reveal a British and French naval buildup at Valetta. We also saw a substantial buildup of military tent camps in the Nicosia area in Cyprus. Large military tent camps continued to mushroom in the center of the island. We had an abundance of data on British tents, and we developed the science of "tentology." By counting the tents and knowing the number of men normally billeted in them, we could come up with a rough number of troops in the camp. We estimated that the number of tents and other structures where soldiers were billeted was sufficient to accommodate up to 60,000 troops. This estimate was included in the Paramount reports.

It was relatively easy to maintain photographic surveillance over the naval base at Valetta, and thus to keep track of arriving and departing naval units. We also overflew the port of Toulon again, where heavy activity at the port and naval base indicated that a task force that included a French aircraft carrier, probably the *Lafayette*, was assembling.

In the meantime, the U.S. Navy spotted the French surreptitiously delivering AMX and Super Sherman tanks in LSTs to Israel at night. The new tanks later showed up in Israeli elite armored divisions. The Israelis liked American World War II half-tracks, which had proved very effective at negotiating the North African terrain, and were now seeking to obtain surplus ones. We could always spot Israeli forces by the presence of half-tracks.

A second detachment of U-2s was established at Incirlik on September 11 and began flying over the Middle East. There were no film-processing facilities there, so the exposed film had to be flown to Wiesbaden for processing and interpretation, causing a delay of about fifteen hours. On October 29, 1956, Bissell ordered Lundahl to establish a film-processing and interpretation facility at the Incirlik airfield. The Air Force had a large stock of photographic chemicals at Wheelus AFB in Libya but refused to provide them, so we went to Eastman Kodak for help. The PID sent a photo interpretation unit and two laboratory technicians, who set up operations in several trailers outfitted for film processing and interpretation.

Many unexpected and often funny things happened with these rapid deployments. The water for film processing at Adana, for example, left a lot to be desired. Eastman Kodak officials said that adding borax to the water would help. Bill Banfield, a senior PID official, and others scoured Adana and bought all the regular 20 Mule Team Borax they could find. One Turkish store owner became suspicious about all this borax buying and alerted the Turkish police, who suspected that it was being used to manufacture illicit drugs. Banfield was grabbed and taken to police headquarters, and only the intervention of a senior Turkish military officer secured his release.

In another case, Charlie Speich, a photo interpreter, had a bit too much to drink and happened upon a Turkish wedding party. Feeling in a celebratory mood, he began to dance to the music. Turkish men wearing traditional costumes with large curved daggers in their belts joined in. Banfield intervened at this point and grabbed Charlie, fearing he would do something foolish, the Turkish men would draw their daggers, and an international incident would ensue. The Turks protested; the interpreter had become the wedding entertainer. Banfield allowed one more dance before he took the happy interpreter back to camp.

The U-2 missions continued over the Middle East: four in August, seven in September, ten in October, and fourteen in November. These missions were under extremely tight security to keep the British, French, and Israelis from learning that they were the targets of American reconnaissance.

In late September 1956 King Hussein of Jordan appealed to Iraq to send troops into his country to deter an Israeli invasion. Iraq agreed to send military supplies to Jordan along with the forces to protect them. Israeli officials began warning U.S. officials in Tel Aviv and Washington that Israel would not accept any Iraqi military deployment into Jordan whatsoever. Prime Minister David Ben-Gurion cabled Eisenhower that Iraqi troops in great numbers were poised at the Iraq-Jordan frontier. Fearing that Israel would use the matter as a pretext to move into Jordan, Eisenhower asked the CIA to determine whether Iraqi troops were indeed in Jordan. On the whole, an Israeli invasion of Jordan seemed unlikely because the British had a treaty obligation to defend Jordan. In any event, a U-2 mission flown over Jordan and Iraq turned up only a small Iraqi force at an Iraqi pipeline pumping station near the Jordanian border. U.S. attachés in Tel Aviv passed the message back to the prime minister.

The situation at the Suez Canal continued to escalate. There were reports that the Egyptian-owned Suez Canal Company was planning to encourage canal pilots to leave their positions on command. We were warned that if this happened, U.S. naval officers would want us to look at the latest U-2 photographs to pinpoint U.S. Navy fleet units transiting the canal and any ships with Americans aboard—essential information if Americans had to be evacuated in the event of war.

In the meantime, the British had called up 20,000 reservists. There was considerable publicity when British army and marine units began arriving at Southampton to be loaded aboard transports. Observers on the ground had no difficulty determining which units were being deployed because the soldiers were displaying their regimental colors as they marched aboard. Among the units being loaded were paratroopers. The U.S. Navy reported the British troop transports as they passed through the Strait of Gibraltar. The waters around Limassol, Cyprus, were not deep enough to accept ocean-going transports, so the troops were transferred to lighters that landed at the port of Limassol.

PID personnel were concerned when the Watch Committee issued Report 322 on October 3, 1956. The report stated that "Anglo-French military action against Egypt in the near future appears unlikely." The evidence we were extracting from the photographs showed quite the contrary.

The information gained from the U-2 missions became a critical source of information after October 15 as relations between the United States, Britain, France, and Israel deteriorated and State Department sources began to dry up. Hoping to forestall a French-Israeli initiative against Egypt, Eisenhower delivered a stern warning to Ben-Gurion, but the crisis deepened. Concern at the White House heightened when the president learned that British and French nationals were being evacuated from Egypt, Jordan, and Syria on a large-scale basis despite the lack of any indication that security in the Arab countries was deteriorating.

Lundahl called a staff meeting and told us that Adm. Arthur Radford, chair of the Joint Chiefs of Staff, would be sending over a number of high-ranking Air Force, Navy, and State Department officers to view the latest information we had on the Cairo West Airfield and the activity at the port of Alexandria. The State Department was ready to order the evacuation of all American dependents in the Middle East. A number of American commercial airliners were already present at the airfield, and we pointed them out. We were told that there were at least 2,000 American dependents in Egypt, 2,000–3,000 in Israel, and 350 in Jordan. The emphasis, however, would be on Egypt. If air evacuation became necessary, Cairo West Airfield would be used. If the airfield was unavailable, trains would move dependents from Cairo to Alexandria, where they would be met by U.S. naval forces. The British had been warned that Americans were going to be removed. Adm. Arleigh Burke transferred his headquarters from London to a flagship in the Mediterranean, and the Navy was on standby to assist in the evacuation with the carriers *Coral Sea* and *Randolph*. A battalion of Marines was also placed on standby. We made a number of enlargements of all the places Americans might be moved if evacuation became necessary.

Tensions had reached the breaking point. The minutes of the October 26, 1956, meeting of the National Security Council note that "in addition to what was happening in Poland and Hungary, there were rumors flying around that the King of Jordan had been assassinated, there were riots in Singapore, and serious unrest in Morocco, Tunisia and Algeria."[5]

There was no direct evidence that the British, French, and Israelis had met or were planning to meet to plan the invasion of Egypt, but indications of collusion were abundant. A special national estimate on July 31, 1956, cautioned: "The danger of such action might materially increase if the Western Powers undertook military action—in which case Israel might seek to join them; or if Western relations . . . deteriorated so drastically that Israel could feel reasonably confident of avoiding severe Western punitive measures as a result of attacking Egypt—presumably with the aim of destroying the Egyptian forces and toppling Nasser."[6] Later, after the crisis passed, the Americans learned that British, French, and Israeli envoys had met in the elegant Parisian suburb of Sevres and had signed a military alliance. The plan was simple. The Israelis would begin the operation with an air attack and paratroopers to secure the eastern entrance to the Mitla Pass. Israeli armor and mechanized units would cross the border into the Sinai Peninsula and advance toward Port Said. Under the pretext that they were intervening in order to separate the Egyptian and Israeli forces because of the danger to the Suez Canal, an Anglo-French expeditionary force would land with the hope of overthrowing Nasser's regime. Although Eisenhower was not party to the details of the alliance, he was continually updated on the high level of military activity at the staging bases in Cyprus, Malta, and Toulon, and was aware that the British and French were conspiring to keep the truth from him. That was enough information for Eisenhower to warn British, French, and Israeli leaders that he would not support an invasion of Egypt.

U.S. attachés began forwarding reports of Israeli mobilization. Overflights of Israeli military installations revealed a number of cars and buses at military camps, an indication that military reservists were being called up for action. Tank transporters and other heavy equipment were being prepared for movement. Dulles was still convinced that the Israelis would attack Jordan, but our aerial photos were showing something different: Israeli tank transporters, columns of trucks, and half-tracks were heading in the other direction, toward Beersheba. We found Israeli tanks hidden in a depression near Nizzana, southwest of Beersheba. Present also were a number of fuel carriers. Ben-Gurion repeatedly assured Eisenhower that Israel would not take part in the dispute between Britain, France, and Egypt, but our evidence indicated that he was planning to do just that. On October 27, reacting to our information, Eisenhower sent a cable to Ben-Gurion expressing his "concern at reports of heavy mobilization on your side. I renew the plea that there be no forcible initiative on the part of your Government which would endanger the peace."[7]

British naval units had begun leaving Malta and assembling south of Cyprus. The British deployed two aircraft carriers, *Albion* and *Bulwark*, as well as the helicopter assault ships *Ocean* and *Theseus*; the French deployed the *Arromanches* and *Lafayette*. In all, the Anglo-French fleet comprised six aircraft carriers, 130 warships, a flotilla of landing craft, and troop transports.[8] The U.S. Sixth Fleet followed close behind and reported on the other fleet's movements. At one point, when an American ship came a bit too close, a British officer shouted, "You know, you guys are really pissing us off." The American reply was, "Yes, we know." To try to allay Eisenhower's concern, Prime Minister Anthony Eden told him that the British actions were merely intended to bluff Nasser and prevent him from seizing the canal.

U-2 images from late October 1956 revealed further invasion preparations taking place on Cyprus. Twenty-one French Nord Atlas paratroop transports—similar to the U.S. flying boxcar—had arrived at Tymbou Airfield. British Hunter fighters and Canberra bombers arrived at RAF Akrotiri Airfield, where there was a frenzy of activity. Transport and fighter aircraft also appeared at the RAF Luqa Airfield in Malta. Allen Dulles remarked "that the arrival of the aircraft could have no other purpose than attack. It was obvious to all that the British and French were planning to neutralize the Egyptian Air Force."[9] Eisenhower sent Eden a series of communications attempting to dissuade the British from using force. Lundahl received a call from Allen Dulles inquiring if any Mystères had been seen in Cyprus, a possible indication that the Israelis would be using them in the attack on Egypt. The answer was no.

Aerial missions revealed the British forces in Cyprus striking their tents, collecting their belongings, loading their baggage onto trucks, and burning their trash and garbage. Long convoys were seen headed for Limassol, where troops transferred to landing ships. The Israelis had mobilized as well, and we spotted a number of armored forces attempting to hide in a wadi. Eisenhower was informed that an invasion was imminent.

The Suez War began on the afternoon of October 29, 1956, when Israeli paratroopers were dropped in the Sinai Peninsula near the Mitla Pass, a natural bottleneck that would block the Egyptians' retreat or reinforcement. Armored units that had been hidden in wadis began moving toward the Egyptian border. That same day, Israeli armor and a motorized infantry column moved into Egypt along the Mediterranean coast, meeting some resistance at El Arish before moving toward the Suez Canal. A second column was moving toward Bir Gifgafa. U-2 photographs showed thousands of Egyptians fleeing toward the canal and hundreds of military vehicles and tanks strewn along roadsides. The Israelis moved toward the Suez Canal but did not occupy it.

U-2 images were studied carefully to determine the steps the Egyptians were taking to defend against the invasion. New antiaircraft artillery units appeared at several airfields. Israel apparently feared that the Egyptian Air Force's Badger bombers might attack Israeli cities.

On October 30, based on photographic knowledge that Britain and France were prepared to invade Egypt, President Eisenhower sent Prime Minister Eden a letter addressing him not only as head of Her Majesty's government but as "my long-time friend, who has, with me, believed in and worked for real Anglo-American understanding." Eisenhower expressed his deep concern over the possible consequences of any attack on Egypt and asked Eden's help "in clearing up my understanding as to exactly what is happening between us and our European allies—especially between us, the French and yourselves."[10] The hard intelligence on British, French, and Israeli military developments allowed Eisenhower to make it clear to Eden that he knew exactly the extent of the "misunderstanding"—an outstanding example of the value of intelligence to diplomacy.

The British and the French had counted on U.S. support—both in the form of understanding and in money and oil now that oil supplies from the region had been disrupted. Knowing that Israel depended heavily on direct and indirect subsidies from the United States, Eisenhower decided to exploit these vulnerabilities to force the British and French to admit they were wrong and the Israelis to retreat back inside their borders. Secretary Dulles called the president at 2:17 PM on October 30 and told him that Britain and France had given Egypt twelve hours to allow their forces to occupy key points along the canal, but he expected the invasion to take place before that ultimatum expired.[11]

On October 30 Henry Cabot Lodge introduced a resolution before the UN Security Council calling for the immediate withdrawal of Israeli forces from Egypt. Britain and France vetoed the resolution. On October 31 Eisenhower and Dulles went personally to the General Assembly, where France and Britain could not exercise a veto, and called for an immediate cease-fire in Egypt and withdrawal of all foreign forces to their former positions. The General Assembly passed the resolution sixty-four to five.

The U.S. government shared no U-2 information with the British during this period; in fact, Lundahl told the British representative to the PID not to come to work; British liaison officers in the Pentagon were told the same.

Britain and France entered the war on the morning of October 31, 1956, with bombing raids against Egypt's principal bomber and fighter airfields. More than 240 French and British planes attacked four bases in the Nile Delta and eight in the Cairo region. More than 100 Egyptian planes were damaged or destroyed on the ground. A small number of fighters and bombers escaped to Jordan, Syria, and Saudi Arabia. All of the Il-28 bombers at Luxor were destroyed. Eisenhower took a firm position against the British when he heard the news, later writing in his memoir: "I felt that in making our own position we were standing firmly on the principles and on the realities of the 20th Century."[12]

A U-2 was overhead during the actual invasion. In addition to flying his assigned track, a reconnaissance pilot had to maintain a constant vigil along his flight path and be alert to all unscheduled opportunities. Thus, as U-2 pilot William Hall was approaching the Cairo area, he saw Canberra jet bombers flying below strafing and bombing aircraft at the Cairo-Almaza Airfield. Hall deviated from his assigned course, circled, and came back twenty minutes later to photograph the aircraft burning on the airfield. We saw no activity indicating that the Egyptians were preparing fighters to attack the invading forces—British, French, or Israeli. Asked about Egypt's Badger bombers, which might be used to bomb Israel and the British and French fleets, we were able to answer that they had escaped and were now at an airfield near the Aswan Dam, out of range of British bombers.

We prepared a large number of briefing boards on the invasion. Lundahl took them to Allen Dulles at the White House and was ushered into the Oval Office. Lundahl showed a number of photos to the president, including those taken before and after the bombing at Cairo-Almaza Airfield, taken twenty minutes apart. The president reflected for a moment and remarked, "Twenty-minute reconnaissance. Now that is something to shoot for."[13] Eisenhower also noted that the Egyptians clearly had not expected an attack because their planes had been lined up along the runways like sitting ducks.

On November 1 the president was informed that aerial photographs of Limassol showed that a naval task force had arrived from Malta and was loading troops and supplies in preparation for an amphibious landing. The Suez crisis was a major topic of discussion at the November 1 meeting of the NSC. Admiral

Radford gave the military briefing using the latest U-2 images. After Radford had completed his briefing, Eisenhower asked "whether it was at all possible that the Russians could have slipped the Egyptians half a dozen atomic bombs." Admiral Radford replied that he doubted it, particularly in view of the Egyptians' manifest failure to make effective use of the other weapons the USSR had already provided.[14] Eisenhower was warned of the impending invasion on Sunday, November 4.

The performance of the British airborne troops during the Suez campaign was found "wanting in every regard." The British paratroopers jumped on Gamil Airfield west of Port Said while the French troopers dropped south of Port Said. The French paratroopers performed admirably, but the British paratroopers were scattered across the terrain; a number of them landed in a sewage lagoon. "Had it not been for Egyptian incompetence and French savoir-faire," a postwar analysis revealed, "the airborne assault on the Suez Canal would have turned out to be a disaster reminiscent of Arnhem."[15] We made a briefing board of the hapless paratroopers in the sewage lagoon and showed it to British intelligence officers years later. One of them remarked, "It was a shithouse operation, so what did you expect to see?"

On November 5, British helicopters landed more airborne troops at Port Said and Port Fuad. Early on the morning of November 6, British and French paratroopers laid siege to Port Said. The British fleet bombarded the coast as landing craft came ashore. British forces took Port Said and began moving south. British paratroopers landed at an old airfield between Damietta and Alexandria. We spotted trails of smoke rising from Port Said, burning planes at the airfields, and heavy damage being inflicted to shipping in the canal. Nasser gave orders to sink all ships in the canal, thereby closing it and destroying the hopes of Britain and France to keep it open to international shipping.

While searching the images we spotted an Israeli armor unit first at Kuntilla and later at Nakhle headed to the Mitla Pass. Eisenhower had called for a map of the area and was following the war plan of Maj. Gen. Moshe Dayan, the Israeli chief of staff. He was heard to say that Dayan had studied his history and geography well.

Soviet Premier Nikolai Bulganin had warned Britain, France, and Israel that the Soviet Union was prepared to get involved in the fracas. President Eisenhower met with Allen Dulles and discussed his concern that the Soviets might intervene on Egypt's behalf through the delivery of fighters, bombers, or volunteers to Syria. There were reports that the Soviets had offered Egypt 250,000 troops and that preparations for their departure were under way. Communications intelligence indicated that Soviet airborne divisions at Bolgorad and Pskov had been placed on alert. Eisenhower asked for a U-2 overflight of Syria to see if Soviet aircraft—either for striking or for carrying paratroopers—were already present at Syrian airfields. It was a presidential election year, and the president was on his way to Gettysburg on November 6 to cast his ballot. On his return, Colonel Goodpaster had the answer from the Paramount Committee. U-2 images acquired over a two-day period showed no Soviet aircraft or forces in Syria.

Initially, U-2s did not fly to the southern end of the Sinai Peninsula. But when the president wanted to know if the Israelis had occupied Sharm-el-Sheikh, a U-2 covered the area. The images it returned revealed Israeli forces around a damaged coastal gun and considerable bomb damage to the city. Eisenhower was pleased that the Strait of Tiran had been opened and that there was no evidence of Israeli collusion with the British and French in the effort.

Eisenhower was utterly convinced of the rectitude of his call for a cease-fire. Eden assumed, wrongly, that Britain's acceptance of a cease-fire would immediately bring about better Anglo-American relations. Eisenhower would not be satisfied, however, until Britain, France, and Israel were out of Egypt. Late on November 6 the British and French accepted the cease-fire and the crisis began to subside. Afterward, an international police force was established along the Suez Canal. Canadians would play a leading role in the force, and senior Canadian officers were permitted to view U-2 photographs of the areas where they would be deployed.

Ben-Gurion issued a statement on November 7 rejecting the UN's order to withdraw Israeli forces and made it clear that they would remain in Egypt until Egypt also agreed to a cease-fire. Eisenhower sharply responded that "it would be a matter of the gravest concern to the world should [Israel's stance] in any way impair the friendly cooperation between our two countries." Acting Secretary of State Herbert Hoover Jr. supposedly also gave the Israeli prime minister a blunt dress-ing down.

Eden had a physical breakdown on November 19. When Foreign Minister Harold Macmillan requested oil, Eisenhower replied that the supply would resume when the British government announced a specific timetable for withdrawal from the Suez Canal. The Israelis indicated they would withdraw when UN peacekeepers were ready to move in. Fourteen U-2 flights monitored the situation between November 7 and December 18, 1956.

We had made a number of briefing boards of the British, French, and Israeli military actions. To aid the president, who was a stickler for locations, all of the boards bore the name of the towns and inset maps. We could see that British forces had moved down to the canal; along the path they had followed were groups, probably POWs, guarded by British and French troops. Numerous damage assessment reports were created. Of special interest was the extent of the damage to ships sunk in the canal and the bridges over the canal.

Lundahl had noticed that whenever Eisenhower did not understand something in a briefing, he would lift one of his eyebrows in an inverted V and keep the other horizontal. Based on that quirk, Lundahl thought that the single briefing boards were not adequately showing the president the damage done to the canal. As a result, Cliff Mullineaux, Mark Chestnutwood, and I were asked to create a mosaic of U-2 photos of the entire canal. We placed individual U-2 photos together on two 4-by-8-foot Masonite boards. The resulting map showed and annotated all of the fifty-two sunken ships and damaged bridges. Eisenhower had specifically asked about an Egyptian merchant ship, the *Akka*, that the Egyptians had sunk near Lake Timsah with the expressed purpose of blocking the canal. The ship was loaded with scrap iron and cement, which had hardened into a sold block. Another major impediment was the damaged Firdan Railroad Bridge, which had fallen into the canal. Lundahl and Dulles were waiting inside when the courier and I arrived at the White House bearing the completed mosaic. We encountered an immediate impediment: the Secret Service would not allow us to enter the White House unless we showed them what was in our large, covered package, but they were not cleared to see it. A call from Dulles cleared the way. When we entered the Oval Office, I quickly noted that there were no tables large enough for the mosaic. Eisenhower suggested we place it on the floor to the right of his desk. He got on his hands and knees and with a magnifying glass that Lundahl handed him crawled up the canal mosaic, muttering, "Stupid, stupid, stupid," and then a loud, "God damn stupid," when he saw that the actions of France and Britain had cut off the principal artery for their oil supply along with that for Commonwealth countries and colonies or former colonies. Two-thirds of the oil that fueled British and French factories and homes came through the canal, especially that from Saudi Arabia, Iran, Kuwait, and Iraq. Eisenhower was clearly more irritated with France than with Britain.

By the end of November, French and British troops were being loaded at Port Said and Israeli forces were retreating back into Israel. The invasion had failed either to keep the canal open or to topple Nasser. Eden resigned in disgrace. The crisis was over, but it left bitter feelings between British and American officers and malice that would linger with France for years. Yet Eisenhower would remark that "everyone in the world says in the last 6 weeks, the U.S. has gained the place it hasn't held since World War II."[16]

A UN emergency force of six thousand was deployed in the Gaza Strip, the Suez Canal, and the Sinai Peninsula to oversee the withdrawal of French, British, and Israeli forces. The UN force created a buffer zone between Egyptian and Israeli forces to keep war from erupting again. The United States was actively involved in advocating aerial inspection of Israeli and Egyptian forces. The PID prepared cameras, which were placed in transports that were used to move UN peacekeepers about and also in the aircraft used to patrol the canal, the Armistice Demarcation Line, the Sinai coast, and the Israel-Egypt frontier.

Clearing the canal was an enormous problem. Although the Egyptians said they would do it, they had neither the heavy lifting equipment nor the trained personnel for such an endeavor. Several American firms wanted to get involved, but Eisenhower wanted the United States to stay out of Egypt. He gave the nod to Chancellor Konrad Adenauer, however, for the use of German firms that possessed the type of heavy lifting equipment required.

When Eisenhower was told that the French had probably mined the canal, he was livid. When confirmation arrived that the French had indeed laid mines, Eisenhower was forced to bend his policy a bit. The U.S. Navy was the only force in the world capable of removing the mines, and the president allowed the Navy to do the job. We were told that the Navy had a big helicopter that pulled a large sled that would explode the mines on contact. Officers from the Chief of Naval Operations came to the PID to see the mosaic, which had been returned by the White House, and asked that it be transferred to them. They claimed it would be most helpful in determining where the obstacles lay so the sled could be more effectively used. They Navy never returned the mosaic, and I was always sorry because it would have made a wonderful display in the Eisenhower Library.

Eisenhower deeply regretted the breach in Anglo-American relations. On November 23, 1956, Winston Churchill wrote Eisenhower a long letter "urging that we leave to historians the arguments over recent events in the Middle East and that we take action in harmony to forestall a Soviet triumph there; it would be folly to let the great essentials to be lost in bickerings, and to let misunderstanding make a gulf in the Anglo-American alliance."[17] Four days later, Eisenhower wrote a poignant response. He, too, wanted to restore close ties. Buttressed, however, by his detailed knowledge of what had happened, he responded, "I hope that this one may be washed off the slate as soon as possible and that we can then together adopt other means of achieving our legitimate objectives in the Mid East. Nothing saddens me more than the thought that I and my old friend of years have met a problem concerning which we do not see eye to eye. I shall never be happy until our old time closeness has been restored."[18]

Eisenhower and Eden's successor, Harold Macmillan, moved to restore relations between the two countries. One of the first steps in that endeavor was to restore working relations between the intelligence services of both nations. British representatives who had been denied entry into U.S. intelligence and defense organizations during the crisis were informed that they could report to their former posts.

After a short hiatus, Eisenhower allowed U-2 flights along the borders of the Soviet Union and its satellite countries to resume. On November 20, 1956, the first of these flights followed a route along the USSR-Iran border. It penetrated the Soviet Union and photographed Yerevan in Soviet Armenia. On December 10 Bulgaria was the target of two missions, one of them flown by Carmen Vito, who had flown the U-2 mission over Moscow. Vito was known to his colleagues as the "lemon drop kid" because he carried these hard candies in the knee pocket of his flight suit. U-2 missions were extended affairs, and a pilot's mouth tended to get dry. The lemon drops did the trick for Vito. U-2 pilots were warned repeatedly about the danger of opening their helmet faceplates, but several pilots were known to do it; some even ate candy bars.

U-2 pilots also carried the means for committing suicide. During one of Vito's preflight briefings, the Air Force enlisted man who oversaw Vito's preflight regimen placed a potassium cyanide-containing "L-pill" in the right-hand knee pocket of his flight suit, unaware that it was the pocket where Vito stored his lemon drops. About midway into a mission over Bulgaria, Vito opened his faceplate and popped into his mouth what he thought was another lemon drop. He began sucking on the object but quickly realized that something was wrong. The lozenge had no flavor and was smoother than his usual lemon drops. Then he realized that he was sucking on the L-pill. He spit it out. Just a thin layer of glass had been all that stood between him and death. When headquarters learned about Vito's close call, James Cunningham ordered all L-pills to be placed in boxes. The pill still posed a danger to the pilot if it was accidentally crushed, so the L-pill was replaced by a needle containing a deadly shellfish toxin which was placed in a drilled-out hole in a silver dollar.

Bissell was determined to get U-2s flying over the Soviet Union again. On September 17, 1956, Admiral Radford, General Cabell, and Bissell met again with the president to discuss it. Bissell indicated that the list of intelligence targets was ready and emphasized the need for additional flights before the Soviets gained the ability to down U-2s. Bissell stressed that there had been no breach of security and underscored the intelligence value of the U-2 images. "The president acknowledged the value," the notes of the meeting report, "but said that the international political aspects are overriding—i.e., the fact that this is being done at all. He said he would talk further with the secretary, who at first seemed to belittle the political risk, but then indicated increasing worry about it."[19]

Hungary

In early October 1956 Lundahl returned from a meeting with Allen Dulles and Bissell and told me to get everything ready to process film from Hungary. Rioting was increasing there, and Dulles was concerned that the Soviets might intervene if the situation continued. Flight tracks for U-2 missions over both Hungary and the Soviet Union were established, and preparations got under way for the receipt of the film in Europe if the missions were flown. The CIA also planned to drop arms and supplies to the freedom fighters. We provided aerial photos from previous U-2 missions of Agency arms and supply drop zones, which were mainly in mountainous areas.

On October 26 some 200,000 Soviet troops with tanks, artillery, and armored personnel carriers rolled into Budapest. Tanks with reinforcements came from Soviet forces in Rumania. The Hungarian army was overwhelmed and powerless against the Soviet forces. That same day, Eisenhower presided over a meeting of the NSC in which he stated that he wanted to proceed cautiously. He did not want to give the Soviets any reason to think that the United States would support Hungary's bid for freedom in any material way. He knew that the Hungarians faced well-trained, well-armed, and well-indoctrinated Soviet troops, whose leaders had shown a callous willingness to commit force against any people seeking freedom. All proposed U-2 missions were canceled, as were the CIA's airdrop plans. The JCS sent a number of Army and Navy officials to visit the PID, and we gave them prints of Hungary-Austria border areas where the refugees were crossing into Austria.

In a November 1, 1956, NSC meeting, Allen Dulles remarked that "in a sense, what had occurred there [in Hungary] was a miracle. Events had belied all our past views that a popular revolt in the face of modern weapons was an utter impossibility. Nevertheless, the impossible had happened, and because of the power of public opinion, armed force could not effectively be used. Approximately 80 percent of the Hungarian Army had defected to the rebels and provided the rebels with arms."[20] Several mid-level CIA intelligence officers felt that the Soviets were sitting on a number of powder kegs in Eastern Europe.

On November 2 Dulles reported to his brother that the Russians had cut off the Austrian frontier, making it difficult to supply arms to the insurgents. On that same day, John Foster Dulles was diagnosed with cancer and had to undergo emergency surgery at Walter Reed Hospital, leaving the State Department leaderless. The loss of his secretary of state was a blow to Eisenhower, who had come to depend on Dulles for advice. Herbert Hoover Jr. became acting secretary of state on November 3.

The fighting spread from Budapest across the country. The United States, Britain, and France protested the Soviet intervention at the United Nations. Bulganin told the president bluntly that "the problem of withdrawal of Soviet troops from Hungary comes completely and entirely under the competence of the Hungarian and Soviet governments." The message was clear. The Soviets were not about to allow this important interior satellite country to break free. To make sure that other bloc countries were properly intimidated, the Soviets sent a half million soldiers to put down the rebellion.

Eisenhower realized that there was little he could do about the situation in Hungary. Trying to move U.S. troops across neutral Austria, Titoist Yugoslavia, and Czechoslovakia was out of the question. France and Britain were not pleased at the president's lack of action and accused him of using delaying tactics at the Security Council. Sympathies ran high for the Hungarians in the U.S. military, but there was an element of ambiguity as well, as later expressed by Adm. Arleigh Burke: "The Hungarian people pleaded for military help from the western nations while they attacked buttoned-up Soviet tanks with Molotov cocktails and rifles. They wanted to be free—would any nation help them? They received sympathy—and later condolences—but no military help. Unfortunately Hungary has no seacoast and intervention by ground forces might have meant war with the Soviets—and again it might not. Nobody could foretell that then—or now."[21] Thousands of Hungarian refugees fled to Austria. Aerial photos taken by the U.S. Navy showed tent camps that had been hastily prepared for them. Under the existing laws, Eisenhower could offer asylum to 21,000 Hungarian refugees. By the end of the year, more than 150,000 Hungarians had left their homeland.

RB-57 Black Knight Flights

After Eisenhower ordered the U-2 flights over the Soviet Union to stand down, Herb Miller, Bissell's assistant, wrote a memorandum asking that the flights be reinstituted to photograph the rest of the critical targets the intelligence community had recommended for coverage. "To bar the United States from reaching this understanding through overflights of the critical regions of the Urals and eastward would be tragic," he wrote.[22] The memo did not go beyond Bissell.

The successes of the U-2 over the Middle East prompted Admiral Radford to apply pressure on the president to overfly the Soviet Union in November. The president turned him down. The issue was raised again at a conference on November 15, 1956, and again the president was against it. The notes of the meeting report that "the president indicated that the United States had recently gained, in the estimation of the nations of the world, a place that it has not held since World War II, and thought that provocative activities which would tend to prevent that force to bear for constructive solutions should be avoided."[23] Allen Dulles asked for permission to fly over the Caucasus and Bulgaria, and the president agreed, saying that he had no objection to flying along the borders of friendly countries. He also said he had no objection to flying over the Far East as long as the flight track avoided the most sensitive areas.

Meanwhile, the Air Force was working on its own aerial reconnaissance program. A lightened, stretched-wing (or "big wing") version of the RB-57 with the more powerful Rolls-Royce Avion-109 engines that could fly at a maximum speed of about 540 miles per hour and reach an altitude of 68,000 feet after burning fuel seemed the ideal vehicle if the guns, armor plating, and one of the pilots were eliminated. The aircraft would carry either two K-37 cameras or two K-38s installed aft of the bomb bay. The new craft was designated the RB-57D. It took some convincing, but Gen. John McConnell, the director of operations at SAC, persuaded General LeMay to accept the aircraft. The 4080th Strategic Reconnaissance Wing of the Strategic Air Command was created to accept, maintain, and fly the aircraft. A West Pointer assigned the name "Black Knight" to the program after the military academy's athletic teams, the Black Knights.

While the U-2 flights over the Soviet Union remained in hiatus, the Air Force began a hard sell for using the RB-57D for overflights of the Soviet Union. After some strong persuasion by Gen. Nathan Twining and assurance that the high-flying and faster RB-57D would not be detected by Soviet radar, President Eisenhower approved a mission. In November 1956 SAC deployed six RB-57Ds to the Yokota Air Base in Japan, then moved three of them from Yokota to Iwo Jima. On December 11, 1956, three RB-57Ds overflew Vladivostok, the headquarters of the Soviet Pacific Ocean Fleet.[24] Although they gave no sign at the time, the Soviets did detect and track the planes. On December 16, 1956, they lodged a strong protest.[25] Eisenhower, according to Allen Dulles, was furious. The RB-57Ds would not fly another Soviet mission. On December 18, still angry, President Eisenhower said he was going to "order a complete stoppage of this entire business." He instructed Colonel Goodpaster to call Secretary of Defense Wilson, JCS chair Radford, and DCI Dulles and inform them that, effective immediately, there were to be no flights of U.S. reconnaissance aircraft over Iron Curtain countries. Each man confirmed that he understood.[26]

We were surprised that Eisenhower had even authorized the RB-57D flights. Vladivostok was not on the national Ad Hoc Requirements Committee's list of highest-priority flights. Both the Air Force and the Navy had overflown Vladivostok during the Korean conflict, so we had sufficient photography available for targeting purposes. We compared film from that era with the images obtained by the RB-57D and found little new intelligence. Vladivostok had become primarily a commercial port for trade with Japan and other nations. It did contain elements of the Pacific Ocean Fleet, however, and was the main port for supplying Dalstroy, the Northern Sea Route, and the hundreds of gulags in Siberia.

1956 in Review

At year's end, the president and Congress were pleased with the results of the U-2 missions over the Soviet Union and the Middle East. While flights over the Soviet Union had been suspended, U-2 flights over the Middle East continued. Allen Dulles asked Lundahl for a report on the accomplishments of the U-2 in 1956, and Cliff Mullineaux, Bob Cunningham, and I created a document with both text and photos. Three handmade copies of the report were created: one for the president, one for Allen Dulles, and one for the PID. The first of the report's three sections consisted of photos and text on the USSR; the second covered the Middle East; and the third included statistics on missions flown, the amount of coverage, and footage of film. The report was straightforward and devoid of technical terminology. Dulles was pleased and took two copies, giving one to the president and using the other to brief Richard Russell and Leverett Saltonstall of the Senate and Representative Clarence Cannon of the House. Dulles kept his copy in his office and showed it frequently to distinguished visitors.

The PID began receiving a number of distinguished visitors for briefings, and that gave some cause for concern. We knew that the Soviets were aware of our presence, and we knew that they possessed new electronic devices that could penetrate the Stuart Building's single-pane windows and possibly listen in on sensitive briefings. Security Chief Henry Thomas designed a secured, emission-proof room that was constructed on the fourth floor of the Steuart Building. It had shelves for displaying briefing boards and a large table surrounded by comfortable chairs. There was also a large screen where Vu-Graphs could be projected. Since "the room" was near my office, my branch became responsible for its housekeeping.

Bissell and Lundahl gave detailed briefings in the room to prime ministers, foreign ministers, ranking intelligence heads, and marshals and admirals from Allied nations, all dressed in mufti and brought to the building in unmarked cars. Bissell would open a meeting by giving a detailed description of the various photographic systems the United States was employing. Then he would tell the guests where the U-2s were deployed. Lundahl would then show a series of briefing boards, usually about the Soviet threat or about concerns in the visitors' own areas. Most of the information Lundahl presented would be confirmation of what the visitor already knew or suspected. Prime ministers of the nations that bordered the Soviet Union usually wanted to know where Soviet strike units were located. Lundahl asked me to attend many of the briefings in case a visitor raised an issue or asked a question for which Lundahl did not have an immediate answer. I would rush out and find the photo interpreter responsible for the subject or area and get the answer. Or I might bring the photo interpreter into the room and let him brief the visitor. Unfortunately, because of the sensitive intelligence information, no record was maintained on what was said or briefed in "the room."

The President's Foreign Intelligence Advisory Board and other intelligence panels also met in "the room" to be briefed by Bissell and Lundahl, not only on intelligence gained but also on future reconnaissance systems. The Guided Missiles and Astronautics Intelligence Committee and the Joint Atomic Energy

Intelligence Committee prepared the daily Cuban Missile Crisis reports there. Robert Kennedy and Robert McNamara visited during the crisis for the latest U-2 updates.

While the many innovators who brought about the amazing Cold War advances in reconnaissance deserve a great deal of credit, these strides could not have been made without money. History has largely ignored five men who, through their position and knowledge in Congress, provided money—much of it secretly—for the CIA's reconnaissance quests. Although they bore the responsibility of oversight, they relied on the integrity of the CIA personnel reporting to them. The first two were often referred to as the "two Georgians": Representative Carl Vinson, chair of the House Armed Services Committee; and Senator Richard Russell, chair of the Senate Armed Services Committee. Information sharing in Congress was limited during that period. Only Senators Saltonstall and Russell, ranking members of the Senate Armed Services Committee, Representative Clarence Cannon (and later George Mahon), and Representative John Taber of the House Appropriations Committee were briefed on reconnaissance developments and missions. They were strong supporters of the Technology Capabilities Panel's recommendations and did not see a need for intrusive oversight of the organizations involved in the new systems. Russell was by far the most knowledgeable and the most dominant person in Congress on intelligence matters. Saltonstall, the minority member of the Senate Armed Services Committee, was always gracious and would thank Lundahl and other CIA personnel profusely after each meeting. Vinson, a crotchety figure, would grouse but always approved CIA actions.

Not enough has been written about the contributions of Representative Cannon, chair of the House Appropriations Committee, and ranking Republican member Taber in approving funds for the more advanced systems. After a budget review with the DCI and Colonel White, the Agency's executive director and comptroller, Cannon would ask, "Now you boys have enough money to do your job?" Not only did Cannon and Taber provide the money, they never leaked information about the U-2, the SR-71, or the satellite systems. Colonel White once appeared before Cannon with the Agency's budget and was asked if it was a "down-to-earth budget." White assured him that it was "right down to the bone, with no fat or gristle in it." Cannon said that he thought so, then commented that he had added $400 million to the budget to deal with contingency issues. Some of the leftover "contingency funds" were used to refurbish old temporary wartime

Navy structures that the Agency used for training, making the facility into a modern campus. The rest was set aside for technological development projects.

Among the latter was “Trapeze.” During the slack flying period over the Soviet Union, a number of experiments were conducted to reduce the U-2’s radar cross section so the aircraft would be more difficult to discern. Radar-absorbing materials were tested without success. Bissell then embarked on projects to make the U-2 invisible to Soviet radar. Trapeze, the first system examined under Project Rainbow, involved wires and ferrite beads as a means of evading Soviet radar. Another project called “Wallpaper” used the Salisbury screen, a British invention that used plastic material overprinted with a metallic, whorl-like pattern along with Echosorb as a means of evading Soviet radar. When these devices were used on the U-2, the aircraft was known as a “dirty bird.”

TEN

the technological capabilities panel

> The TCP was a fountain of ideas.
>
> *Arthur C. Lundahl*

WS-117L was the literal and actual progenitor of many of the new ideas the Technological Capabilities Panel (TCP) would foster, promote, and help transform into a variety of systems that affect our lives today. The TCP's ideas came both from individuals and from teams. TCP members saw that satellites could broaden our view of the earth and that we could further increase our knowledge by launching remote sensing devices into space that could detect, record, and transmit details invisible to the human eye. Eisenhower quickly grasped the military significance of having satellites in space. He was interested in these new vehicles and wanted to see them and learn how they worked.

The TCP recommended the construction of the Titan and Minuteman ICBMs along with the Thor and Jupiter IRBMs. It also recommended a sea-launch ballistic missile system that later became the Polaris. These programs posed vast production, logistical, and deployment challenges. TCP member William O. Baker later recalled that Eisenhower was "very interested in the details of how this defense technology was coming on." When Eisenhower wanted to know how a missile could be launched underwater, "they had him up at Narragansett Bay when the Navy had the first launch ejection. They got him so close that he got drenched when the missile broke water."[1] The Navy enjoyed giving the president, an Army man, a bath. The TCP recommended speeding up the development of the DEW Line, which became operational in August 1957, and later the Ballistic Missile Early Warning System, which became functional on February 1, 1961.

A number of projects had their genesis while the U-2 missions over the Soviet Union were in hiatus. The Photo Intelligence Division, for instance, evaluated the performance of the various camera systems employed in U-2 training missions and made some interesting discoveries. The science of meteorology was one beneficiary. Normally, cloud-covered images were considered of no value and were discarded. But a U-2 flying at 70,000 feet could photograph hundreds of textbook examples of various cloud formations. Lou Franceschini began collecting them and brought them to the attention of Arthur Lundahl, who in turn brought them to the attention of distinguished meteorologists. The meteorologists were so impressed that they asked if a U-2 could be tasked to fly over a typhoon. The mission's requirement statement was simple: conduct reconnaissance above a typhoon.

The storm selected was Typhoon Kit, and a U-2 flew over it on November 14, 1956. The results of that mission marked a significant advance in meteorological science. The bowl-shaped eye of Typhoon Kit, the first typhoon seen in its entirety, was approximately thirty miles in diameter. Photogrammetric analysis showed that the top of the clouds had reached 38,000 feet and that the typhoon contained nine cyclonic swirls rather than the one previously assumed.[2]

U-2s were assigned to fly over subsequent typhoons, and meteorological knowledge was enhanced with each flight. On July 14, 15, and 16, 1958, U-2s flew high above Typhoon Winnie, which caused great damage on Taiwan. Typhoon Ida was photographed about 750 miles off the coast of the Philippines in September 1958. We were surprised that it had maximum surface winds of 240 knots, with an average of 145 knots.[3] When President Eisenhower saw the photos, he remarked rather facetiously that he already knew a little about weather from his wartime experiences.

The TIROS Program

Data from the U-2 typhoon flights were later used in planning the orbital parameters and specifications for cameras to be used for the TIROS and military meteorological satellites. The TIROS program (Television Infrared Observation Satellite) was an experiment to determine if satellites could be used to observe earth's cloud cover and to create a meteorological information system. It emerged from the Air Force WS-117L satellite reconnaissance competition in 1956. RCA officials had submitted a proposal for a television reconnaissance program. When it was not selected, RCA sold the concept for a television infrared weather satellite to the Army Signal Corps.

The program was funded by the Advanced Research Projects Agency (ARPA), and the president was briefed on it. Eisenhower told the TCP and NASA director James Webb that he wanted this program under NASA so that the information it gathered could be shared with the world. He also wanted it under NASA to shield the upcoming Corona program and the classified Department of Defense meteorological system by launching it openly from Cape Canaveral.

TIROS 1 was placed in orbit on April 1, 1960, and produced the first weather pictures that same day. When the crude photos it returned were shown to President Eisenhower, he chided NASA administrator Dr. T. Keith Glennan for acquiring the first photo on April Fool's Day. *TIROS 1* was a relatively crude satellite that was used primarily to test instrumentation and the operational systems concept. It was spin stabilized and was programmed for 470–800-mile altitudes with circular orbits of 48–60 degrees orientation. It circled the globe every ninety-five minutes taking primitive but unique pictures of the world below. The satellite carried two television cameras, one high resolution and one low. A magnetic tape recorder for each camera stored data while the satellite was out of the range of a ground station and transmitted it when the satellite came back into range. Later TIROS satellites were programmed for subsynchronous polar circular orbits.

Eisenhower saw the possibilities of this satellite system: improvements could be made not only in weather forecasting but in disaster warnings in connection with hurricanes, tornadoes, flooding, and severe local weather situations. *TIROS 1* began continuous coverage of the earth's weather in 1962 and immediately became a hit with meteorologists. *TIROS 1* photos showed that the earth's cloud cover was clustered in many unexpected ways that could not be seen from surface observations. Succeeding TIROS launches involved more sophisticated satellites. The science of meteorology was combined with the relatively new medium of television and became immediately popular with the public. Combined with data from Doppler radars and surface observations TIROS provided valuable weather warnings.

But the TIROS program was insufficient to predict the weather that photographic satellites needed to produce useful images. In 1961 the National Reconnaissance Office (NRO) funded a classified low-altitude weather satellite—the first operational system of its kind—that orbited the Eurasian landmass in front of imaging satellites. It transmitted vital meteorological information and made cloud-free photography over areas of interest possible. The first launch, on May 23, 1962, ended in failure. The second launch, on August 23, 1962, was a success. Launched into a sun-synchronous 450-mile circumpolar orbit, it provided 100 percent daily coverage of the Northern Hemisphere at latitudes above 60 degrees. Tape-recorded pictures were transmitted on each pass over the Western Hemisphere to ground stations that relayed them to the Air Weather Service, Air Force Global Weather Central, at SAC headquarters at Offutt AFB.

The system was identified publicly in the 1970s as the Defense Meteorological Satellite Program (DMSP) and was later combined with the TIROS and other NASA programs into a single program, the National Polar-Orbiting Operational Environmental Satellite System.[4]

The Corona Program

With General Operational Requirement 80 in March 1955 the Air Force approved construction of and provided technical requirements for space vehicles that could collect photographic and signals intelligence. In June 1956 the Air Force chose Lockheed's newly formed Missile and Systems Division to design and build its military satellites. The goal was to create a broad search and surveillance system emphasizing strategic reconnaissance and early warning. In 1956, under the innocuous designation Weapons System 117L, Advance Reconnaissance Systems, the Air Force began developing an array of reconnaissance satellites in connection with the development of the ballistic missile. A ballistic missile would serve as the satellite's launch vehicle. Priorities for such programs at the time were low, however, and the funding was limited. Sputnik would change that.

In 1958 the Air Force split WS-117L into three programs: Corona photographic, the Missile Alarm Defense System (Midas) for early warning, and Sentry (later renamed Samos television approach satellite). The most promising near-term project was Corona. On February 10, 1958, Dr. James Killian and Dr. Edwin Land met with the president to seek his permission to develop an earth satellite equipped with photographic apparatus in a "recoverable capsule, which could be used to yield both scientific and extremely important military information."[5]

Land explained that the satellite would emit no signal and would therefore be covert. The imaging satellite could take pictures from space as it passed over the Sino-Soviet bloc and would periodically eject the film inside a capsule that could land in a preselected area. The president was enthusiastic about the idea and gave his full approval. He emphasized that the CIA "should have complete and exclusive control of all intelligence phases of the operation." He also wanted very few people to know about it.[6]

The final project proposal was submitted on April 16 and Eisenhower formally agreed to it on April 21, 1958. Just four days later Allen Dulles informed the CIA comptroller that $7 million had been allocated for the Corona Project for FY 1958. ARPA was designated as the funding agency and exercised general control of the project. The Air Force Ballistic Missile Division would serve as ARPA's agent and supervise the project. Bissell submitted a project outline and cost estimates to the president on August 9, 1958; a detailed memorandum of the security apparatus of the project was submitted on November 5.[7]

Eisenhower had insisted that the CIA control the program because the Agency had demonstrated an ability to follow strict security procedures during the development of the U-2 and had also shown a capacity to move quickly from conception to operation. Land and Killian wanted to streamline both the program and its management, and they too felt that the CIA could do that best.

Funding and priorities were increased, and the program was placed under a joint Air Force/CIA team headed by Richard Bissell of the CIA and Brig. Gen. Osmond Ritland of the Air Force. The organization consisted of a Program Office, Program Staff, Launch Base, Operations, and Recovery Group. Bissell had developed an exemplary support staff that could move money, personnel, and equipment quickly. He was an outstanding administrator with influence not only with the TCP but also with the scientific community. There would be continued liaison with Lockheed Missiles and Space Company, Itek Corporation, Fairchild Camera and Instrument Corporation, Eastman Kodak, Douglas Aircraft, and General Electric—the companies that produced the booster, film, camera, and recovery systems. Launch and recovery of capsules would be the domain of the Air Force Satellite Control Facility at Sunnyvale, California, which established a close liaison with the PID.

A competitive design by Itek, a private corporation formed in 1957 to acquire the employees and assets of the Boston University Optical Research Laboratory when the U.S. Air Force ceased funding the effort, was selected to produce the camera. It used a 24-inch, 70-degree panoramic camera that would take long images on a 70-mm strip of film. The exposed film would be wound on a reel inside a small, bucket-shaped reentry vehicle.

Vandenberg AFB was selected as the Corona launch site. Fifty-five miles north of Santa Barbara, a huge promontory called Punta Arguello juts out into the Pacific Ocean. The wild and isolated site had been chosen by the Air Force in 1956 as a missile launch base. In December 1959 the Air Force would fire the first missile from the base.

The Corona program resulted from an extraordinary blend of curiosity and passion. Never had the evolutionary development of new technology captured the support of so many senior executives. It would foster system designs far more advanced than anyone had expected. One apparently insurmountable obstacle after another had to be overcome. Technology-driven innovations required constant improvements sustained over the long term. The Corona program called for a continuous collection of timely, detailed, and accurate data. This goal was complicated by security concerns. Those who knew about it could not talk to people who were not cleared.

The Samos Program

Although the press reported that SAMOS stood for Satellite Missile and Observation System, the name was not an acronym. The program was named after the Greek island Samos, home of Midas. Samos was an untested and highly complex real-time television system that would take a picture, develop the film in orbit, scan the film, and transmit images to earth within a matter of hours. We were told that the resolution would be about sixty feet, limited primarily by the 6-inch-focal-length camera and the narrow bandwidth of the microwave downlink.

The idea of satellite-borne television cameras that could relay data to earth intrigued the Air Force. In 1952 RAND had conducted an extensive study of satellite reconnaissance known as Feed Back. A summary of Feed Back noted: "The overall conclusion to be drawn from studies of simulated television pictures is that reconnaissance data of considerable value can be obtained, and that complete coverage of Soviet territory with such pictures will result in a major reversal of our strategic posture with respect to the Soviets."[8] We were told that when SAC commander Gen. Curtis LeMay was briefed on it, he said, "Whose f—— idea was this anyway?" and practically threw Col. William G. King, the Samos project manager, out of his office.[9] As Dr. Land would say, it was a good idea but the technology was not there.

The program became known as "Pied Piper" when Lockheed engineers working with Kodak camera scientists developed a camera that would expose the film and develop it in orbit with a new semidry process. The film would be scanned in a manner similar to that used by wire photo organizations. The resulting image would be transmitted to earth over a radio link and assembled in the manner of a wire photo, in swaths. When doubts about the program arose, the Air Force attempted to downplay the problems. It was still trying to protect its own Samos program and did not want Corona to be flying during the same period Samos would be flown. In a memo to the president, Secretary of Defense Neil McElroy claimed the “Corona was duplicative in coverage to the already programmed Samos project; and that this project, programmed to be lofted in 1960 is contemporaneous with Samos.”[10]

George Kistiakowsky, as the president’s science adviser, was closely watching the Samos program and expressed his doubts early about its value. On May 26, 1960, Kistiakowsky met with Eisenhower, Gordon Gray, and Andrew Goodpaster to discuss the problems with both the Samos and Corona programs. The discussion quickly turned to Samos. According to William O. Baker, the president asked Kistiakowsky to evaluate the Samos program because “it was struggling.” Problems had been identified with the bandwidth and the ground stations’ readout time.[11] Yet, the Air Force was insisting on going forward with Samos and was asking for an additional $269.3 million for FY 1961.

The NSC and the director of the budget took another look at the Samos program at a special NSC meeting held on August 25, 1960. Eisenhower had given his reluctant approval for Samos but wanted to make sure that we ended up with a photographic system able “to identify with certainty missile sites both in their construction and after completion.”[12] The NSC had learned on August 24 that Samos would not yield intelligence results of the necessary quality—at least not anytime soon. At this point, William Baker later said, “Edwin Land got involved . . . [and may have] talked to Doolittle and others about the evaluation.”[13]

A turf battle arose over which organization would manage the project if Samos became operational. Predictably, General LeMay insisted that it belonged to SAC. Eisenhower disagreed, stating emphatically that he wanted a centralized system for analyzing imagery intelligence because he did not trust the Air Force to analyze the intelligence in an unbiased manner.

The first attempt to launch *Samos E-1*, on October 11, 1960, failed when the satellite failed to go into orbit. When the system did become operational, myriad problems surfaced. The electronic components did not function properly. The images the satellite transmitted to the ground station were not encoded, which meant that they could be transmitted only over the continental United States. The ground station did not always receive the data. We did receive some very poor imagery taken over China, but the interpretability was far poorer than Corona's. The Air Force regrouped and attempted to save the program by proposing E-5 and E-6 recovery packages with five- and eight-foot resolutions.[14]

Eisenhower and Kistiakowsky were displeased both with the way the Air Force was managing its space projects and with their rising costs. Eisenhower refused to release further funds until some of the many problems were solved. When the final evaluation was made of the difficulties encountered and the limited returns of the system, Samos was removed from Air Force control and placed under a new organization, the Office of Missile and Satellite Systems. The program was terminated in September 1961.

There is a postscript to this story. When, in the summer of 1963, NASA asked for proposals for a lunar orbiter imaging satellite, Boeing-Eastman personnel modified the Samos cameras and successfully obtained detailed photos of the moon that were used to select Apollo landing sites.[15]

Signals Intelligence

Next to human intelligence, signals intelligence is the oldest intelligence field. SIGINT was particularly important during World War II, when Britain and the United States pioneered decryption techniques that allowed them to read vital German and Japanese coded radio traffic. Edwin Land did not understand the importance of SIGINT, but William Baker did. President Eisenhower asked Baker to chair the Ad Hoc Task Force for the Application of Communication Analysis for National and International Security, which quickly became known as the SIGINT committee. The task force would be concerned with "accelerating and improving the collection and processing of SIGINT, altering collection priorities and responsibilities, increasing cryptanalytic research, and adopting selected organizational changes at the National Security Agency to effect these recommendations."[16] The team members were Luis Alvarez, William Baker, Henrick Bude, William Friedman, Richard Garwin, David Huffman, John Pierce, Nathan Rochester, Oliver Selfridge, and John Tukey. The group, most with no prior knowledge of cryptology, operated between 1956 and 1958, primarily at the CIA and the NSA. They studied all phases of communications intelligence (COMINT) interception and production. Despite initial reservations the NSA warmed up to the panel, especially to Baker. Louis Tordella, a long-time NSA deputy director, later said: "I doubt that in the knowledgeable community in Washington that NSA . . . had a better friend than William O. Baker. . . . I also doubt anyone in Washington knew more sensitive material about the U.S. government, Defense, State, and CIA than Baker."[17]

Baker recalled that "we got NSA more and more excited about the fact that at one end the new computer and computational capabilities, along with language studies and the beginning of the digital age, were coming on strongly and, at the other end, these collection possibilities were very real."[18] The whole concern, Baker said,

> was to inject into cryptanalysis as much new digital technology and solid-state circuitry as we could. The first transistorized computer [TRADIC] had not been put together. . . . But it was clear that the whole field was expanding very rapidly and we would have the opportunity to create very compact collection systems—processing systems, on one hand, and on the other hand, very good possibilities of cryptanalysis. So this took a multi-dimensional form, embracing very new frontiers of solid-state circuitry, electronics and, on the other hand, the propulsion and space-based work which Sputnik had driven us into, which the Air Force had a very good feeling for and had done a lot of work on.[19]

The NSA took the recommendations of the task force to heart and hired the Institute of Defense Analysis to create a cryptology think tank to study long-range computer applications to cryptanalysis.

Certain electronic components in both Soviet and U.S. missiles would radio back reports of what was happening during the missile's flight, and the CIA and the Air Force began to build stations to intercept this telemetry. William Perry, a leading SIGINT expert from Sylvania Laboratories and later with Electronic Systems Laboratory, was a key participant. Perry has never received credit for his work in a variety of intelligence fields. He was a frequent visitor to the PID, and it was a joy to brief him on Soviet systems. It was primarily his efforts to merge the photographic intelligence we were obtaining with that obtained from the telemetry, ELINT, and communications intelligence that generated a tidal wave of information on Soviet missile systems.

Long before there was an organization to determine missiles' trajectories, range, burn, and number of warheads, there was Curt Olsen, a lone CIA analyst who was doing a lot of mental telemetry analysis and had festooned his office with graphs and his blackboard with formulas and methods to interpret the data.

Olsen was sure that the telemetry from Soviet missiles was revealing information on range, burn time, propellant flow rate, and other technical details; it was just a question of deciphering the signals. In this age before computers, noted analyst Gene Poteet, “feasibility studies and engineering calculations involved solving spherical trigonometry equations using slide rules, tables of logarithms, and hand cranked calculators.”[20] When computers became available, it was obvious that they would be able to do some, if not most, of this work. The big contribution of the SIGINT committee in this regard was to develop a program that could identify and exploit Soviet telemetry records that had been warehoused at the NSA. On November 7, 1963, the CIA established the Foreign Missile and Space Analysis Center (FMSAC) to analyze telemetry and other communications intelligence.

Electronic intelligence gathering (ELINT), in the form of the interception and analysis of radar and guidance beacons, had become a major issue for the armed forces. Bureaucratic pride, turf protection, and jealousy abounded as the various intelligence agencies fought over who should have control of this vital information. In 1957, at the president’s direction, the Science Advisory Committee of the Office of Defense Mobilization set up a study panel under William Baker. The panel’s report, issued on January 23, 1958, recommended that the responsibility for ELINT be assigned to the NSA. President Eisenhower authorized extensive airborne ELINT-gathering missions along the USSR border in mid-1959, when the Soviets began conducting a number of missile tests. The United States also needed to know the precise location of all Soviet radar and command sites to determine if there were any gaps in the radar coverage that would provide an avenue for U.S. aircraft to fly through without being detected.

On August 24, 1959, Eisenhower approved a satellite program that was given the innocuous name Galactic Radiation and Background (GRAB). The GRAB satellite had two purposes: one overt and one covert. One payload, announced publicly, measured solar radiation. The second, highly classified, payload was designed specifically to collect ELINT from Soviet air defense radars.[21] The Naval Research Laboratory managed GRAB for the director of naval intelligence and the NSA. The Navy launched the GRAB electronic intelligence satellite on June 22, 1960. It orbited for a number of months, and the data it collected on Soviet air defense radars was downloaded to ground stations and recorded on magnetic tape. The tapes were sent to the NSA, SAC, and the CIA. In the event of war, SAC needed to know the locations of the radar sites to avoid them, jam them, or destroy them with aerial bombardment. It was especially necessary to destroy those in northern Russia so that our B-52 bombers could operate there. SAC incorporated the GRAB data into its target dossiers. GRAB would lead to succeeding satellites that were more powerful and more technically sophisticated. It was followed by Dyno and later by an improved series of Poppy satellites. Miles Copeland, a retired intelligence officer, remarked in 1977 that "a satellite circling the world will pick up more information in a day than the espionage service could pick up in a year."[22] And that data could be transmitted to military forces in the field.

The PID maintained a photographic database of all imagery of Soviet radar stations as part of its national responsibility. After a number of meetings, Arthur Lundahl agreed with group- and division-level managers that this information rightly belonged with the Strategic Air Command because enemy radar order of battle was of vital concern for SAC's mission.

Over the next few years three types of satellites were launched. The first, which used a low earth orbit, could monitor the entire world every day using a single satellite. The Russians invented the concept for the second system, the highly elliptical orbit. A Soviet ELINT satellite could loiter over the United States and relay information to the Soviet Union. The third type of satellite used a geosynchronous orbit. It rotated at the same rate as the earth, so it appeared to be fixed at a given point above the equator.

Quill Radar Satellite

The major factors limiting photo-imaging satellites were clouds and darkness. Dr. Land advocated experimentation with radar and infrared systems that could penetrate clouds and find and image large military installations. The Air Force responded by beginning the development of a radar system named "Quill"—a joint undertaking involving Boeing, Goodyear, and the Environmental Research Institute of Michigan (ERIM). Two questions arose immediately. First, was it wise to use such a system? The beam it emitted could easily be detected by the Soviets. Senior officials in the United States argued that the repercussions could adversely affect all photographic satellites. Second, could an aircraft radar system be modified to function in a satellite, or should a new system be developed? Of the two organizations most familiar with radar systems, Goodyear Corporation and ERIM, the latter was selected to design an experimental satellite that would operate only over the United States. Len Percello and other senior ERIM officers visited the Photographic Intelligence Center for long discussions about which areas would be imaged.

After the first Quill was launched in December 1964, the PIC was asked to evaluate images of Michigan, Illinois, Ohio, and the northwestern United States. A team of interpreters determined that the resolution was not very good, but airfields, cities, and industrial installations could be identified. There were a number of interesting anomalies on the images that tried our skills. I was called by an interpreter and shown a large "bloom" over a small Illinois town where maps indicated no industries. We had no photographs of the town, so I called a cleared individual in the CIA's Domestic Contacts Office and asked if its Chicago representative could check out the town and call me to report what he saw. A few hours later I received his reply: "There's not a damn thing in this town except a number of agricultural machinery outlets." Therein lay the answer. The numerous reflectors from the machines were responsible for the "bloom." There was another "bloom" near a railroad line in the area of Columbus, Ohio. We did have aerial photographs of that site, but the only thing they showed was a weed-covered lot. Again, I asked for it to be checked out, and the reply was similar: "There is only a weed-infested lot where there used to be a junkyard." In this case, the presence of all that iron and rust was responsible for the "bloom." An image of a big storm off the coast of Oregon actually showed heavy rain clouds, a feature thought impossible for radar. Another interesting image showed areas where roads and highways had been washed out. We made a number of briefing boards depicting the imaging capabilities of Quill that were shown to the Technological Capabilities Panel and the president.

Lou Franceschini and Carroll Lucas from the PIC, with help from Autometric Corporation, prepared a report on the results of the Quill mission. Land was briefed and thought that radar technology could be developed into a viable source of round-the-clock coverage of strategic installations.

SOSUS Underwater Detection System

While one segment of the TCP was looking at airborne systems, another was looking at underwater communication and detecting devices. Communications intelligence and U-2 and other photographic sources had made it obvious that the Soviets were developing an ocean-going navy with both missile- and torpedo-firing submarines that threatened to render obsolete much of the U.S. Navy's undersea posture. The Navy was the only branch of the service collecting acoustic intelligence and would have to take on this problem alone. At this point, William

Baker recalled, "the plans began for the undersea cables that would be used as a kind of trip wire to tell where the submarines were passing around the world."[23]

Referred to initially only as "new techniques for undersea warfare," the undersea cables were part of the recommendations the TCP urged President Eisenhower to approve to provide deep-water long-range detection. W. Maurice Ewing of the Lamont Geological Observatory had proposed such a "trip wire" application for detecting and tracking Soviet submarines in 1956 at the Project Nobska study on undersea warfare at Woods Hole Oceanographic Institute. Harvey Brooks, a member of the president's Scientific Advisory Committee, supported the program, and Eisenhower saw that funds were allocated to the Navy. The result—the Sound Surveillance System (SOSUS)—was given a high priority by the Navy. Multiple hydrophone arrays linked by cables were placed on the sea floor at key locations in the Atlantic and Pacific oceans to track submarines by their faint acoustic signals. The sounds picked up by the hydrophones were transmitted to shore stations equipped with Shore Signal Information Processing Segments for analysis. Since the demise of the Cold War, the system has been employed in a number of ecological projects, including tracking whales and dolphins.

The Transit Navy Navigation Satellite System

The launch of *Sputnik 1* on October 4, 1957, was a monumental event. George Weiffenbach and William Guier of the Johns Hopkins University Applied Physics Laboratory (APL) were especially intrigued by the craft's radio signals. After some study they were able to determine *Sputnik 1*'s orbit by analyzing the Doppler shift of its radio signals during a single pass. Frank McClure, a senior scientist at APL, went a step further and postulated that if a satellite's position was known and predictable, the Doppler shift could be used to locate a receiver on earth. The receiver had to accurately and reliably recover the Doppler signals, satellite ephemerides, and satellite timing data.

The TCP had recommended—and Eisenhower had approved—the construction of Polaris, but the program required an extremely accurate all-weather navigation system. The submarine's position had to be known precisely in order for the vessel to accurately fire a missile at a designated target. ARPA provided early funding, and the development of a navigation system began in 1958 at the APL. When the Navy assumed control of the project, it became known as Transit, or the Navy Navigation Satellite System. The program was kept under the tightest security. A prototype satellite launched on September 17, 1959, failed to achieve orbit. The first successful tests of the system were made on April 13 and June 22, 1960, when two satellites (*Oscar* and *Nova*) were placed in low polar orbits at an altitude of six hundred nautical miles and became the first satellite navigation system. Global coverage required a constellation of five satellites. When the system became fully operational, at least ten satellites—including a spare for each satellite in the constellation—were kept in orbit. The system was used primarily to obtain accurate location information for ballistic missile-firing submarines, but was also used by the surface fleet and for hydrographic and geodetic surveying. The accuracy of the system remained classified for many years. A number of problems had to be solved before Transit became functional. The submarine's computer had to be small enough to fit through the submarine's hatch—no small problem in those days when computers were sometimes as big as entire rooms. A new computer, the AN/UKY-1, was built with rounded corners to fit though the hatch. It was about five feet tall and sealed to be waterproof.[24]

An experiment was conducted in which the Transit system obtained the exact position, in longitude and latitude, of a Polaris submarine, which was determined independently by Corona stellar cameras. John Cain and Chris Mares of the PIC worked with the Navy on this project. Both systems proved to be accurate within two hundred feet. Transit was continuously improved through the years, but the system remained classified until the summer of 1967, when Vice President Hubert Humphrey announced that it was available to commercial ships and aircraft of all nations.

Transit had drawbacks. Moving aircraft could not use it, and it could not provide altitude. The Army and Navy began working on programs to provide location, speed, and altitude of aircraft and military movements. The Transit system was retired at the end of 1996 and replaced by the NAVSTAR Global Positioning System, or GPS, as it is commonly called today. The GPS constellation consists of twenty-four satellites circling the globe every twelve hours and provides twenty-four-hour navigation services that can be used to target an enemy—or to find one's location anywhere in the world.

During crisis periods with the Soviets, Polaris-carrying submarines were given precise geodetic targets. Once an order was given to strike a target, there could be no recall. Using the Transit system, the submarine would go to an appointed spot and launch its missiles without breaking radio silence. Eisenhower understood this implicitly, but the Navy command had some doubt whether President John F. Kennedy did. When President Kennedy visited the Navy's CINCLANT headquarters at Norfolk, Virginia, on April 19, 1962, Adm. Robert Lee Dennison gave him a thorough briefing on Polaris firing procedures. Afterward, Dennison asked the president if he had any questions. "He didn't say anything, and there was an appreciable pause, which seemed like a long time [but] may have been six or seven or eight seconds. Finally, he said, 'Can those missiles be stopped?' I said, 'No sir. These submarines are reeling in their underwater antennas, the countdown has started and there's no way to stop them.'" Dennison added, "I don't know whether he liked it or not, but I've wondered often what he was thinking about, what can happen in a matter of a few seconds—not half an hour or fifteen minutes for him to think about countermanding an order to shoot."[25]

Midas and Defense Support Program Satellites

The Missile Alarm Defense System (Midas) was developed with the goal of providing instant warning—supported by infrared, radar, and other intelligence sources—of Soviet missiles heading toward the United States. The principle behind Midas was to detect the exhaust plumes of very hot gases when missiles were launched and relay a signal to earth that would be analyzed at the North American Defense Command (NORAD). Although a number of different project numbers and names have been associated with this undertaking, the effort finally became known in defense and intelligence communities as the Defense Support Program (DSP). In contrast to the publicity given to the Corona program, little was published on the DSP until recently. For more than thirty-five years, Midas satellites have detected infrared plumes from their stations 22,300 miles in space. They have also detected nuclear detonations that some nations were determined to keep secret.

The program had a rocky start and then a rather jerky progress. Although it employed the same Agena upper stage that Corona used, the satellite had to be launched atop the more powerful Atlas, a none-too-reliable booster rocket that had only about a 75-percent success rate. After the conclusion of feasibility studies, ARPA director Roy Johnson stated publicly on December 3, 1958, that work had begun on an infrared early warning program that would be called Midas.

While most decision makers in the military and intelligence communities agreed that an early warning system had to be operational at the earliest possible date, there was considerable debate as to what the system would actually consist of and how it would function. After a series of revisions, the final plan called for a constellation of twelve satellites placed in geosynchronous orbit to detect the infrared emissions of missile launches. Even after the secretary of defense approved the plan, there were many unresolved issues; among them were developing power sources; collecting and evaluating infrared signals; determining where the ground station should be located; and, of course, successfully launching the satellites.

After considerable study, a decision was reached that Australia would be the best place to build the Midas ground station. Prime Minister John Gorton visited the United States and gave permission to build a site in his country, but touchy negotiations were involved before a station site was selected six miles from Woomera. The site, named Nurrungar ("to hear" in the Aboriginal language), had begun as a British missile-testing base in 1947. Some Australians objected to the base, fearing it would become a Soviet target in the event of war.

As had often been the case in the past, conflicts surfaced among the military services when the issue of the program's control arose. The Air Force, the primary contractor, displayed little interest in the Navy's concern about movements of Soviet bombers that could threaten the U.S. fleet. SAC made a strong bid for control, but the program remained under Air Force management.

On February 10, 1960, President Eisenhower flew to Florida and toured Cape Canaveral, accompanied by Secretary of Defense Thomas Gates, as *Midas 1* was being prepared for launch.[26] The launch, which took place on February 26, 1960, ended in failure. *Midas 2*, launched three months later on May 26, was successful, but the satellite tumbled as it circled the earth and could not be operated as planned. *Midas 3* ended in failure in July 1961. Formidable technical and operational problems remained; the program was suffering from cost overruns, and internal squabbles were threatening to tear it apart. As the cost of Midas rose sharply, some scientists urged the development of an over-the-horizon radar detection system that would give about the same warning time at less expense. Eisenhower was impatient with the project, particularly when he compared it with the success of Corona. Lundahl told us that Bissell had received overtures to take over the Midas project but he refused, saying he had a full plate with Corona.

The problems led Secretary of Defense Robert McNamara to delete all but development funds for Midas from the FY 1963 budget. One postponement after another caused the operational date to be moved up to 1966. Finally, after considerable development work and improvement, the system successfully monitored Soviet missile launches from Tyura Tam, Kapustin Yar, and Plesetsk, as well as missile launches from submarines.

PIC personnel worked closely with the Midas developmental office when it became operational, helping to distinguish emissions that were not from missile launches or nuclear detonations from those that were. Peat fields burning near known missile launch sites caused considerable concern, as did gas flares from oil fields and refineries. We checked out lightning-caused fires in the Siberian taiga, field burning and forest clearing, and large detonations at open-pit mines.

Nuclear weapons were still being tested aboveground at that time, and a new early warning capability to detect these detonations was developed under a program called "Vela Hotel." The first pair of Vela satellites was launched in October 1963, the second pair in 1964, and the third pair in 1965. Each of the paired satellites carried X-ray, gamma ray, and neutron detectors. On September 22, 1979, the bhangmeter (a device for detecting the yield of an atomic explosion in the atmosphere) on a Vela satellite detected a brief, intense double flash of light that analysts determined probably came from a nuclear device near the southern tip of South Africa. No consensus was ever reached on what nation or nations were responsible for the detonation. Many in the CIA considered Israel the most likely perpetrator,[27] but the controversy continues to this day. The United States had prior knowledge that the Israelis and South Africans were cooperating on a number of secret projects.

The Vela satellites could detect ICBM launches, MRBN and IRBM launches, submarine-launched ballistic missiles, and aircraft flying with afterburners on. The United States and USSR were conducting all of their nuclear detonations underground by this time, but the Vela system detected French and Chinese aboveground tests. During the Yom Kippur War in 1973 Vela detected SAM and Scud missile launches.

On May 26, 1972, President Richard Nixon and Leonid Brezhnev of the Soviet Union signed two treaties produced by the Strategic Arms Limitation Talks (SALT). Corona and other detection satellites would become an important part of the technical means by which the treaty could be verified. The agreement also prohibited launching antisatellite weapons that would damage, render inoperable, or change the flight trajectory of space vehicles.

The A-12 Oxcart and the SR-71 Blackbird

Barely two months after the first U-2 missions overflew the Soviet Union on July 4, 1956, Richard Bissell and Col. Jack Gibbs started defining a successor to the U-2. In the fall of 1957 Bissell contracted for an analysis of a single-seat plane that could fly at extremely high speed and altitude. The analysis revealed that supersonic speed greatly reduced the chances of detection. The general requirements the analysis produced were for an aircraft incorporating maximum radar-absorbing capabilities able to fly at about 80,000 feet at Mach 3. Lockheed and the Convair Division were informed of the requirements. Dr. Land, meanwhile, was challenging his colleagues to organize research and development for an even more effective reconnaissance system. On October 24, 1957, Land and his colleagues discussed two major possibilities. One was a manned aircraft "to be designed for greatly improved performance and reduced radar cross-section"; the other involved the development of a satellite photographic system.[28]

Allen Dulles and Bissell briefed President Eisenhower on December 17, 1957, on the progress toward a successor to the U-2. Also present were Killian, Land, and Edwin M. Purcell from the Science Advisory Committee, and Air Force secretary Donald Quarles. Dulles reviewed the results of the U-2 missions to date and said that an even better craft more invulnerable to detection was possible. The proposed aircraft would be a high-speed, high-altitude, long-range reconnaissance craft capable of evading known SAM systems as well as Soviet fighter jets. It would also be invisible to Soviet radars—the first ever stealth aircraft. Lockheed and Convair were asked to submit proposals.

On January 23, 1958, Kelly Johnson presented a proposal to Bissell for a new high-speed aircraft that would cruise at Mach 3.0 at 90,000 feet and have a range of four thousand nautical miles. Johnson presented his concept to a very interested Land panel on July 23, 1958. In late November 1958 a CIA review panel agreed that such a craft was possible, and further that it could be rendered "virtually undetectable by radar and above the dangers posed by Soviet surface-to-air missiles."[29] The new plane would be built from the ground up specifically to conduct reconnaissance rather than being an adaptation of an existing airframe. That same month the Land panel specified that "the successor reconnaissance aircraft would have to achieve a substantial increase in altitude and speed; be of reduced radar detectability; suffer no loss in range to that of the U-2; and be of minimum size and weight."[30]

Lockheed and the Convair Corporation were asked to submit formal proposals for this aircraft. Lockheed's design was named "Archangel," a carryover from "Angel," the name given to the U-2 during its development. "Fish" or "Kingfish" was the nickname given to Convair's proposal. The president remained deeply interested in the U-2's successor, and Killian and Purcell briefed him on February

13, 1959. Commenting on the low radar visibility resulting from the craft's special shape, Purcell said, "The best shape would be a flying saucer with no equipment on its underside; this is next best—a triangle with all equipment features on top." Eisenhower said that an aircraft flying at such high speed and altitude with little resistance should have great range. Purcell confirmed this, adding that the craft "will be very hard to track by radar because it moves so fast between [the radar's] sweeps."[31]

On July 20, 1959, the president, Bissell, Allen Dulles, Kistiakowsky, Killian, and Goodpaster met again so that Killian could brief the president on the two aircraft proposals. Convair's "Super-Hustler" was a small ramjet craft that would be carried beneath the B-58 Hustler in the position normally used for a pod. It would be launched at about 50,000 feet and would fly at Mach 3.2 at 90,000 feet. The Lockheed proposal was for a very advanced turbojet that would fly at 85,000 feet at the beginning of a mission and rise to 95,000 toward the end. The initial version would fly at Mach 3.2; a later version would fly at Mach 3.5.

On August 20, 1959, Lockheed and Convair submitted their proposals to a joint Department of Defense, Air Force, and CIA selection panel. The panel selected the Lockheed design because the Convair B-58 lacked the thrust to bring it to the speed necessary to start the ramjet and would require modified engines. Eisenhower authorized $91 million for the Lockheed craft's development. The original name, "Project Gusto," was terminated, and the project was renamed "Oxcart." The president always referred to it simply as "the big one." On August 28 Kelly Johnson wrote in his project log: "Saw Mr. Bissell alone. He told me that we had the project and that Convair is out of the picture. The [CIA] accepts our conditions (1) of the basic arrangement of the A-12 and (2) that our method of doing business will be identical to that of the U-2. [Bissell] agreed very firmly to this latter condition and said that unless it was done this way he wanted nothing to do with the project either."[32]

On September 14, 1959, the CIA awarded a contract to Lockheed pending further studies. By mid-January 1960 Lockheed had demonstrated that a new concept of shape, fuel additive, and nonmetallic parts would reduce the Oxcart's radar cross section substantially. Bissell, however, was very upset to learn that those changes substantially reduced the aircraft's performance, and it would not be able to attain the penetration altitude of 90,000–100,000 feet he had promised President Eisenhower. Kelly solved the problem by decreasing the aircraft's weight by 1,000 pounds and increasing the fuel load by 2,000 pounds, bringing the operational altitude up to 91,000 feet. Afterward he noted: "We have no performance margins left; . . . instead of being 10 times as hard as anything we have done [this project] is 12 times as hard."[33] On January, 26, 1960, the CIA and Lockheed signed a contract to produce twelve aircraft at an estimated cost of $100 million; the actual cost turned out to be $170 million.[34] Construction began in September 1960 and continued on a two-shift basis until mid-1964. Eisenhower wanted a tight lid placed on the development of the aircraft and asked for a team structure comparable to the one employed during the U-2 program.

The new reconnaissance aircraft was officially designated the A-12 (single seat), but the intelligence community continued to call it the Oxcart. Dulles said that it could fly faster than a speeding .30-06 bullet. The Air Force version of the craft would be designated the RS-71 (Reconnaissance Strike-71); a later tandem two-seat version known as the Blackbird was designated the SR-71 (Strategic Reconnaissance-71). The CIA's A-12, designed to penetrate heavily defended airspace, relying on its speed and altitude to escape destruction, was in some ways superior to the Air Force's SR-71. It flew higher and faster and had superior cameras. The A-12 could photograph a seventy-two-mile-wide swath and carried 5,000 feet of film with a resolution of twelve to eighteen inches; the SR-71 could photograph only a twenty-eight-mile swath and carried 3,300 feet of film with a resolution of twenty-eight to thirty inches. The A-12 was flown by a pilot who was also the navigator and could carry only an optical camera, however, and the SR-71 carried a two-person crew and had not only optical capability but also infrared and side-looking radar.

By November 1960 the runway at Area 51 in Nevada had been increased from 5,000 to 10,000 feet to accommodate the Oxcart. A complex of hangars, barracks, and a variety of antennas had grown up near the runway. By that time, however, some were questioning the value of the A-12 project. The downing of Gary Powers in May 1960 had caused an international incident, and satellite reconnaissance was becoming a major intelligence source. Goodpaster spoke to the president about it. "After considering the matter," Goodpaster noted, "the president said he was inclined to think that it should go forward, on low priority, as a high performance reconnaissance plane for the Air Force in time of war."[35] Eisenhower was "unenthusiastic," according to Bissell, but he did stay the course.[36] He made it abundantly clear, however, that the Oxcart would not overfly the Soviet Union unless the CIA could prove, absolutely, that it would be invisible to Soviet defense radars.

Then the CIA had to tell the president that the Oxcart would not make its initial flight as planned because testing was still under way. In fact, it was unlikely to be operational until spring 1962.[37] Kelly Johnson made an appeal not to stretch out the program with additional tests because the changes being tested would entail little savings to the overall cost of the aircraft.[38] Many problems remained with the aircraft. "Never had an engineer had so many problems to solve in such a short period," Lundahl would remark. "It was a saga of untiring work, dedication, creativity, and indomitable determination and courage in the face of overwhelming obstacles." In flight, the A-12 would be operating at temperature extremes ranging from –90 degrees at its highest altitude to 90 degrees when it was being refueled at 30,000 feet. A titanium alloy had been selected for the aircraft's skin, but titanium was in short supply; in fact, the principal producer was the Soviet Union. The CIA managed to get the titanium by creating a series of shell corporations to purchase it. A 1994 article in *Air Force* magazine reported on other problems: "The fuel tanks, constituting by far the greater part of the aircraft, would heat to about 350º F, so special fuel had to be created and the tanks rendered inert with nitrogen. Lubricating oil was formulated for operation at 600º F, and contained a diluting agent in order to remain liquid at operation below 40º F. Insulation in the plane soon became brittle and useless."[39] Tank farms to hold the specially refined fuel were set up at Edwards AFB and Beale AFB in California and at U.S. air bases at Eielson, Alaska; Thule, Greenland; Kadena, Okinawa; and Incirlik, Turkey.

The A-12 made its maiden flight with Louis Schalk at the controls on April 26, 1962, and its second flight on May 4, 1962. Bissell, who was present, was impressed. When he returned, he came to the PIC and briefed senior officers on what to expect. We had basic information about the cameras that would be installed in the A-12 and how they would be protected from the heat and cold. The camera lenses would peer out through a quartz window.

As the flight tests progressed, residents of Nevada and other western states were subjected to an increasing number of sonic booms. On a May 24, 1963, flight, the pilot recognized an erroneous and confusing airspeed indication and ejected from the aircraft, which crashed fourteen miles south of Wendover, Utah. The wreckage was recovered in two days and the CIA concocted a cover story that an F-105 had crashed. We were subsequently told that on one test flight the pilot lost control temporarily and the plane lunged forward and down, creating a sonic boom that broke nearly every window in a small Utah town.

As satellite reconnaissance programs became more and more successful, the CIA feared that Eisenhower, and later President Kennedy, would cancel the A-12 project. Bissell, Lundahl, and Cabell continued to pressure Dulles to stay the course. When John McCone became DCI, he urged Kennedy to keep funding the program. There was also support for the A-12 in Congress, especially from Senator Robert Byrd of West Virginia. Identifying the actual role of the A-12 was something of a public relations problem. NASA deputy director Hugh Dryden and James Cunningham of the CIA met and decided to say that the aircraft had an air-launched capability. In October 1962 the Air Force ordered three A-12 interceptor variants under Project Kedlock, and that aircraft was given the designation YF-12A.

Continued testing resulted in more sonic booms and even some sightings, especially by airline pilots, causing consternation. Lundahl and Kelly Johnson were in frequent contact, of course. Lundahl visited Kelly Johnson at the A-12 plant and at Groom Lake in Nevada, and Kelly would stop by the PIC when he was in Washington giving Bissell progress reports. Bissell told Kelly that there was talk that President Kennedy might cancel the project because of the rising costs.[40] A downcast Kelly remarked, "No one will ever come along and produce an aircraft greater than this one . . . even by the year 2000."[41]

But the project did continue. President Lyndon Johnson was brought up-to-date on it a week after taking office. A few months later, on February 24, 1964, he announced: "The United States has successfully developed an advanced experimental jet aircraft, the A-11 [*sic*], which has been tested in sustained flight at more than 2,000 miles per hour and at altitudes in excess of 70,000 feet. The performance of the A-11 far exceeds that of any other aircraft in the world today. The development of this aircraft has been made possible by major advances in aircraft technology of great significance for both commercial and military application."[42]

The first time I saw the A-12, at Edwards AFB, I was impressed by its size, and also by the pans under the aircraft's wing collecting dripping fuel. I was told that the twin engines had the power of forty-five diesel locomotives. They delivered a combined thrust of 65,000 pounds and consumed 12,000 gallons of fuel every ninety minutes. The engines made a screaming noise as the aircraft rolled down the runway gaining speed. As it darted to the sky, the afterburners turned on with a thunderous roar. Later, when the plane touched down, it deployed a large drag chute to help with braking.

Over the years, we evaluated the aerial photos taken on a number of A-12 and SR-71 training flights. Several test flights were particularly impressive. One was a flight down Route 1 from Griffis AFB in New York to Seymour Johnson AFB in North Carolina. The cameras imaged every traffic jam on the vital East Coast arteries in less than thirty minutes. Another flight covered the 1,450-mile length of the Colorado River in less than forty-five minutes. The presence of the superior Soviet Tall King air defense radar and the deployment of SA-5 SAMs, designed to intercept high-speed, high-altitude aircraft such as the Oxcart, precluded any air reconnaissance missions over the Soviet Union.

U-2s had been flying periodic missions over North Vietnam and Cambodia since 1962. We analyzed every mission at the PIC. When we spotted SA-2s being deployed, ranking CIA officials expressed concern about the safety of the U-2 missions and considered deploying the A-12s instead.

On May 16, 1967, A-12 Black Shield missions were approved "by the highest authority to provide a capability to search for SSM's and associated equipment that might be introduced or deployed in North Vietnam."[43] A-12s were deployed to Kadena, Okinawa, and began flying periodic Black Shield missions over North Vietnam that provided valuable intelligence on the infusion of Soviet military equipment into North Vietnam along with vital intelligence on North Vietnam's air, army, and navy orders of battle. Diplomatic reports indicated that the Vietcong were not only transporting war materials into Cambodia to be used against our troops but were storing them there in caches. The French, who had invested a lot of money in Cambodia and wanted to keep that nation out of the conflict, maintained that the reports were not true. The Joint Chiefs of Staff considered secretly bombing the caches. Arguments erupted that went all the way up to the president. Two A-12 flights were conducted over Cambodia, and a detailed report prepared by PIC analyst Ed Puchalla confirmed the existence of a number of arms caches. Some at CIA headquarters were concerned about releasing the report, but I and senior PIC officers maintained that we had to call the shots as we saw them. When Gen. John D. Ryan of the Air Force told us that he wanted to know more about Cambodia and the caches, I told him that we would send over our Cambodian expert, an Air Force captain, along with some of the photos. The captain looked shocked when I told him he would be briefing General Ryan. He began wetting his fingers and using them to press down his hair. I asked him what in the world he was doing. He replied, "I need a haircut and I hope that Gen.

Ryan doesn't notice it." I told him to concentrate on his briefing and worry about his hair later.

The A-12 flew twenty-nine successful missions from May 1967 to May 1968—twenty-two over North Vietnam, two over Cambodia, four over North Korea, and one over the DMZ. Every spring and summer the North Koreans staged large military exercises near the DMZ. A-12 missions confirmed that they were indeed exercises and not preparations to invade the DMZ.

With the further deployment of U.S. troops to Vietnam, daily or near daily reconnaissance flights were needed not only over battlefields but also to gather intelligence about the arms the Soviets were delivering to the port of Haiphong that would subsequently be deployed against our forces. The question was who would conduct the reconnaissance: the CIA's A-12s or the Air Force's SR-71s. A series of missions designated "Nice Girl" was planned for October 1965 to help make that decision. The results were to be evaluated at the National Photographic Interpretation Center (NPIC)—which superseded the Photographic Intelligence Center in 1961—by representatives of the CIA, Air Force, and Defense Department. At first, both aircraft flew the same missions but on different dates. Because the missions were flown in different weather conditions there were too many variables to determine which of the two aircraft was superior. The aircraft were also imaging different targets. We proposed that they fly side by side, or one following the other, and photograph the same targets within seconds or minutes of each other.

The joint mission was flown on November 3, 1967. As we had predicted, the A-12 camera provided better images, but because we were at war, the SR-71 won out. It soon became the most valued reconnaissance vehicle of the Vietnam War. I asked then-DCI Richard Helms in a meeting why he gave in to the Air Force over the Vietnam missions. He replied that the cost of flying either craft on a daily basis would be "humongous" and the CIA could not afford it. Also, the Air Force had more SR-71s than the Agency had A-12s—thirty-one versus fifteen. When a Government Accounting Office study claimed it was too expensive to keep both systems operational, the responsibility of high-altitude flights was shifted to the Air Force and President Johnson canceled the A-12 program.

The SR-71s flew basically the same route over Haiphong and Hanoi on each mission, and then followed the rail lines up to the Chinese border. The fact that they flew the same pattern at about the same time each day made them excellent targets for SA-2 missiles. The North Vietnamese fired more than nine hundred

SA-2s at SR-71s in attempts to bring them down. Chatter indicated that Russians were present at some of the SA-2 sites as well. We captured a number of those attempts on film. Allied fighter planes were on standby to attack the SA-2 sites revealed when they fired missiles against U.S. aircraft. The North Vietnamese were playing a shell game with their SA-2 missiles, both moving them around the country and attempting to camouflage them. One of our imagery interpreters found more than 150 such sites, and we passed the information along to field commanders. We saved the lives of many aircrews because we could locate SAM sites and antiaircraft positions and have them targeted for strikes. SA-5 sites that could present a threat to the SR-71s were another high priority at the NPIC. On a visit to Beale AFB, I asked the deputy commander if any SR-71s had been hit and was told that one came back with a small hole the size of a bullet that probably came from an SA-2 missile.

When the USS *Pueblo* was seized, President Johnson ordered an A-12 Black Shield mission flown over North Korea on November 26, 1968, before deciding whether to authorize an attempt to rescue the crew. The pilot reported, and we confirmed, that the *Pueblo* was at the Wonsan dock and that the crew members had probably been removed, so no rescue was attempted. President Johnson sent a large number of B-52s to Guam and deployed a naval task force near North Korean waters. North Korea ordered a large mobilization of its forces, fearing an attack by the United States. Information on North Korean air and surface-to-air defenses and troop deployments near the DMZ were of particular interest at that time.

The crowning achievements of the SR-71 began on October 6, 1973, when Egyptian and Syrian forces launched a massive attack against the Israeli Bar Lev Line along the Suez Canal and at the Golan Heights. The Washington Executive Action Group (WASAG) was uncertain what was happening along the battlefront and demanded current intelligence. The Air Force, under some pressure, agreed to deploy SR-71s to obtain the information. When England and Germany refused to grant the United States permission to use their air bases, a decision was made to fly the missions from Griffis AFB in New York. The eleven-hour, 12,000-mile missions from Griffis to the Middle East battlefields and back would require five air-to-air refuelings from sixteen KC-135 tankers. Several high-ranking officers were not pleased to hear that, fearing that fuel or mechanical problems might force an SR-71 to land at a foreign base. If that happened, a senior officer said, "it would be a crisis of the first magnitude." Pilots were told that if they had mechanical or fuel problems, they were "on their own." The SR-71s overflew the Sinai battle area early in the morning. When they returned, the film was processed at the Eastman facility at Rochester, New York, and a plane kept on standby flew the film to the NPIC for analysis. Working through the night, photo interpreters interpreted the damage inflicted on the Israeli, Egyptian, and Syrian armored forces and presented a three-part situation board on the battlefield to the WASAG the next morning.[44]

The SR-71 flights continued as the Yom Kippur War turned into one of the largest tank battles of the twentieth century. A situation map was prepared showing not only the number of Egyptian and Israeli tanks engaged in battle but also those that were destroyed. When the tide of battle shifted, the Israelis began to pound the Egyptian and Syrian forces on two fronts. The Israelis crossed the Suez Canal into Egypt, precipitating a major crisis. The Soviets began an enormous military transport to supply the Egyptian forces, prompting a U.S. resupply effort to the Israelis. There was evidence that the USSR might be alerting Soviet airborne forces for possible intervention. Henry Kissinger began his shuttle missions to the Middle East and Moscow. The Soviets were now demanding that the United States join with them to stop the fighting. President Nixon placed U.S. military forces on DEFCON 3 (increased readiness without the declaration that war is likely).

The Yom Kippur War lasted eighteen days. SR-71 missions revealed Sinai to be a killing field. Israeli, Egyptian, and Syrian armies lay in tatters. We spotted large graveyards of tanks, armored personnel carriers, and support vehicles. A cease-fire was declared on October 22, 1973. The SR-71 flights provided valuable, up-to-date intelligence during this period and represented some of the finest performances in the annals of U.S. wartime military aviation.

SR-71s continued flying during the Carter administration. When Cuba received MiG-23s from the Soviet Union, there was a question as to whether they were the export variety (i.e., not equipped for carrying nuclear weapons) or were the version capable of carrying nuclear weapons. If nuclear capable, the aircraft would be a violation of the Kennedy-Khrushchev agreement after the Cuban Missile Crisis that called for the removal of nuclear-capable Il-28 bombers. SR-71 missions and other sources determined that the MiG-23s were of the export variety. Sonic booms from the SR-71 overflights created some apprehension for Castro and the Cuban government.

Drones and the D-21 Tagboard

After Eisenhower ended U-2 missions over Russia following the downing of Gary Powers, the United States was without a vehicle to observe activities inside the Soviet Union. In their deliberations on new reconnaissance vehicles the Technological Capabilities Panel members expressed interest in using remotely controlled aircraft for espionage missions. The Snark cruise missile was considered for the job, but its speed and reliability left a lot to be desired. The first unmanned reconnaissance vehicles would instead be a series of drones built by the Ryan Aeronautical Company, the principal maker of target drones. At the suggestion of the Department of Defense, a number of Firebee target drones were converted into reconnaissance vehicles, but long-range results were poor. A longer-winged, redesigned vehicle, the Ryan Model 147A Lightning Bug, could reach altitudes above 50,000 feet and could take pictures with a resolution of between one and two feet. Carried aloft and launched from the C-130 Hercules, the Lightning Bugs photographed the coast of Communist China. During the Vietnam conflict the drones were moved to Ben Hoa Airfield and flew hundreds of high-altitude missions under the code name "Blue Springs." But some of the most impressive photography of the Vietnam conflict was taken by the Ryan 147SC Buffalo Hunter, which flew under the clouds, often surprising Vietcong engaged in military operations. I created a special package of the best of these photos. One of the NPIC's most spectacular briefing boards showed images from a flight when a drone inadvertently flew under power lines in North Vietnam. When the war ended, one of the drones, named Tom Cat, had carried out more than sixty-eight espionage flights.

Eisenhower expressed interest in an unmanned vehicle that could penetrate the Soviet Union and China, and on October 10, 1962, the CIA authorized Kelly Johnson to study the feasibility of modifying the A-12 to carry and deploy such an unmanned reconnaissance drone. The Agency's name for the project was "Tagboard D-21." The idea was to have the A-12 launch the drone over friendly territory. The drone would conduct photographic reconnaissance missions over enemy territory and then either return to the launch base or be expendable after it dropped its photographic package. It needed to have sufficient speed to outrun SA-2 missiles and a range in "thousands of miles." There was no unanimity of thought on what the drone would look like or how it would function. Suggestions included giving existing drones ramjet engines, modifying an existing fighter, and building a much smaller drone.

Kelly Johnson began designing a drone that would be mounted on a special launch pin on the aft fuselage of an A-12. The forty-three-foot-long D-21 was equipped with a ramjet engine and was capable of speeds in excess of Mach 4. It resembled its mother ship and was often referred to as the "Baby SR-71." After launching, the drone would follow a preplanned flight profile with camera on and off points. When its mission was complete, the drone would be guided to a predetermined point, usually over water, and the palletized camera unit would be ejected. The camera would be recovered either by a C-130 during its parachute descent or by a Navy destroyer if it fell into the sea. The D-21 would then descend and self-destruct by means of a barometrically activated explosive charge. On November 5, 1962, Johnson recorded: "The drone is developing without much discussion between Headquarters and us. I think I know what they want, but no one has spelled it out. We will try to get 6-inch ground resolution photography, a range of 3,000 nautical miles, and a payload of 425 pounds for the camera."[45]

The program received a big blow when Kelly came to Washington to explain that a D-21 had collided with the mother A-12 on its release during a test flight. The pilot and control officer had ejected, but the latter drowned when his flight suit filled with water. Interest in the project continued to wane as the resolution obtained from KH-4 and later KH-7 satellites improved. The Soviets had embarked on a massive defense system with the Tall King radar and a SAM program that included the SA-5, which many felt had been designed to intercept the SR-71. The SA-5 had tremendous thrust and was estimated to reach altitudes of 125,000 feet. A proposal that the D-21 be carried aloft by a B-52H bomber was tested next, with more failures than successes, although the later tests showed promise.

There was a period during the Vietnam War when we needed details on the shipment of military goods from the Soviet Union and China via China's rail system. A project called "Senior Bowl" was proposed to launch a D-21 drone from a B-52. The drone would be launched over South Vietnam, fly over the North Vietnamese rail lines and the rail transfer point between North Vietnam and China, and then overfly rail lines in Communist China before exiting over Shanghai. The first drone launched simply disappeared. Another drone flew two hundred miles off target north of Shanghai, and neither it nor its film was recovered. The third D-21 took off and continued to fly, but no one knew where it went. We were not told what happened to the fourth mission, but it was a failure as well. Senior Bowl was canceled in July 1971.

My division at the NPIC was responsible for preparing detailed reports on Soviet aircraft industries. When we received a request for a report on TSAGI, the Soviet's main aircraft research and design bureau, I gave the project to Ms. Charlotte Clinger, one of our foremost research analysts. While reviewing collateral information she came across a report that the Soviets had recovered a U.S. drone in Kazakhstan and were studying it. I immediately called the program office and Arthur Lundahl, and I briefed Kelly Johnson on the third lost drone. More details on the drone came out on July 5, 1995, when Sergei Khrushchev was interviewed by R. Cargill Hall and Richard S. Leghorn. "Yes, they found [the drone]," he said; "it was a very light weight vehicle. My friend told me that they brought it to Vladimirovka [a Soviet research facility], near the Volga River, in Southern Russia. They had some difficulty moving and delivering it by helicopter, but I really know nothing about the outcome. Nobody saw it in the air, it was found after it landed in Kazakhstan."[46]

Carl Duckett, the CIA's deputy director for science and technology, was also interested in drones. Years after the drone research began, he showed us a new drone in his office. It was the size of an eagle and was shaped and painted to resemble a large bird. The drone had a tiny engine that would propel it about one thousand miles. While the engine functioned well, there were some problems controlling the vehicle and the project was dropped.

The CIA and UFOs

Reports of unidentified flying objects surged during the Cold War years. Fears that the Soviet Union might achieve a major breakthrough in weapons development was to some extent responsible for the heightened interest in UFOs. The U.S. Air Force began collecting photos and reports of UFO sightings in 1948. In 1952 the effort was formalized under Project Blue Book.

Detailed analysis of the photos often revealed that the object could be attributed to a film defect, soot, a grease mark, a drop of moisture, lint, lens flare, movement of the camera, overlapping exposure, a lens out of alignment, or atmospheric impurities. Some photographers submitted images for the sheer joy of confusing experts. A favorite trick was to flip a hubcap or plate up in the air and photograph it. But no explanation was possible for some reported UFOs. Air Force analysts examined all the photos and categorized each into one of three categories: hoaxes, insufficient data for analysis, and no rational explanation. Test flights of the high-flying U-2 accounted for a rash of UFO reports. Several photos were taken of the sun reflecting off a U-2 in large, ball-like lights. Many of the sightings came at sunset and were made by airline pilots flying to and from California. As the sun set, the lower atmosphere was in darkness while the U-2 was being illuminated by the sun. This often caused a strong reflection, or what airline pilots called a "bloom." When A-12s and SR-71s began to fly, airline pilots—many just out of the service—sent in more reports, sure that nothing made on earth could fly that high. There were also photos of the fiery trail the SR-71 left under certain atmospheric conditions. At the height of the Cold War, the Air Force and the CIA willfully misled the public by claiming that the thousands of UFO sightings were caused by a variety of aerial phenomena.

Lt. Col. Bob Base, the officer in charge of Project Blue Book, periodically came to the NPIC with a fistful of UFO sightings. I would call the U-2 and A-12 project officers and ask if there were flights on the dates the UFOs were sighted. If there were, Base would write a letter to those who had reported the UFOs saying that "their sightings would be investigated."

In 1968 Dr. Edwin U. Condon conducted an extensive study and recommended against further study of UFOs because the field did not appear fruitful for any major discoveries. He visited the NPIC, and Lundahl briefed him on UFO reports that actually concerned U-2 and SR-71 flights. On December 17, 1969, after seventeen years, the Air Force canceled Project Blue Book. In August 1997 the CIA finally admitted in an article in a declassified version of *Studies in Intelligence* that more than half of all UFO sightings during the 1950s and 1960s were actually supersecret reconnaissance aircraft.

ELEVEN
the U-2 flights resume

Fabelhaft! Fabelhaft!

Konrad Adenauer

President Eisenhower maintained severe restraints on U-2 flights over the Soviet Union, authorizing each flight individually and limiting their number to brief bursts of activity. But he also realized that the United States was constantly at risk of surprise attack and wanted the best possible information on Soviet strategic capabilities. Further, he thought the military services were wasting a great deal of effort and money on misdirected programs. In May 1957 he approved nine carefully planned flights over the Urals and Siberia that would be known as Operation Soft Touch. The primary requirement was to search rail lines for possible ICBM launch sites, to overfly missile launch centers at Kapustin Yar and Tyura Tam, and to overfly the anti–ballistic missile (ABM) launch facility at Sary Shagan. Nuclear installations at Omsk, Novosibirsk, Krasnoyarsk, Semipalatinsk, and Tomsk; and mining, chemical, and uranium concentration complexes in Kazakhstan and Central Asia were also mission objectives.

The intelligence community had begun receiving reports that the USSR was developing an ICBM system back in 1953–54. We were aware that the Soviets had brought some four hundred scientists who had been involved in the German V-2 missile program at the end of World War II to the Soviet Union. The United States and the USSR "cannibalized" Nazi missile research and development institutions and plants. We knew that one Soviet officer who went to Germany to round up V-2s, launch facilities, blueprints, and engineers was Sergei Pavlovich Korolev, future head of the Soviet multimission missile design bureau. The Germans initially were housed on Gorodomlya Island in Lake Seleger. The Soviets thoroughly and systematically exploited the scientists' knowledge of all phases of German missile development: missile frames, rocket power plants, and guidance and control equipment. When the German experts were released, an extensive U.S. and British interrogation program called Dragon Returnee debriefed them and obtained considerable information on the Soviet program. The returning Germans indicated that their talents had been used to carry out fundamental research and design work under Soviet guidance that would lead to the development of large-thrust rocket engines. There was little doubt that the German scientists and captured V-2 equipment contributed substantially to the Soviets' knowledge of missiles—as they did to ours.

We were surprised to learn that some of the German scientists had actually worked at OKB-1 (also known as NII-88 and Scientific Research Institute No. 88), the bureau headed by Sergei Korolev at Kaliningrad, about five miles northwest of Moscow. Their knowledge was used in the construction of larger engines and missiles. A number had personally met Korolev. Propulsion specialists had been sent to Moscow/Khimki Propulsion Plant No. 456, headed by Valentin Glushko, the Soviets' premier missile engine designer. From Dragon Returnee we also learned that rocket engines were being fired at a test station near Zagorsk.

The first overt sign of a major Soviet ICBM program came in a public statement on April 23, 1956, by Premier Nikita Khrushchev announcing the fact. The so-called missile gap controversy began on August 26, 1957, when the United States detected the Soviets' first successful firing of an ICBM. TASS, the Soviet news agency, announced the successful test of a "super long-distance, intercontinental multi stage, ballistic rocket" and boasted that it was "now possible to send missiles to any parts of the world."[1] Democratic Party leaders howled that the United States was far behind the Soviets not only in missiles but in strategic weaponry. Edwin Land described the TCP's reaction to the launch to Albert "Bud" Wheelon, director of the CIA's Office of Science and Technology: "We simply cannot afford to defend against all possible threats. We must know accurately where the threat is coming from and concentrate our resources in that direction. Only by doing so can we survive the Cold War."[2] The intelligence community needed to find out whether a missile gap did indeed exist, and how big it was. The gap would have to be delineated in precise numbers, not intelligence guesses. The threat of a Soviet strike with nuclear-tipped ICBMs with only thirty minutes' warning and with no realistic prospect for defense or deterrent added to Eisenhower's concern.

The German scientists in the USSR had been told that a missile launch facility was under construction in Central Asia. Large shipments of cement and lumber had been shipped to a station code-named Tashkent 70. In sum, we knew in 1955 that an ICBM test facility was being established somewhere south of the Aral Sea, but its location was unknown. Finding the site became a priority target for a U-2 mission. Eisenhower approved such a mission on May 6, 1957, and it was flown on August 5. The U-2 mission tracks were aligned along the main Aqtobe-Tashkent rail line. We found the missile launch complex in the Bet Pak Dala Desert, south of the Aral Sea and near the north-flowing Syr Dar'ya River. A huge launch pad was identified at the end of a spur extending some fifteen miles into the desert from the main line. As the chief information officer of the PIC, it was my duty to ensure that all available collateral information was factored into the U-2 photo-interpretation effort and that it included the maps and charts necessary to precisely locate all new installations. I also prepared all the briefing notes for Art Lundahl and named the new installations the photo interpreters identified. The name I initially applied to this new installation, Tyura Tam, was used to brief the director of central intelligence and the president. Once the president had been briefed on an important installation, the name was not changed. It was the practice to derive an installation's place-name from that of the nearest town. The best map available to me was one that had been prepared by Mil-Geo, the geographic component of the Wehrmacht, that showed the town of Tyura Tam at the point where the rail spur diverged into the desert toward the launch pad. Tyura Tam was marked "Bf" (for Bahnhoft) on the map. The spur probably led to a prewar quarry that, in later years, served as the flame bucket for the first launch pad.[3]

Years later, at a meeting at the Smithsonian Institution, Soviet cosmonauts told me that they detested the name Tyura Tam and that it never appeared in Soviet announcements or publications concerning their deep-space and ICBM programs. The Russians continue today to refer to their space center as the Baykonur Cosmodrome—even though Baykonur is some two hundred miles away from the site. I have often wondered why the Soviets did not use the name Tyura Tam to begin with. It may have been the result of their overwhelming penchant for security; or it might have been because in Kazakh, *tyuratam* means "arrow burial ground"—hardly a good name for a missile test center. *Baykonur*, on the other hand, in Kazakh means "the master with the light brown hair." We made a number of briefing boards of the missile test center. Eisenhower was particularly interested in the size of the launch pad.

After the startling announcement of their missile capability the Soviets launched three artificial satellites in quick succession: *Sputnik 1* on October 4, 1957; *Sputnik 2* on November 3, 1957; and *Sputnik 3* on May 15, 1958. In 1959 the Soviets initiated a new phase of rocketry by launching three "cosmic" rockets to the moon. All of their flights were heavily instrumented.[4] The military significance of having an object in space was huge, and it was vital for the United States to learn more about the Soviets' launch site.

A second U-2 mission flown over Tyura Tam on August 28, 1958, achieved nearly vertical coverage of the test center. The images showed only one launch pad (stand). The aperture's diameter measured fifty feet. A missile using that site would be enormous, about twice the size of its American contemporaries—the Atlas and the Titan ICBM. The aperture size raised doubts about whether a missile that large could be successfully deployed for operational purposes. *Sputnik 1* lifted off that launch pad five weeks later. The imagery was impressive enough, but Lundahl called on his friends at the Naval Photographic Intelligence Center, who used measurements the PIC's photogrammetrists provided to create a model of the missile center that pleased both Bissell and Eisenhower. A detailed report of the test center was also published. It was not until the Paris Air Show in 1967 that the Soviets exhibited their ICBM and space booster—the SS-6 Sapwood—publicly. It was indeed a huge missile, weighing more than 280 tons. The four conical multichambered boosters strapped to a sustainer confirmed our earlier hypotheses that the missile's size would make it difficult for deployment in either a soft or silo configuration. The Soviets would construct four launch pads for the SS-6 at the Plesetsk Missile and Space Center, which we would see on satellite photography.[5]

Photo interpreters looked everywhere for a gantry crane, similar to those used in the United States, to position and service the Soviet missile on the pad. Missile experts said there had to be a gantry. John Rooney, the PIC's missile specialist, searched the images again and again but could not find one. When the Soviets began launching astronauts, we carefully analyzed photos of astronauts walking up to a platform but could not figure out how they entered the spacecraft. Years later, with better coverage, we were able to discern four large missile-servicing arms. The missile and warhead were mated horizontally and moved to the launch pad, and a hydraulically operated strongback lifted the missile to a vertical position. Servicing and bracing arms were then raised to the erected missile. On one of the arms were various working levels. Crew members climbed up steps and boarded an elevator that took them to one of the levels to enter the spacecraft.

Intelligence indicating that Soviet installations on the Kamchatka Peninsula were monitoring ICBMs fired from the Tyura Tam Missile Center that were impacting in the Klyuchi area brought new concern that the Soviets might be ahead in developing an ABM program. Eisenhower approved a U-2 mission on May 6, 1957, that was flown on June 8 from Eielson AFB near Fairbanks, Alaska. It was intended to fly over the Chukchi and Kamchatka peninsulas to the Klyuchi impact area, but bad weather prevented the overflight. A second attempt on June 20 was marred because of a camera malfunction. The weather cleared on September 16, and another flight photographed the impact area. The fact that no ABM radars were seen in the impact area brought a sigh of relief that the Soviets had not progressed to an anti-ICBM system. Although we found several small radars, they were of the tracking variety and mainly for informing officials at Tyura Tam where their missiles had impacted. Nor could we find any missile impact craters. Later, with better coverage, we would clearly see the long elliptical scars made by the impacting missiles. These scars were plotted and later correlated with launches from Tyura Tam by the CIA's Office of Scientific Intelligence.

The Soviets had detected the U-2 mission as it approached Provideniya on the Chukchi Peninsula and scrambled four MiGs to intercept it. The CIA prepared a detailed report on the Soviet radar's performance that was correlated with the U-2's flight path.

Vozrozhdeniya Island

The August 5 U-2 mission that photographed Tyura Tam covered another high-priority target on Vozrozhdeniya Island—the Soviet Union's primary biological and chemical proving ground. Vozrozhdeniya is an arid island in the Aral Sea. We knew from wartime German intelligence that biological weapons had been tested on the island in the 1930s. In the 1950s the island was again involved in biological and chemical weapons research and testing. We would learn from successive missions that testing was done primarily during the summer. Lundahl made it clear that interpreters were to report only what they saw; they were not to extrapolate what it might mean in actual production of chemical and biological weapons. They saw quite a lot.

The transports carrying people and animals to the island left from the port of Aralsk and ended at the port of Kantubek on the island. Kantubek village contained housing, warehouses, schools, a park, a power station, and a playground. There was also a small airfield on the island. A few miles from Kantubek was a large enclosed complex with stables, warehouses, sheds, and several large laboratories. A number of military vehicles, including tanks, showed up on the photos. Numerous trails led from the enclosed complex to test areas farther inland. In one area were posts spaced at intervals where animals were tethered for tests. At another area were long lines of railings with feed troughs. A large tower was at the highest point on the island. The site was similar in a number of ways to the U.S. Chemical and Biological Test Site at Dugway, Utah. Gordon Heath wrote a detailed report on our findings. After seeing what the Soviets were up to, the U.S. Army Chemical Warfare Service began to clamor for additional funds.

Kapustin Yar Missile Test Center

The CIA became aware of the Kapustin Yar Missile Test Center in the late 1940s, when former POWs who had worked on reconstructing Stalingrad gave convincing evidence that a missile test center was located about seventy miles southeast of that city. Prisoners who had worked on the rooftops of the war-destroyed buildings reported seeing a fiery trail arching in the sky and trails leading high up into the sky, evidence that both surface-to-air and surface-to-surface missiles were being tested.

American, British, and Canadian intelligence officers met each year to share information on Soviet missile developments. I was a member of the group, and I had compiled an extensive report of German POWs' missile observations from Stalingrad. We knew, for example, that a V-2 train captured by the Russians in Germany had gone to Kapustin Yar, and that captured V-2s were launched from there in late October 1947. Peenemünde, the principal German rocket research center, was in the Soviet Zone of Germany after the war, and Russian scientific personnel had gathered all the missile equipment and transferred it to Kapustin Yar. The U.S. Air Force established large ultra-high-frequency radar at Diyarbakīr in eastern Turkey that became operational in June 1957. The radar detected a number of missile launches and tracked the flight of a missile with a range in excess of one thousand miles that landed near Lake Balkhash. Although these medium- and intermediate-range guided missiles were no threat to the continental United States, they did pose a threat to NATO countries and U.S. forces deployed in Europe and Asia.

Considerable pressure was exerted on Eisenhower to approve a U-2 mission over the missile complex. He agreed, and the mission was flown on September 10, 1957. The intelligence gleaned showed that the missile-testing complex was a beehive of activity. A large area was devoted to testing the SS-3 Shyster short-range ballistic missile (SRBM), the SS-4 Sandal medium-range ballistic missile (MRBM), and the SS-5 Skean intermediate-range ballistic missile (IRBM). There was also an enormous tent encampment. Near the tents was a large firing and training area for SA-1, SA-2, and SA-3 missiles. Vladimirovka Airfield, south of the missile test range, contained air-to-air and air-to-ground missile handling facilities and a cruise missile test area. One of the U-2 images showed an air-to-surface missile being loaded onto a bomber.

The intelligence community had known for some time that the Soviets were test-firing a new surface-to-air missile. The big questions were its range and when it would be deployed. It was given the designation SA-2 and the NATO code name "Guideline." Obviously, the SA-2 had to be considered a threat to our U-2s. When an SA-2 was paraded through the streets of Moscow on November 7, 1957, attachés at the U.S. embassy obtained excellent photographs of it. The missile was nine feet long and had two stages—a solid-fuel booster and a liquid-fuel sustainer to boost its 386-pound warhead. Its maximum altitude was not known, but it was determined to have a slant range of twenty-five nautical miles. Construction of SA-2 sites was first noted around Moscow, and the first site outside the Soviet Union was detected at Glau in East Germany. British (BRIXMAS) forces in West Germany obtained good-quality ground photographs of the site. Located southwest of Berlin, it consisted of six launchers in a Star of David pattern. The site had high security and was later partially camouflaged. The acquisition radar was given the name "Spoon Rest" and the guidance radar the name "Fan Song." Within months we began to see SA-2s deployed at a number of strategic sites in the Soviet Union. First we would see site preparations, then missiles on launchers. Gen. James Doolittle and others saw these sites and the Soviets' new fighter jets as a growing threat to U-2 operations. In a conversation with Lundahl, Doolittle said that the Soviets in a desperate situation might use an atomic warhead on one of their SA-2 missiles or an advanced air-to-air missile to down a U-2. (Doolittle was aware that the United States had had an air-to-air atomic missile for some time.)

Sary Shagan Missile Test Center

The firing of missiles from Kapustin Yar to impacts in the Lake Balkhash area indicated possible antimissile activity in the area. We did not know precisely where the activity was located, however, only that it was in the vicinity of Lake Balkhash. Sary Shagan became a prime target for U-2 intelligence collection, and Eisenhower approved an overflight. On August 21, on a mission to the Semipalatinsk Nuclear Proving Ground, U-2 pilot Sammy Snyder flew a search pattern over the area near Lake Balkhash, flying back and forth so that the photographs from each pass overlapped. When we analyzed the images, we were surprised to find a very large antimissile test station at Sary Shagan east of Kapustin Yar. The station, the size of New Jersey, was replete with all kinds of trails, cable lines, and instrumentation sites. We were looking for parabolic antennas and instead found a large installation more than nine hundred feet long and fifty feet wide. John Parash, the initial photo interpreter, thought it looked like a long hen house, and it was subsequently labeled the "Hen House" radar. U-2 photographs taken on April 9, 1960, revealed a second large radar, named the "Hen Roost," that consisted of two antennas separated by a half-mile; each antenna was five hundred feet long and sixty-five feet high. The two radars were judged to be for target acquisition and target tracking. A unique series of interconnected lines on poles sighted later was given the name "Hen Nest." The location of these radars near the Lake Balkhash impact area had a startling effect on the intelligence community. Photo interpreters spent many hours preparing a detailed report on all the facilities at Sary Shagan, and interpreters were still finding new instrumentation sites years later.

Sary Shagan was the USSR's major research and development center for antimissile, and later ABM, defenses. Because Moscow was the first city defended by such a system, developments around Moscow were painstakingly analyzed and compared with activities at Sary Shagan. Mitch Cwiek, the principal analyst for Sary Shagan, used acetate overlays to make the comparisons. Using U-2 and, later, satellite photography (beginning in 1960), he produced a detailed report showing that an ABM system was being deployed around Moscow.[6] We later learned that four tests with nuclear warheads were conducted several hundred miles above the earth at missiles fired from Kapustin Yar toward Sary Shagan.

The big task was to determine the carrier frequency and structure of the large radars at Sary Shagan. It was done in a novel way: by intercepting signals after they had been reflected from the moon. Bud Wheelon, the deputy director for science and technology, related in an article published in 2005 that "the U.S. Navy made the first successful intercept of the Hen House signal in January 1964, when the moon was in the correct position to reflect a signal from Sary Shagan to the 150-foot Naval Research Laboratory antenna in Maryland. The CIA conducted a similar program using the 150-foot radio astronomy telescope at Stanford University."[7] A sixty-foot RCA radar antenna near Morristown, New Jersey, that was pointed toward the moon determined the precise locations of all the Soviet radar installations.[8] William O. Baker reported that the U.S. Navy had also acquired radar reflections from the moon and planned to use another such antenna to intercept SIGINT signals reflected off the moon.[9] The Soviets began building large Hen House-type phased array detection and tracking radars in the 1970s; by the 1980s nine were in varying stages of construction on the periphery of the USSR.

The Semipalatinsk Nuclear Weapons Test Center

U-2 missions produced a lot of information on Soviet nuclear activities. Henry "Hank" Lowenhaupt in the CIA's Office of Scientific Intelligence was, in my opinion, the best analytical nuclear intelligence officer in the nation. He had graduated with a Ph.D. in chemistry from Yale in 1943 and was immediately drafted into the Army. He was shipped to Georgia, where he went through basic training for eight weeks, until the Army realized his potential and sent him to the Pentagon to serve on the Manhattan Project under Gen. Leslie Groves. Hank joined the Central Intelligence Group, the predecessor of the Central Intelligence Agency, in 1946 and became the ranking expert on Soviet nuclear installations. When people at the highest levels of the U.S. government became concerned that the Soviets were trying to create an atomic bomb, the Joint Nuclear Atomic Energy Intelligence Committee (JNAEC) was formed on December 31, 1947. The committee would speak with one voice on nuclear issues relating to the Soviet Union, and Hank was one of its foremost leaders.

The Soviets' first plutonium bomb, tested on August 29, 1949, had a yield approximating that used at Hiroshima. The CIA was caught completely by surprise. Admiral R. H. Hillenkoetter, the director at the time, had postulated that "the earliest possible date by which the USSR might be expected to produce an atom bomb is mid-1950 and the most probable date is mid-1953."[10] The intelligence community had little knowledge of the details of the event or where the weapon had been produced. The first test was named "Joe 1" (after Joseph Stalin), and following tests would retain the Joe prefix. A CIA commentator wrote in 1953 that "reliable intelligence" of Soviet long-range plans and intentions regarding nuclear weapons was "practically non-existent," and "little improvement can be expected in the near future."[11]

Lowenhaupt came down to the Industrial Register at the CIA and told us the test had been conducted somewhere near the northern part of the Caspian Sea. We searched thousands of documents and could not find any indication of a test facility there. A few weeks later he asked us to search for a test site near Lake Balkhash. While there was an abundance of reports of copper and other mining activity in the area, there was no information indicative of a nuclear test area.

After a careful analysis of seismic and acoustic data, Lowenhaupt asked if we had any information on the Semipalatinsk area. We did have some information on the city because the American Armour Company had built a slaughterhouse there for the Soviets during the 1930s and there were some primitive maps of the area. We had some photographs of the city and the Semipalatinsk fortress where Dostoyevsky had served in the Siberian Regiment's Seventh Line Battalion after serving time in an Omsk prison. Through a variety of sources, including further seismic information from tests, the test area was determined to be about 100 miles northwest of the city of Semipalatinsk in a vast arid area, but its precise geographical coordinates were not known. For cover reasons, Soviet atmospheric and underground test areas were referred to as Mountain Seismic Station, Object 905, Semipalatinsk 21, the Polygon, and still later as Training Ground No. 2.

William O. Baker, who worked on science projects for both President Truman and President Eisenhower, recalled in a subsequent interview that "neither President Truman nor Dr. Buckley [Oliver Buckley, Truman's science adviser] had any very clear convictions about what they should do."[12] According to Baker, Dean Acheson had formed a small group called Project 18 that met and prepared a report on Soviet atomic activities. There was indeed cause for alarm. "On the basis of what we knew about the Soviets, about their whole technical base, about their whole industrial capabilities, about their atomic bomb and particle physics alike," Baker said, "we asked: how soon are they going to get the hydrogen bomb?"[13]

America's first thermonuclear device, "Mike," was exploded on November 1, 1952, at Eniwetok atoll in the Pacific. The weapon weighed 60 metric tons. On August 12, 1953, the Soviets tested a nuclear device using lithium deuteride at the Semipalatinsk Atomic Proving Ground. It was a technological breakthrough. Although twenty times smaller than Mike, the device yielded about 400 kilotons.

The Soviets detonated a medium-yield (later determined to be in the 20–40-kiloton range) bomb on September 14, 1954, near the village of Totskoye in the Urals, about 120 miles southeast of Kuybyshev and some 600 miles southeast of Moscow. On November 20, 1955, the Soviets tested a thermonuclear weapon, dropped from a Tu-16 bomber, with a yield of 1.6 megatons.

The Totskoye test surprised the U.S. intelligence community because it was not conducted in a desert or arid region; a number of towns and villages were in the immediate area. Lowenhaupt rushed in to ask if we had any information on the area; we did not. Lowenhaupt doubted that Totskoye would become a second proving ground; more likely it was a military exercise with a nuclear detonation. Later satellite images of the area showed little because the blast was an airburst. We could, however, make out areas where thousands of troops had been billeted in tents, and tracks left by tanks and other armored vehicles.

The tests at Semipalatinsk made that spot a prime intelligence target, and Eisenhower gave permission for U-2 overflights of the area. Sammy Snyder overflew part of the site along the river on August 21, 1957, on his way to the Tomsk Atomic Energy Complex. Jim Charbonneaux precisely overflew the area on August 22 and captured most of the atmospheric test area on one frame of photography. Charbonneaux had flown over the U.S. nuclear proving ground at Frenchman's Flat near Las Vegas and immediately recognized what he saw and what he was about to image. Photo interpreters Chris Dole and Joe Seng analyzed the spectacular photos and could see the effects of a tower-detonated nuclear weapon. A number of revetments were in the large blackened area, and various pieces of military equipment were scattered about. A plethora of cable scars led to a control center. Also visible were three large airdrop markers, one of which showed the effects of a recent test. Another airdrop marker had been enhanced for an upcoming test. Later, while he was a training officer assigned to the NPIC, Charbonneaux told me that he had prayed that the Soviets would not detonate a weapon while he was over the target in his fragile U-2. A mere four hours after his flight, Joe-36 was airdropped and detonated. Its yield was half a megaton. Charbonneaux had also photographed the bomber on the ground at Semipalatinsk Airfield that would shortly drop Joe-36. On a shot tower was a nuclear weapon "cab" for the low-yield device that was detonated on September 13. We also identified a military garrison along the banks of the Irtysh River some fifty miles east of the test site that would later be known as Moscow-400. The garrison housed not only military personnel but also the scientific and technical personnel required for the tests. We prepared a number of mission highlight briefing boards that were shown to President Eisenhower.

The Semipalatinsk test site would be the subject of countless NPIC reports. We determined that tests were conducted in four distinct areas there: the atmospheric test area, Shagan River (shafts), Degelen Mountain (tunnels), and Konystan (shafts). Years later, photo interpreters Nancy Clifford, Jim Richey, and Bill Mugford—as civilians—would visit these sites.

With the advent of thermonuclear bombs, the Soviets needed a site for detonating large-yield weapons. Novaya Zemlya, in the Soviet Arctic, consisted of two large islands—Northern and Southern—divided by Matochkin Shar. SAC reconnaissance planes operating out of Thule, Greenland, during the 1950s overflew and photographed the island. Most of the missions were flown in the winter when the island was covered by snow. Only two inhabited areas were seen. In 1955 the Soviets detonated three nuclear devices on Novaya Zemlya, but the one that got the most attention was a superbomb with a yield of approximately fifty-eight megatons. Satellite imagery showed little evidence of the detonations because most were either airburst, underwater, or underground. We did locate all of the support facilities and living quarters. Adits for the underground testing were later spotted being dug in the mountains.

Tomsk Atomic Energy Complex

The Tomsk Atomic Energy Complex was on a rail line north of the Trans-Siberian Railroad where attachés were forbidden to travel. Information from German POWs helped to pinpoint the nuclear installation. They reported that villagers had referred to an "Atomsk" near the Tomsk railroad station. Another POW reported seeing a large industrial installation near the city, and another reported that thousands of penal laborers worked there. A POW tailor was told by his Soviet supervisor that some of his customers were officers at the plant. After the tailor was repatriated, his fur hat was tested and found to contain uranium residue that possibly came from fallout or a reactor. The Tomsk area became a prime target for a U-2 mission. Lowenhaupt captured the intrigue of selecting the target in his paper "Mission to Birch Woods."[14]

This was not the first time Tomsk had been considered for a mission. Back in 1949 Lowenhaupt had persuaded the Air Force member of the Joint Atomic Intelligence Committee to seek permission to fly a B-25 from Iran over the Urals to

Tomsk and then ditch the aircraft in the Barents Sea, with the Navy rescuing the pilot. On December 30, 1949, Secretary of State Dean Acheson denied his request.

Eisenhower did give permission to fly over the Tomsk Atomic Energy Complex, which the Soviets referred to as Tomsk Post Office Box 5, Tomsk-7, and the Siberian Chemical Combine. On August 20, 1957, Sammy Snyder flew his U-2 over a portion of the Semipalatinsk Nuclear Proving Ground and headed for Tomsk. The images he obtained of the complex were spectacular. Dick Kroeck was assigned to interpret them. The complex was right in the center of the photographic frame. We identified one completed plutonium production reactor with an associated tall stack, cooling towers, and an irradiated fuel-handling structure on the south side of the complex. Vapor plumes from one of the cooling towers indicated that the reactor was operational. A reactor building and associated turbine hall, containing a dual-purpose reactor designed to produce both plutonium and electric power, was under construction on the northern side of the complex. A large excavation for a second dual-purpose reactor was being dug at the extreme northern end of the complex. The complex also included a chemical-processing facility and a nearly complete gaseous diffusion plant, with another under construction, as well as water treatment facilities, fuel rod assembly facilities, a large thermal power plant, a transformer substation, and many smaller structures. Nearby was a large group of apartment complexes. Heavy security in the form of multiple fences was evident about the various production sections and around the complex. I called Lowenhaupt at the Office of Scientific Intelligence when we received the photos and he rushed over. He looked at the duplicate positive on the light table and then stared at the ceiling, enraptured. He looked back down and moved the stereoscope around the light table in disbelief. We had photographed the first atomic energy complex in the Soviet Union. When Allen Dulles was told of the success of the mission, he said, "You mean you really did know that something atomic was going on way out there in the wilds of Siberia."[15]

We made a series of briefing boards of the complex, and with help from Lowenhaupt and Kroeck I prepared the notes that accompanied the boards. There was so much information in those few photos that our study was just beginning. Photogrammetrists Chris Mares and John Cain conducted detailed mensuration of all the buildings. Dick Kroeck, Hank Lowenhaupt, and Wallace F. Howard prepared a detailed report on the installation.[16]

At the 1958 Second Conference on Peaceful Uses of Atomic Energy in Geneva, the Soviets showed a photograph of an "atomic power station somewhere in

Siberia." They also showed a film of the exterior and interior of a reactor that was surreptitiously photographed by a member of the U.S. delegation. Lowenhaupt brought the photo of an "atomic power station somewhere in Siberia" over to the NPIC along with the photos taken of the film. Chris Mares was able to get dimensions on the size of the reactor and the size of the reactor blocks containing the fuel rods. There was no longer doubt that the photos of "an atomic power station somewhere in Siberia" were of the Tomsk reactor. NPIC personnel prepared a brief on the findings.[17]

Kyshtym Atomic Energy Complex

The Kyshtym Atomic Energy Complex was considered even more important than the Tomsk complex. The town of Kyshtym (also known as Teca and Ozersk) consisted of a copper refinery and an electrode plant that produced purified graphite. The U.S. intelligence community became interested in Kyshtym in 1945 when a massive project involving thousands of slave laborers began. Former POWs provided information that the facility under construction was for atomic purposes. The Kyshtym Atomic Energy Complex, known by the Soviets as Chelyabinsk 40, Chelyabinsk 65, and Plant No. 817, was situated about forty miles northwest of Chelyabinsk on the shore of Lake Kyzyl-Tash. When it became known that leading Soviet chemists and physicists were stationed there, the complex became even more worthy of attention. Of special interest was a Soviet scientist—then relatively unknown in the West—named Igor Vasilyevich Kurchatov, who was later identified as one of the leading scientists in the Soviet nuclear program. In 1949 the Joint Nuclear Energy Intelligence Committee reported, "Present information indicates that a plutonium project for the production of fissionable materials is being developed. It is reasonable to suppose that the Soviets have had at least one low-energy pile (probably graphite) operating for a year or more although no incontrovertible evidence exists."[18] But the CIA's expert, Hank Lowenhaupt, had little doubt that the Kyshtym plant would produce plutonium in the reactor and convert it to plutonium metal for nuclear purposes.

When the Soviets had detonated an atomic device on August 29, 1949, there had been an immediate demand for detailed information on Kyshtym—the source of plutonium for the device. Intelligence from former POWs and other sources indicated that Kyshtym had been part of Kyshtym Estates and that copper and kaolin had been mined and processed there. Lowenhaupt discovered that

President Herbert Hoover, as a partner in a British mining firm in the 1900s, had visited and overseen many of Kyshtym's mining operations, including the copper mines and a refinery the firm owned in the area. Lowenhaupt asked that the Hoover Collection at Stanford University be searched for information on the site. Hoover's papers included documents related to the Kyshtym copper mines and a large, detailed map of the entire Kyshtym area.[19] For targeting purposes, the Kyshtym Nuclear Energy Complex was pinpointed on Hoover's map as being on the shore of Lake Kyzyl-Tash. It immediately became SAC's highest-priority target.

Reports and rumors in Moscow that a nuclear accident had occurred at the Kyshtym complex in 1957 or 1958 that had forced the evacuation of thousands of people heightened our interest in the site. At first it was thought that a reactor had malfunctioned. When we saw the complex on satellite photography some five years later, we could see there had been an accident but could not determine where it had occurred. It was not in the reactor area. We did find a large new berm south of the chemical reprocessing area where a new double security fence had been installed. Considerable earth-moving activity was observed in several areas of the complex. A berm had also been constructed at Lake Karachay, where tons of radioactive waste had been dumped. We prepared a detailed report of accident-related activity for the intelligence community. The Soviets later admitted that radioactive wastes from the plutonium plant stored in stainless steel and concrete tanks had exploded in 1957, showering some seventy square miles with dangerous radioactive particles.[20] Kyshtym was a prime target on another U-2 mission, but the entire complex was covered by clouds. And it was a prime target on Gary Powers' ill-fated flight on May 1, 1960.

Satellite images obtained in 1964 allowed interpreters to determine the functions of the various facilities at the Kyshtym complex. They consisted of three separate reactor areas (I, II, and III); a chemical processing area; the Tatysh production area south of areas I, II, and III; and integrated water treatment and power facilities.[21]

Kola Peninsula Flight

While the Air Force and the Army were getting their high-priority targets covered by U-2 missions, the Navy was not—and its representatives were getting increasingly hard to live with at the Ad Hoc Requirements Committee meetings chaired by James Reber. Intelligence on the construction and basing of Soviet submarines was of the highest priority to the Navy, which listed submarine production yards at Leningrad, Gorki, Komsomolsk, and Nikolayevsk as targets. The Navy particularly wanted photos of the large shipyard north of the Arctic Circle at Severodvinsk, which was building ballistic missile-firing submarines. The other yards were producing large numbers of Whiskey-class (W) and Zulu-class (Z) submarines, the Whiskey's successor. The Navy kept pressing for coverage of the Northern Fleet bases in the Murmansk area and the large naval base at Petropavlovsk in the Soviet Far East, hoping that Murmansk and Severodvinsk could be photographed on one mission.

The Severodvinsk submarine shipyard was beyond the range of a U-2 flying from Giebelstadt to Murmansk, even with "slipper" tanks on the wings. At the urging of the Navy, Eisenhower authorized the Murmansk flight, which was flown on October 13, 1957, and covered the naval bases at Polyarny, Sada Guba, Olenyya Guba, Severomorsk, and Murmansk. Submarines were seen only at the Polyarny base. We counted one F-class submarine, eight W-class subs, and one Z-class sub there. All were diesel powered. A Don-class submarine tender and two Bolva barracks ships were also seen. On the basis of that information, Navy experts concluded that the Northern Sea Fleet was essentially a defensive one. Its prey would be U.S. naval task forces entering the fleet's home waters or the nearby Baltic Sea. The mission yielded a precise, up-to-date naval order of battle of the Northern Sea Fleet. At Severomorsk, the fleet's headquarters, we saw a heavily secured area that was presumed to be the first naval nuclear weapons storage site we had observed. At Murmansk naval and port bases we identified a variety of vessels belonging to the Northern Sea Fleet along with commercial, fishing, scientific, and ice-breaking vessels. Photography of good interpretability was also obtained of MiG fighter bases, along with the disposition of Barlock radars and Soviet air defenses on the Kola Peninsula. The Soviets scrambled MiG-19s and MiG-21s in an attempt to down the U-2. Analysis of the photography revealed MiG contrails, and the U-2 photographed one of the MiG-19s flying beneath it.

The Norwegians scrambled their fighters as the U-2 penetrated their airspace because the CIA had not asked permission to overfly Norwegian territory. From a variety of sources the Norwegians quickly deduced that the U-2 had overflown Murmansk. The head of the Norwegian intelligence service, who had been friendly with the CIA, demanded copies of the images of Murmansk and the

Kola Peninsula. Bissell called Lundahl and asked if some of the photos could be shared. He wanted to remain on good terms with the Norwegians because he was thinking of using Bodo, Norway, as a future U-2 base. Lundahl asked Bissell to have the Norwegians list their targets of interest and then sent Sid Stallings, his special assistant, to Norway with the photos. Stallings taught Norwegian photo interpreters how to interpret the U-2 photos and provided them with copies of the photo interpretation keys we had prepared on submarines, aircraft, and radar stations. He stayed in Norway to help not only with the interpretation effort but also with the preparation of Norwegian photo interpretation reports, which he brought back. The reports made no mention of the U-2 imagery; they were written as if the Norwegians had overflown the area. Stallings gave me copies of the reports, and I entered them into the NPIC database.

We had made a series of briefing boards on the success of Soft Touch missions, and on August 23, 1957, Deputy Director Charles P. Cabell, Richard Bissell, and Air Force chief of staff Nathan Twining met with President Eisenhower to report on the success of the missions and to show him the boards. Eisenhower was pleased about the success of Soft Touch but disturbed that the Soviets had tracked the flights. He was told that Soviet pilots in MiG-21s had tried zoom climbs—diving their aircraft to gain speed and then pulling up into a nearly vertical climb—to reach the U-2. All an alert U-2 pilot had to do was maneuver to one side or the other of the attacking plane, leaving the Soviet pilot hanging in midair with little or no control of his plane. The photos showed a number of MiG-21 aircraft carrying air-to-air missiles attempting zoom climbs to down the U-2. The closest a MiG ever came to intercepting a U-2 was near Chirchik in Kazakhstan. A MiG-21 almost reached the U-2's altitude but was off to the side.

Bissell asked Eisenhower to approve two repeat flights: one to the Dodonovo reactors (Krasnoyarsk 26) and the other to the gaseous diffusion plant (Combine 820) at Angarsk near Irkutsk. The intelligence community also wanted to learn more about what was happening at Irkutsk Aircraft Plant No. 39. On August 4, 1957, a U-2 had flown undetected from Lahore toward Irkutsk over the Kara Kum and Gobi deserts, but the pilot encountered bad weather and turned back. The mission was rescheduled for August 5 but was canceled shortly after takeoff when technical problems developed. Eisenhower denied both requests. Knowing that the U-2s at Giebelstadt were scheduled to go back to Adana, Bissell asked the president to allow a U-2 to fly from Giebelstadt over the Soviet Union to Adana.

The president replied that he did not wish to conduct any further overflights of the Soviet Union. While we had coverage of the Soviets' three main missile test centers—Tyura Tam, Kapustin Yar, and Sary Shagan—we had yet to find a site that actually deployed an MRBM, IRBM, or ICBM.

Eisenhower was increasingly displeased with the intelligence estimates the military services were providing on the Soviet Union, because data from the nine U-2 missions indicated that many of them were wrong. Wanting an impartial look at the information gleaned from the missions, Eisenhower asked his science adviser, Dr. George B. Kistiakowsky, to form a panel of experts to compare the USSR's strategic capabilities with those of the United States. Under Project Jam Session, twenty-six U.S. experts on nuclear and missile technology met at the Photographic Interpretation Division in September 1957. Such experts as Wernher von Braun, Gen. John B. Medaris, Clark Millikan, William Pickering, Simon Ramo, Herbert York, and the heads of laboratories from major U.S. weapons development laboratories were briefed and took part in the exercise. Two future CIA deputy directors for science and technology—Albert D. Wheelon of the Ramo Woolridge Corporation and Carl E. Duckett of the U.S. Army's Ballistic Missile Agency—were also among the group. Wheelon and Duckett would play important roles during the Cuban Missile Crisis.

The experts met and deliberated for three weeks in "the room" at the PIC. Lundahl gave them free rein to speak to anyone at the center and had hundreds of enlargements of U-2 photos made for their use, along with drawings and stereograms of Soviet missile, nuclear, aircraft, and biological and chemical installations. If there were questions as to dimensions, sizes, and shapes, the center was ready to conduct any photogrammetric analysis the group wanted. I was placed in charge of the logistics requirements, message center, and physical comfort of the experts while they were at the center. I was especially impressed with Dr. Pickering of the Jet Propulsion Laboratory of the California Institute of Technology, who soon became the dynamic leader of the group. His extensive knowledge of U.S. weapons systems proved extremely useful for the comparisons with Soviet installations. Kistiakowsky, a true gentleman with a sly wit, sat at a table and perused every briefing board we had made for the experts. After nearly a month of effort the panel issued its report: The United States was ahead of the Soviet Union not only in weapons research but also in the deployment of strategic weapons. Pickering was rather emphatic in asserting that the Soviets could not compare with the United States in such endeavors, even though the U.S. military services—

especially the Air Force—repeatedly claimed the opposite in yearly budget battles. "We went looking for a body," Kistiakowsky said, "but only found a skeleton."[22] If Eisenhower had allowed further U-2 missions, we might have solved the "missile gap" debate back in 1957. But the flights remained in hiatus for more than a year and a half.

The rancor between the United States and Britain over the Suez War had passed by now, and the intelligence organizations had settled down again to a good working relationship. President Eisenhower was enjoying good relations with Prime Minister Harold Macmillan and decided that both the prime minister and Chancellor Adenauer of West Germany should be briefed on the results of Operation Soft Touch. Lundahl and Hans "Dutch" Scheufele were selected to conduct the briefings. They went first to London and were driven to Whitehall, where the prime minister and his air marshal were waiting. Lundahl later said that the briefing was well under way when Macmillan "got up . . . and walked to the window to adjust the Venetian blinds, and with a slight wink said, 'We can't be too careful. Lenses are so good these days.'"[23] The prime minister and air marshal were clearly pleased with the results of the U-2 operations and the update, and Macmillan said he would send his personal thanks to President Eisenhower.

Lundahl and Scheufele flew from London to Frankfurt. They were driven to a construction site in Bonn and met by CIA official Seymour Bolton, who carried a roll of blueprints in his hand. When Lundahl asked why the blueprints, Bolton said it was to confuse East German spies. After exchanging cars along the way, the men arrived at the chancellor's office and were met by David K. E. Bruce, the U.S. ambassador to West Germany, and John Bross, a senior Agency official. Ushered into the chancellor's office, they were greeted by the chancellor and Reinhard Gehlen, chief of the West German Federal Intelligence Agency. Lundahl later said that Gehlen let the chancellor conduct the briefing. Lundahl "showed the chancellor one briefing board after another on the whole gamut of Soviet strategic weapons and targets." Lundahl added that the chancellor displayed a stoic face as he listened to the briefing, obviously pondering the subject matter. He looked at the U-2 photographs carefully and seemed not to believe what he was seeing. Several times he asked his translator or Scheufele to elaborate on the terms Lundahl was using. He was so impressed with the quality of one of the briefing boards that he shook his head in disbelief and exclaimed: "*Fabelhaft! Fabelhaft!*" (fabulous! fabulous!). About this time, Adenauer's secretary entered and said that Senator Estes Kefauver from Tennessee was waiting. The chancellor asked if the senator could join in the briefing. Bross said no, the senator was not cleared. The chancellor smiled broadly.

The briefing continued, with Lundahl and the chancellor discussing the use of subways for civil defense centers, until the secretary entered again to end the briefing. Lundahl and company were ushered out a different door so they would not encounter Kefauver. When Lundahl told Allen Dulles about the Adenauer briefing, the DCI laughed uproariously at "*Fabelhaft! Fabelhaft!*" Successful intelligence briefings and presentations in Germany were subsequently characterized in station cables to CIA headquarters by the single word "*fabelhaft*." Other intelligence officers adopted Adenauer's laconic approach. When CIA headquarters queried the Bonn station requesting permission for a group of intelligence officers to visit West Germany, for instance, the reply was a terse: "*Keine schwitze*." Consulting their German dictionaries, headquarters personnel were relieved to learn that *keine schwitze* simply means "no sweat."

After meeting with Prime Minister Robert Menzies of Australia, Eisenhower asked the CIA to brief Menzies on the Automat program. The presentation was conducted in Allen Dulles' office in the CIA's Central Building. Dulles beamed with pride as Lundahl briefed the prime minister, who was astounded by the progress that had been made in aerial reconnaissance. After expressing his thanks, the prime minister offered any help his government could provide in the endeavor. Dulles said he would keep that in mind.

Sputnik

The International Geophysical Year (IGY) commenced with several nations launching a number of scientific missiles. The Soviets put on a spectacular display of rocketry. Articles on Soviet and Soviet bloc missile launch activities were carefully collected, translated, and published weekly by the U.S. Department of Commerce under the title "Information on Soviet Bloc International Geophysical Cooperation." The United States attempted four highly publicized test flights of the intermediate-range Thor missile on January 25, April 19, May 21, and August 30, 1957. All ended in failure. A test flight of the Atlas ICBM on June 11 also ended in failure. The initial Soviet ICBM test and subsequent launches convinced the intelligence community that the Soviets had broken through with their ICBM program and were ready to deploy a substantial number of ICBMs.

William O. Baker remembered that the president and the TCP were expecting the Soviets to do "something unexpected and fairly ominous—they weren't quite sure what."[24] The unexpected event would be Sputnik. On October 4, 1957, America was shocked when the Soviets announced the successful orbit of the earth by the world's first artificial earth satellite, *Sputnik 1*. The satellite circled the globe every ninety-six minutes, emitting an eerie radio signal. That "beep-beep" had an enormous impact on the U.S. media. The Soviets' impressive feat brought an avalanche of public criticism, not only of U.S. space efforts, but also of the American educational establishment and the nation's scientific priorities. Killian would write that Sputnik created a crisis of confidence that swept the country like a windblown forest fire. Edward Teller claimed that the United States had lost a battle more important than Pearl Harbor.

On November 3 the Soviets launched their second satellite, an impressive spacecraft that carried a dog named Laika. Criticism of U.S. scientific efforts intensified, and Eisenhower was again criticized for moving too slowly and doing too little. The launches seemed to supply irrefutable evidence that the Soviets had surpassed the United States in ballistic missile technology. Newspapers on November 7 carried Khrushchev's boast that by 1970 the Soviets would surpass the United States in heavy industry and in the production of consumer goods as well. That evening, Eisenhower announced that he would speak to the nation. He later described his problems in preparing what he hoped would be a reassuring talk. "I had made as strong a case for confidence and sane direction as I could. I was hampered, of course, by the fact that I could not reveal secrets, which in themselves would have reassured our people. For example, shortly before this address Foster Dulles in a meeting with Allen Dulles, Goodpaster and me, asked, 'should we disclose tonight that the United States has the capability of photographing the Soviet Union from very high altitudes without interference?' Reluctantly, I decided I could not make such a revelation."[25]

Allen Dulles had made Lundahl aware that his brother, Secretary of State John Foster Dulles, was going to propose that Eisenhower show U-2 photos and said to be prepared if the president accepted the offer. Lundahl called me, and we assembled a set of briefing boards on Soviet installations that included long-range bomber bases, missile test centers, and atomic installations. Later that day, Dulles told Lundahl that the president decided not to show U-2 photos.

Eisenhower addressed the nation that evening on "Science in National Security" and tried to reassure Americans and his critics that the United States had made impressive technological strides.[26] He cited in detail the developments and technological advances made by the Army, Navy, and Air Force; but the key point of the speech, without mentioning the strides being made by the TCP, was the emphasis he placed on the possibilities of modern technology. William Baker thought that the president did something more important than short-term reassurance: "What Eisenhower did in that speech was to outline the role of science and engineering, not only in national security—which, of course, was his first agenda item—but in the whole progress of the country for the next 30 or 40 years."[27]

The firestorm did not subside. Many in the United States, especially the president's critics in Congress, viewed the Soviet space successes as evidence that the Soviet missile and space programs were far ahead of America's. If the Soviets could orbit a satellite, they could reach the United States with missile-borne atomic weapons. Wernher von Braun added fuel to the fire when he said that a missile fired from a satellite would have almost "line of sight" accuracy. President Eisenhower had advanced a "freedom of space" concept for satellites of all nations to overfly the entire globe. The Russians did not seem to object to the idea, and no countries objected to the Sputnik overflight. Eisenhower thus thought that the launch of Sputnik set a precedent for the later flights of U.S. photographic satellites, from which we could learn more about the USSR's military capabilities. The panic created by Sputnik provided a new impetus to the TCP to create a new series of information-gathering satellites. Large sums were allocated, and WS-117L began accepting ideas for satellites that would gather information on the Soviet Union.

Sputnik truly awakened the American public and government to the danger posed by missiles and satellites. Doolittle recalled: "Up to that time, the American public had discounted the progress and capabilities of the Soviets. We had for a long time thought rather disparagingly of the Soviets as, perhaps, agrarians with their shirttails out and whiskers. But we came to realize that they had a very fine technological capability."[28]

The U.S. Navy attempted to launch a Vanguard satellite in December 1957 as a response to Sputnik. The Vanguard rose a few feet above the ground and exploded. The launch, viewed by millions on nationwide television, added to the feeling that the United States had fallen further behind the Soviets in missile technology. As devastating as Sputnik was to American morale, the Vanguard fiasco was even greater. It was a national embarrassment, and Senate Majority Leader Lyndon Johnson was stinging in his criticism.

The U.S. missile and space efforts might have proceeded more quickly had they not resided in various competing military services, their laboratories, and their contractors. Each service immediately began trying to carve out its own role. To counter the publicity that Sputnik was achieving, Wernher von Braun, developer of the Redstone and Jupiter C rockets, declared that placing a satellite in orbit was no big deal and said that he could launch a satellite within sixty days using leftover Jupiter C missiles. Neil McElroy suggested that ninety days would be a more realistic goal. On January 31, 1958, *Explorer 1* became the first American satellite in orbit.

The Army launched its own vigorous proposal for a reconnaissance satellite system. Spurred on by von Braun's team at the Army Ballistic Missile Agency and the Jet Propulsion Laboratory, the Army proposed three configurations with orbital payloads of twenty, one hundred, and five hundred pounds. General Medaris briefed us on the proposal, which involved launching satellites for reconnaissance, electronic intelligence, communications, meteorology, and geodesy. We were primarily interested in those with photo-taking capabilities. The one-hundred-pound payload would be equipped with half-inch vidicom tubes to take a series of photos, and could transmit these to the ground. The five-hundred-pound payload would fly at an altitude of three hundred nautical miles and would also employ vidicom television tubes and a magnetic tape recorder to transmit images to a ground station. Of interest to the CIA was that at each rotation of the satellite, pictures would be taken of a swath ten miles long and up to one hundred miles wide. Overlap, providing stereo, would be achieved on a succeeding pass. The Army maintained it could have the five-hundred-pound photo satellite operational in May 1959. The Army's proposal, however, conflicted with both the Air Force's Samos and the CIA's Corona program; it was rejected.[29]

Seeking expert opinions about U.S. scientific efforts, Eisenhower arranged to meet with fourteen of the country's foremost scientists on October 15, 1957. Three members of the TCP were in attendance: Dr. Killian, Dr. Land, and Dr. James Fisk. Other participants included D. Z. Beckler, L. V. Berkner, H. A. Bethe, D. W. Bronk, C. P. Haskins, A. G. Hill, I. I. Rabi, H. Scoville, A. T. Waterman, J. B. Weisner, and J. R. Zacharias. Notes taken by Eisenhower's aide, Col. Andrew Goodpaster, reported that "the president said that he wanted to have the group in to learn their state of mind and to see what ideas and proposals they might have that they would like to advance. He said he had been reflecting very earnestly on the question of how all of the many scientific activities throughout the government could be best supported."[30] The president asked the group to tell him "just what we have done in the area of science since 1945."[31] He had in mind, of course, what the TCP was considering for future scientific endeavors.

Senator Henry Jackson and Senator Stuart Symington were vocal critics of the president. Jackson claimed that Sputnik was a devastating blow to the prestige of the United States, and Symington warned that the Soviets were gaining superiority in the missile field. Senator Lyndon Johnson opened hearings by the Senate Armed Services Committee on November 25 to review the U.S. defense and space programs. The hearings would be characterized at the White House as the "hogs at the trough." Johnson heaped blame on Eisenhower, charging that the Soviets had beaten Americans at their own game with daring scientific advances. The only member of the TCP to testify was Jimmy Doolittle. He would later relate that the hearing was probably the greatest gathering of the scientific–technological–military-industrial-complex elite ever assembled. Ranking military members—along with presidents or officers of Lockheed, Douglas, Boeing, Chance Vought, Bell, North America, Aerojet General, Hughes, Curtiss Wright, Ramo-Woolridge, the Army Ballistic Missile Agency, and the Jet Propulsion Lab—testified that not enough was being spent or being done to advance America's position relative to that of the Soviet Union.

One of the U.S. experiments during the IGY was to survey the interaction of magnetic fields and charged particles that takes place in the far reaches of the atmosphere. *Explorer I* was intended for that purpose. Under the leadership of Professor James Van Allen of the University of Iowa, the satellite would discover and define the inner and outer radiation belts surrounding the earth that would later be referred to as the Van Allen Belts. The belts posed no danger to humans, but there was some concern as to what effect they would have on film, integrated circuitry, and sensors. One of the side benefits of the IGY was at least tacit international acceptance of the freedom of passage of vehicles operating above the airspace of sovereign lands.

SS-3s in East Germany

During the Cuban Missile Crisis, it was often reported that Cuba was the first country in which the Soviet Union deployed offensive missiles outside its borders. That might not have been the truth. East Germany may have been the first. After the launch of Sputnik, President Eisenhower ordered a speedup in the production of ICBMs. Both the Army and Air Force had developed IRBMs with a range of 1,500 miles—the Jupiter and the Thor, respectively. The slow development of the

Atlas and Titan ICBM, combined with the launch of Sputnik and fear that our troops in Europe were endangered, led some of Eisenhower's advisers to suggest deploying Thor IRBMs in Great Britain. Eisenhower was agreeable but was hesitant to propose the idea directly to Prime Minister Harold Macmillan because there were still anti-American feelings in Britain as a result of the 1956 Suez War. Instead, in January 1957, the proposal was presented to the British defense minister. At the Bermuda conference between Eisenhower and Macmillan, an agreement on the deployment was reached, and the formal U.S.-U.K. agreement was signed on February 22, 1958. Construction of the first site began in May. The first of sixty Thor missiles arrived at the British IRBM squadron at Feltwell RAF Base on September 19. These missiles had a range of 1,600 miles and speed of 12,000 miles per hour. The RAF Bomber Command maintained the missiles. On February 11, 1959, a practice launch was carried out at Feltwell in front of the press.

Khrushchev saw the deployment of Thors in England as a threat to the Soviet Union, and at the next Warsaw Pact meeting held in Moscow warned that Soviet missiles might be based in Eastern Europe as a countermove. At the NATO heads of government meeting in Paris in December 1957, the United States offered Jupiter missiles that would later be deployed in Turkey and Italy. On a trip to Albania, Khrushchev threatened to place missiles in Albania and Bulgaria.

Eisenhower authorized a U-2 mission that was flown over Albania on April 27, 1957. Since Albania was a mountainous country, Lundahl asked that we search every inch of the images for indications of a missile base or new construction activity. Paul Dietz was the branch chief directing the search. His work was so thorough that even flocks of sheep and goats were facetiously plotted on maps—but no missiles.

In August and September 1958, HUMINT reports indicated that the Soviet army's 72nd Engineer Brigade was constructing missile bases near the towns of Vogelsang and Furstenberg-Havel, forty-three and fifty-two miles, respectively, north of Berlin. They immediately became high-priority targets for reconnaissance. In September and October a special covert aircraft with a 100-inch camera captured extensive construction under way at the installation, which became known in NATO circles as Vogelsang 4823. The Furstenberg-Havel area was beyond the range of the camera. At the time, the only missiles in the Soviets' arsenal capable of reaching the Thor bases in England were the SS-3 Shyster MRBM and the SS-6 ICBM. The increasing tensions between East and West were further aggravated when Khrushchev announced that he planned a peace treaty with East Germany.

Additional reconnaissance in 1959 indicated three key structures at Vogelsang and later at Furstenberg-Havel, but no missiles. Communications intelligence indicated that the Soviet 72nd Engineer Brigade, previously recorded as being at Kapustin Yar, the Soviets' main testing site for MRBMs and IRBMs, had indeed been in East Germany. A defector, Col. Oleg Penkovsky, also indicated that there were missile brigades in East Germany. There were reports of rail fuel tankers there as well.

In a Joint Chiefs of Staff presentation before a House committee on January 13, 1960, General Twining reported "indications" of Shyster missiles in East Germany and noted that National Intelligence Estimate 11-4-60 of December 1959 referred to "evidence" that nuclear missiles with a range of seven hundred nautical miles had been deployed in East Germany.[32] The SS-3 deployment may have been a stopgap measure until the Soviets could deploy SS-4 and SS-5 missiles in the western USSR in 1961. I was the division chief responsible for the Warsaw Pact countries. When we received higher-resolution satellite images, a very competent analyst named Charles Tuten showed me photographic evidence that SS-3 missiles had probably been deployed in East Germany for a short period at the sites previously mentioned. We reported this evidence in a classified report. Early in 2000 a German historian found evidence in Russian archives of Soviet deployment of medium-range missiles at two sites in 1959.[33] Tuten, on his own, later visited the two sites, now in Germany, and proved fairly conclusively that indeed the two installations had the capability to launch SS-3s.

Little Rock and Venezuela

The PIC had gained the reputation of having a wealth of aerial photographs and other current intelligence information and of being willing to offer it to anyone in the intelligence community with the appropriate clearance. We had the finest current photographic file of the world in existence, and we could provide a target folder on a possible foe in less than three minutes. Lundahl later recalled that the PIC

> worked hard to impress whoever came to the building or where we sent our materials. We were known all over the world and had the marvelous reputation of being able to call up data quickly. If someone wanted a report or background info, they would call [us]. . . . "You people know where everything is [they would tell us] and . . . get us what we want faster than we can

> get it through our own resources." This was a rather stunning statement . . . but it made us feel good. One time a Marine general visiting [the center] wanted to see how long it would take us to find a map on a given area. We said we have no idea, why don't you try us. So he named a place and within 10 minutes, while he was sitting in my conference room, [he had] all kinds of maps relating to this place—many the general had never seen before.[34]

Two incidents—one domestic and one international—illustrate just how useful the center could be in an emergency situation. On September 4, 1957, black students were to enter Little Rock Central High School for the first time. Governor Orval Faubus, who was dead-set against integration, called out the Arkansas National Guard and placed troops around the school with orders to prevent the black children from entering. A federal judge enjoined Faubus and the Arkansas National Guard from interfering with the integration of Central High. The state and local police were losing control and there was fear that the children could be hurt, perhaps even lynched. The mayor of Little Rock sent a telegram to President Eisenhower asking for federal troops to maintain order. Gen. Maxwell Taylor alerted the 101st Airborne Division to stand by for possible duty in Little Rock. Maj. Gen. John M. Willems, chief of Army Intelligence, called Lundahl and asked if, by chance, a U-2 had overflown Little Rock in one of its training flights. I checked our plot files and found that one had not, but we did have detailed maps of the United States that we used during U-2 test and training flights. Among them were maps of Little Rock, which we sent to Willems. Five hundred troopers of the 101st Airborne were flown in and billeted that afternoon; by evening another five hundred had arrived. The troopers escorted the black students into the school on September 25, 1957. The crisis cooled in Little Rock, although the civil rights movement would generate others over the coming years.

Lundahl likened the White House during this crisis period to a train station, with people running in and out of Eisenhower's office as others waited outside. Lundahl had arrived with Allen Dulles, whose leather briefcase was full of the latest information on the Suez crisis. They waited. A gentleman came in and sat next to them. He also had a large briefcase. Lundahl then realized that the individual was Attorney General Herbert Brownell, who was handling the Little Rock crisis.

In the spring of 1958, Vice President Richard Nixon and his wife, Pat, represented the United States at the inauguration of Arturo Frondizi as president of Argentina and then went on to visit Uruguay, Paraguay, Bolivia, Peru, Ecuador, Chile, and Venezuela. In his book *Six Crises*, Nixon wrote that the CIA had informed the Secret Service of rumors of a plot to assassinate him in Venezuela. The country was controlled by a junta and had a strong Communist Party in opposition.[35] The Nixons landed at Maiquetía Airport in Caracas on May 13, 1958, and were greeted by an unwelcoming crowd. Some even spit on the Nixons from an observation deck. As they were being driven to the U.S. embassy, their car was stopped four times by roadblocks. The car was pelted with stones and beaten with clubs. The bulletproof windows were closed and the doors locked. At one point the crowd began to rock the car and the occupants feared it would be overturned.

I had just gotten home from work when Lundahl called me and said, "Nixon is in trouble. What do we have on Caracas, Venezuela?" I said I knew that we did not have U-2 photographs. He said, "See what you can find. There will be a military delegation coming to the center later." I called George MacGilvery, the chief of the CIA Map Library, and was pleased to learn that the library had very good current maps not only of Caracas and the surrounding area but also of the whole country, made by oil companies operating there. I grabbed them all and headed for the PIC. At nine o'clock Maj. Gen. John M. Willems, an Airborne general, a Marine general, several colonels, and a CIA officer appeared. I knew General Willems, the Army G-2, from previous meetings. I pointed out the location of the embassy and the ambassador's residence on the maps. Willems pointed to a golf course and said, "We'll drop them there." By "them" he meant two hundred troopers from the 101st Airborne Division who were already on their way to Puerto Rico from Fort Campbell, Kentucky; two thousand more were on standby. The Marine general said that a Marine task force was proceeding to the Venezuelan coast. Willems asked if he could have all the maps and I, of course, agreed.

The Defense Department issued a statement the next day saying that "as a precautionary measure two companies of airborne infantry and two companies of Marines are being moved to certain U.S. bases in the Caribbean Area."[36] The Marines deployed the 1st Battalion, 6th Marines, and elements of Marine Aircraft Groups 26 and 35 off the coast of Venezuela. A naval task force along with the carrier *Tarawa* was there as well. Two additional Marine companies were sent to Guantánamo, Cuba, and twenty-five B-47s were placed on alert.[37]

The junta got the message, and this time Nixon had no problem on the drive from the embassy to the airfield. Eisenhower wanted an appropriate reception when the Nixons returned. When they came back after an overnight stop in

Puerto Rico, President Eisenhower put protocol aside and greeted them at National Airport along with fifteen thousand people. Lt. Col. Vernon Walters, Nixon's interpreter at the time and later deputy director of the CIA, told me that if the Communist protestors had overturned the vice president's limousine, all in the vehicle would have been killed. He was equally certain that had a Molotov cocktail been thrown at the locked-down car, "we would have been fried."

I worked closely with Walters as our careers progressed and helped prepare a number of briefings for him. When he traveled with the first ladies he always wore a transmitter in his belt in case there was trouble. Very conscious about his weight, he told the tech people who provided him with the special belts that he wore a size 38. It was all too obvious that 38 would be too small for him, so the inventive tech people created a 42-inch belt and stamped "38" on the inside. When Walters put it on, he said, "I told you my size was 38." Among the many briefings we prepared for him were special briefings for Pope John Paul. When the pope died, reporters asked R. James Nicholson, the former U.S. ambassador to the Vatican, if the pope had been well informed on world issues. Nicholson replied that indeed he was, inasmuch he was periodically briefed by (then) General Walters.

Super Genetrix and Other Dismaying Incidents

Discoveries in space were many during the 1950s. One such was a change in the west-to-east jet stream. The jet stream is normally at 55,000 feet, but in June and July it turns abruptly upward near the Bering Sea to 100,000 feet. That fact would have enormous bearing on an Air Force project. The Air Force had a new balloon reconnaissance system called the Super Genetrix. The new system had much better cameras than did the earlier Genetrix and could stay aloft for about a month.

On May 16, 1958, the secretary of state, the chairman of the Joint Chiefs of Staff, Gen. Curtis LeMay, Allen Dulles, and Air Force Col. Paul Gremmler met with the president at the White House to seek his permission to fly the new balloon over the Soviet Union. Eisenhower was a little weary that day, and after reviewing the plans deferred his decision until the secretary of state could discuss the idea with some experts on the USSR and the U.S. ambassador to the Soviet Union.[38] The next day, the president met with Killian, LeMay, Secretary Dulles, DCI Dulles, and Gremmler and again deferred his decision.

At still another lengthy meeting at the White House on May 29 involving Secretary Dulles, DCI Dulles, Deputy Secretary of Defense Donald Quarles, and Colonel Goodpaster, the president revealed his trepidations. Goodpaster's doodled notes include: "Must anticipate the Soviets would shoot one down"; "World situation worsening—we invading"; "Cover ups"; "Cost of embarrassment"; "Increased tension"; "If testing air currents at different altitudes, better state as 'project air currents'"; and then, with emphasis, "Managerial direction."[39]

On June 20, 1958, Quarles wrote to President Eisenhower: "It is my understanding that you were recently not disposed to approve the Air Force proposal to overfly the Soviet Union with some thirty systems operating at programmed altitude of over 100,000 feet. This suggested to us the possibility of greatly reducing the size of the program."[40] Quarles stressed the urgent need for this vital and otherwise unobtainable intelligence and promised that the possibility that one of the balloons could be shot down was virtually nil. When the president met with the Dulles brothers, Quarles, and Killian about the project on June 23, Quarles reiterated that assurance.[41] Eisenhower approved the project on June 25, 1958, with a limited go-ahead, "on the understanding that the group that was meeting with the president would itself consider the operational specifics and attendant public statements, cover and diversionary operations, etc.—with political considerations to be given top priority."[42] Goodpaster's notes indicate that the president wished a small trial of two or three, perhaps four or five balloons.

President Eisenhower had a deep-seated fear that these flights might provoke a war or, more likely, a serious "convulsive" incident such as closing off traffic to Berlin. He was committed to achieving a long-term understanding between the United States and the Soviet Union and was reluctant to risk provoking Khrushchev any further. Soviet officials were aware that their protests of overflights were not being seriously addressed and were afraid to admit that there was nothing they could do about the aircraft flying over their airspace. At the time there was no U.S. expert who could read Khrushchev's bluster when he was threatened or humiliated.

On July 2, 1958, Quarles sent a memorandum to the president on the "High Altitude Balloon Reconnaissance Program." The memo called for the launch of three camera-carrying balloons from an aircraft carrier located at approximately 150 degrees west, 50 degrees north, on July 7, 1958. The balloons were programmed for 110,000-foot elevation in the daytime and were to travel the western air currents at that altitude. As a cover, at the same time, approximately eight balloons would be flown at about 40,000 feet in an easterly current in order to pass over the United States, where some would certainly be sighted. These balloons would not carry cameras. Quarles assured the president that "security of the operation would be maintained at a maximum."[43]

The president approved the project and a trial flight of the balloon at a meeting involving Secretary of Defense McElroy, Deputy Defense Secretary Quarles, and Secretary Dulles on July 3, 1958. The president insisted that the balloon be limited to meteorological observations and that it carry no camera over the United States. Wilson said the project would cost only about $750,000.[44] The Air Force, long determined to prove its capability in aerial reconnaissance, said it would exploit the missions. An improved 12-inch panoramic HYAC camera produced negatives of 100 lines per millimeter, a great improvement over the resolution produced by Genetrix's 6-inch cameras. The balloons, like those of Genetrix, had a light-sensing device that turned off the cameras at night. The PIC had been promised a duplicate negative and a duplicate positive of the film.

Bad weather delayed the launch of the Super Genetrix photo balloons for three successive days. On July 7, 1958, three photographic balloons were released from the deck of an aircraft carrier in the Bering Sea to take advantage of the east-to-west jet stream. The balloons rose to 100,000 feet and began to drift westward over the Soviet Union. Crews were dispatched to Europe to reclaim them. Each balloon was equipped with a timing device that would cause it to drop its camera and payload after crossing into Europe. Unfortunately, a technician forgot to reset the timing devices after the three-day weather delay. Air Force technicians had calculated that the balloons would cross the Eurasian landmass after four hundred hours aloft. At the PIC we waited to view the results of these missions, and waited.

Nothing was heard about the balloons until the Polish government launched a protest, which was followed by one from the Soviets. One of the three balloons had come down in central Poland and the other two fell into Soviet hands. The president was furious. When the Air Force had proposed using timers to bring the balloons down after a mission, he had said no, fearing that a malfunction would bring the balloons down prematurely. What the Air Force had done was nothing less than insubordination. The president ordered Goodpaster to inform the Air Force, "The project is to be discontinued at once and every cent that has been made available as part of any project involved in crossing the Iron Curtain is to be impounded and no further expenditures are to be made."[45]

The Air Force added fuel to the flames of the president's wrath on July 29 when Fred Ayer, special assistant to the secretary of the Air Force for intelligence, called Goodpaster to confirm that one of the balloons had indeed gone down in Poland on July 28 and read a statement the Air Force planned to release on the matter. The statement had not been coordinated with the secretary of state or the secretary of defense. Goodpaster told Ayer "that the president had reserved all major decisions in the matter to himself, and would wish for the matter to be brought to his attention with recommendations of Mr. Quarles and Secretary Dulles or Mr. Herter. Mr. Ayer argued against doing so, and Goodpaster finally told him flatly that it was essential that the matter be handled in this way."[46]

The president was further incensed that the Soviet radars had detected the balloons at an altitude of about 110,000 feet and the U.S. radar had failed to detect them at an altitude of about 63,000 feet.[47] The president ordered Goodpaster to look into that, too.

James Lay of the NSC later said that the president was on a tear for three days afterward, ranting and raving about the stupidity of the whole balloon project and the failure of the Air Force to obey his orders. Bissell told Lundahl that the president treated General Twining with barely concealed contempt. Lay said the president kept mumbling, "Half ass, half ass," followed by an emphatic, "Goddamn half ass." Goodpaster, always the diplomat, wrote into the official record that the president "deplored the way in which this project had been handled."[48] The balloons had given the Soviets both legitimate grounds for anger and invaluable propaganda material. On July 31, still angry, Eisenhower sent a formal memorandum to Secretary of Defense Neil McElroy stating, "There is disturbing evidence of deterioration in the process and discipline in the armed forces. Unauthorized decisions . . . have apparently resulted in certain balloons falling within the territory of the Communist Bloc and overflight over routes that contravened my standing order."[49]

A series of other military incidents angered and disturbed Eisenhower. The Soviets had been making overtures for negotiations, and the U.S. military seemed determined to hinder them. On June 7 an Army helicopter with a crew of two got lost in a thunderstorm, ran out of fuel, and landed in East Germany. When the United States asked the Soviets to help in getting the men released, the Soviets replied that it was a matter of negotiations between the United States and the East German regime. The crew was later released. On June 27, 1958, an Air Force C-118 transport (a military version of the Douglas DC-6-A) with nine Air Force personnel aboard on a flight from Nicosia, Cyprus, to Tehran, Iran, was shot down over Armenia. Five of the crew bailed out; the remaining four managed to land the burning plane. All were captured. The plane carried cargo for U.S. military and diplomatic missions in Iran and Pakistan. At first, a spokesman from Air Force headquarters in Wiesbaden claimed that none of the command's planes was unaccounted for. On June 28 there came a strident Soviet protest that the plane had penetrated Soviet airspace for 105 miles. The protest included a statement that particularly bothered Eisenhower: "One cannot fail to see that this position of the U.S. government is not conducive to easing of tensions relations between our countries even though the U.S. government has declared more than once that, like the Soviet Government, it desires an improvement of these relations."[50] Democratic leaders immediately demanded strong and direct action to release the crew. On July 8, after extensive interrogations of the crew, the Soviets were satisfied that the aircraft was not an ELINT or any other type of intelligence collector and released the crew. I witnessed the debriefing of the crew after they returned to the United States. The interrogation produced plenty of evidence that the crew was not alert during the flight and was lured into the Soviet Union by a false beacon.

On September 2, 1958, yet another incident involving the Air Force came to light. Gen. Thomas D. White, the Air Force chief of staff, informed General Goodpaster that an Air Force EC-130 on an ELINT mission was shot down somewhere along the Turkish-Soviet border. White said that the mission was planned to approach no closer than eighty-five miles to the Soviet border. Then General White sent Gen. James Walsh, the director of Air Force Intelligence, to the White House "with a report indicating that the aircraft had been off course, had crossed the Soviet border (possibly lured by a false radio beacon) and that it had been shot down."[51] Six of the crew died in the crash, and their bodies were presented to U.S. authorities twenty days later. Despite its best efforts, the State Department was unable to learn the fate of the eleven remaining crew members. Eisenhower saw this as one more case of lack of command emphasis and supervision and told General White what he thought. General White later called and said "he had taken several steps to tighten up further the conduct and supervision of such reconnaissance flights."[52]

TWELVE

tactical use of the U-2 and related technical developments

> I see no reason why they [tactical nuclear weapons] can't be used just exactly as you would use a bullet or anything else.
>
> *President Dwight D. Eisenhower*

Eisenhower's Army experience had taught him the importance of tactical reconnaissance for learning the terrain and the enemy's installations, locations, strength, composition, and disposition. He also knew that sophisticated modern reconnaissance techniques would enable the United States to determine the capabilities, limitations, and to some degree the intentions of the enemy. But even the best reconnaissance cannot forecast the intentions of foreign leaders or military officials, and Eisenhower would learn that many foreign leaders could not be trusted—as proven by aerial photography.

The Chinese Offshore Islands Dispute

Several small islands lying off the coast of China were the focus of two major Cold War crises. The first began on New Year's Day 1955 when President Chiang Kai-shek of Nationalist China, based on the island of Taiwan (known as Formosa at that time), pledged to attack the mainland in the not-too-distant future. Premier Chou En-lai of the People's Republic of China replied that an invasion of Taiwan was imminent. Communist China's air force had raided the Tachen Islands held by Chinese Nationalist forces on November 1, 1954, and shortly afterward began shelling the islands of Quemoy and Matsu as a prelude to the invasion of the Tachens. Chiang Kai-shek begged Eisenhower to shell the mainland to forestall an attack on Taiwan. The United States and Taiwan signed a mutual defense treaty on December 2, 1954. The treaty required the United States to defend Taiwan, but questions remained about the ownership of Quemoy and Matsu.

After discussions with congressional leaders, Eisenhower sent a message to Congress that "clearly and publicly establish[ed] the authority of the president as Commander in Chief to employ the armed forces of the nation promptly and effectively for the purpose indicated if in his judgment it became necessary."[1] Some in the Eisenhower administration viewed the statement as a blank check. Eisenhower sent his aide, Col. Andrew Goodpaster, to Taipei, Taiwan's capital, to evaluate the situation in person. Goodpaster learned that about 100,000 troops—a third of the Nationalist forces—were dug in on Matsu and Quemoy. Covert CIA officers were among them. U.S. Navy reconnaissance flights revealed no buildup of naval forces on either side. Eisenhower was under considerable pressure from the U.S. military to intervene, but he clearly had no taste for the endeavor. Instead he remained vague enough about his plans to keep the Chinese Communists and the Soviets guessing.

Secretary Dulles deliberately added to the confusion when in a March 12, 1955, speech he stated that the United States had new and powerful weapons of such precision that they could utterly destroy military targets without endangering unrelated civilian centers. He was more specific three days later when he stated that the United States was prepared to use atomic weapons in case of war in the Taiwan Strait. Eisenhower rejected using air strikes against mainland China. But at a press conference he had declared, "In any combat where these things [tactical nuclear weapons] can be used on strictly military targets and for strictly military purposes, I see no reason why they can't be used just exactly as you would use a bullet or anything else."[2]

Eisenhower had drawn a line in the sand with that statement, and by mid-April 1955 the Chinese Communists got the message and stopped shelling the islands. The crisis was over, but there was still a major problem with Communist China. The day Eisenhower had taken office, he had received word that a B-29 carrying thirteen Americans, eleven of them airmen in uniform, had been shot down over China. Nothing was heard about their fate until November 23, 1954, when Peking Radio reported that the men had been given prison terms ranging from four years to life for espionage.

At a conference held in Bandung, Indonesia, on April 23, 1955, Chou En-lai indicated that the Chinese had no intention of going to war with the United

States and were ready to negotiate not only on Taiwan but also on other problems. Secretary Dulles answered in a news conference on April 26 that the United States was willing to negotiate, but not while the Chinese were holding U.S. prisoners. The airmen were released on August 1, 1955, and talks began about the release of other Americans being held by the Chinese. CIA covert officers John T. Downey and Richard G. Fecteau had been shot down while on a CIA operation in 1952. The Chinese maintained that they were on a mission unrelated to the Korean War and had refused to release them. Fecteau was released in 1971 and Downey in 1973.[3]

The offshore islands dispute between the Chinese Nationalists and Chinese Communists erupted again in early 1958 when Nationalists flying F-86 Saber jets and Communists flying MiG-17s engaged on numerous occasions. Sporadic naval skirmishes also occurred near Quemoy and Matsu. On August 23, 1958, after a lull of more than three years, the Chinese Communists resumed heavy shelling of Quemoy and Matsu. With the renewed shelling came concern that the Communists might be preparing to invade the islands—and possibly Taiwan.

During this period the Russians and the Chinese Communists began demanding the withdrawal of the U.S. Seventh Fleet from the Taiwan Strait. The president ordered U-2 missions flown over the islands and along the coast of mainland China to determine if forces were preparing to invade the islands or Taiwan. The first mission was flown on June 19, 1958, over the China coast and islands from Shanghai to Canton. PIC interpreters had been dispatched to the 548th Reconnaissance Technical Squadron at Yokota Air Base in Japan, about thirty-five miles north of Tokyo. The base had been declared an Overseas Photo Interpretation Center (OPIC), with cleared personnel and with the processing equipment necessary to handle U-2 imagery. OPIC and Air Force personnel analyzed the images and prepared immediate reports for field commanders and the intelligence community. The images revealed that while air activity was high, there was little activity in the military barracks areas and ports along the coast. The shelling had destroyed a few fishing huts on Quemoy's shore but had left the island's fortifications undamaged. Analysts were able to determine that no invasion of either the offshore islands or Taiwan was imminent. U-2 negatives were flown to Washington, and we made numerous briefing boards on Matsu, Quemoy, Amoy, and installations along the China coast that were shown to Eisenhower.

Eisenhower described Chang Kai-shek as "a proud, sometimes stubborn, sovereign ruler and our ally."[4] But the photos clearly showed that Chiang was magnifying the situation. "Much of the information on which he based his apprehensions differed markedly from that provided by our intelligence services," Eisenhower later wrote in *Waging Peace*. "His version of the effectiveness of the Communist artillery bombardments of the Quemoy garrison surpassed anything that had been reported to me."[5]

When Lundahl showed Eisenhower the briefing boards we had prepared on the heightened activity at Communist Chinese airfields, the president stroked his chin, lifted one eyebrow, and said, "We'll see what we can do about it." In September he decided to provide the Chinese Nationalists with Sidewinder air-to-air missiles.

Secretary Dulles met with Eisenhower on August 12 and told him that "if Quemoy and Matsu were lost, the Chinese Nationalists do not consider that they could hold Formosa. Morale would crumble and Chiang's control would be lost."[6] On August 23 the Red Chinese army commander ordered the Nationalist forces to surrender, intimating that an invasion was near. On August 27, to reassure Taipei and deter Beijing (at that time called Peking), Eisenhower ordered reinforcements to the Seventh Fleet. He also authorized an increase of military equipment, arms, and advisers on Taiwan. On September 25 four Nationalist Air Force F-86Fs armed with the newly acquired Sidewinders shot down four Chinese MiG-17s.[7] It was the first use of the Sidewinder in combat. In the months that followed, the Nationalists downed more than one hundred MiGs in aerial dogfights. They also strafed a number of boats and junks that could be used for invasion purposes.

Chiang Kai-shek pleaded with Eisenhower to order the Seventh Fleet to shell the mainland. Adm. Felix Stump, the commander in chief of the Pacific Fleet, agreed. The PIC became a beehive of activity as officers from the Joint Chiefs of Staff demanded more and more U-2 photos and greater and deeper analyses of them. We created a large number of target folders that were packaged and sent to the field under tight security to be opened and used in the event of war.

The shelling of the Communist-controlled offshore islands continued at the rate of about 8,000 rounds a day. Adm. Arleigh Burke proposed carrier aerial strikes against the islands' batteries. PIC, Army, and Navy photo interpreters had been working to locate and analyze all of the artillery positions not only on Amoy but on the mainland as well. This was difficult because some of the guns were kept in caves and tunnels when they were not actually in use. An artillery officer tried to determine the caliber of the artillery pieces by the size of the tunnel openings. The larger-caliber guns were targeted for possible atomic weapons.

In a September 4, 1958 speech, Secretary Dulles warned China that Eisenhower "would not hesitate" to use armed forces to ensure the defense of Taiwan. He told the Chinese that "military dispositions have been made by the United States so that, a Presidential determination, if made, would be followed by action both timely and effective." He went on to point out that "the securing and protection of Quemoy and Matsu have become increasingly related to the defense of Taiwan." That day, the Communists suspended the artillery bombardment of the islands for three days.[8]

In response to the urging of Adm. Arthur Radford for air strikes against Chinese airfields the PIC prepared a number of enlargements of the airfield images. Radford also advocated warning Beijing and Moscow that the United States would use nuclear weapons to defend the islands. The Joint Chiefs and Secretary Dulles were agreed that nuclear weapons would be employed if the Chinese attempted to invade Quemoy and Matsu. Admiral Burke likewise supported using nuclear weapons against mainland China. "There's no use of having the stuff and never be able to use it," he said.[9]

At the PIC we heard that the Air Force was pressing the president to approve the use of nuclear bombs during the crisis. One of the Chinese Communist targets of special interest was Amoy Island, the main source of the shells falling on Quemoy and Matsu. Two naval officers came over to the center, and we provided them with detailed photos and drawings of the island. Target areas were delineated for nuclear weapons. Eisenhower received a note from Khrushchev threatening that an attack on the Chinese People's Republic would be regarded as an attack on the Soviet Union. Eisenhower dismissed Khrushchev's statement as pure bluff. He also declined to use nuclear weapons and turned down Admiral Burke's request to send carrier strikes against the mainland artillery batteries.

U-2 missions continued along the coast and over the mainland. We were able to report with confidence that there were still no imminent preparations for invading the offshore islands or Taiwan itself. The U.S. government provided the Chinese Nationalists with information on the rendezvous areas of boats and junks that would be used for an invasion, and the Nationalists began bombing and strafing those areas. The Communist Chinese had moved their naval forces, primarily older vessels that had originally been given to Chiang Kai-shek's government, farther south to avoid confrontation with the Seventh Fleet.

Eisenhower had placed U.S. forces on a "readiness alert" and told them to be "prepared for immediate war operations."[10] On September 7 he approved the U.S. Navy's request to escort Chinese Nationalist LSTs carrying supplies to within three miles of Quemoy and Matsu. He later approved stationing LSDs (landing ship docks) off the islands beyond the range of the Communists' guns. Small Nationalist amphibious craft would carry the supplies to support the garrisons. American observers were on the islands to oversee these supply efforts.

When the Chinese Communists on October 6, 1958, announced a unilateral cease-fire for a week, the Nationalists took advantage of the respite and brought in tons of supplies to both islands. The Communists began shelling the islands on alternate days. An Army ordnance specialist who visited the PIC during the crisis told us that the Chinese were using old Russian shells that had accumulated during World War II and were nearing the end of their useful life. He said he could not think of a better and faster way of disposing of old shells than firing them at the opposition. And then the shelling ceased.

The crisis abated because the Communists knew that Eisenhower was prepared to employ the 7th Fleet and the Strategic Air Command to support his diplomacy. Historian Stephen Ambrose considered "Eisenhower's handling of the Quemoy-Matsu crisis . . . a *tour de force,* one of the great triumphs of his long career. The key to his success was his deliberate ambiguity and deception." Ambrose in turn quoted Robert Devine: "The beauty of Eisenhower's policy is that to this day, no one can be sure whether or not he would have responded militarily to an invasion of the off shore islands, or whether he would have used nuclear weapons."[11]

The last U-2 mission during the crisis was flown on October 22, 1958. The Navy and Air Force, however, wanted to be certain that Red Chinese forces were standing down. The commander in chief, Pacific, and Air Force command wanted another mission to verify it before U.S. forces were reduced. They proposed using an Air Force RB-57 flight along the China coast to do that.[12] On November 28, 1958, the president gave his approval for a flight "to determine any CHICOM buildup opposite Taiwan and the Offshore Islands,"[13] but he stressed that permission to execute reconnaissance missions must be secured on a mission-by-mission basis. The mission was flown by an RB-57A, but the quality of the images it produced could not compare with U-2 images. PIC and Air Force analysts reviewed copies of the film and confirmed that there was no buildup of Chinese forces preparing to invade the offshore islands or Taiwan.

Knowing that the president would never grant permission to fly RB-57s over the Soviet Union, the Air Force pressed him to transfer three RB-57As, and later some RB-57Ds, to the Chinese Nationalists. An agreement was reached with the Chinese Nationalists: the Air Force would supply the planes and technical support personnel, and the Chinese would provide the pilots and airfield. Handpicked pilots would be sent to the United States for training. The agreement specified that the Chinese Nationalists would fly RB-57A missions only over agreed-upon targets in Communist China. Two RB-57As, each equipped with two K-38 cameras and a type T-11 mapping camera, were flown to Tao Yuan Air Base in Taipei.[14] The Chinese Nationalists would process the film they obtained under Air Force guidance and send duplicate copies of the negative and positive to the USAF processing site at Yokota. The missions were flown over mainland China and included two deep penetrations, one over the outskirts of Beijing and the other over Shenyang.

Eisenhower, always a man who considered the consequences of his actions, confronted several issues while the idea of using tactical nuclear weapons was batted about during the Chinese crises. Both the United States and the Soviet Union were conducting extensive nuclear tests during the late 1950s. President Eisenhower became concerned that aboveground nuclear detonations were contaminating the ground, air, and seas—as indeed they were. The use of tactical nuclear weapons could potentially do a great deal more damage. He hoped that the United States, Britain, and the Soviet Union would cease testing and reach some sort of an agreement on future tests. After a U.S. test on October 31, 1958, he declared a testing moratorium. The Soviets followed suit and stopped their tests until September 1961, when without warning they began testing again.

In discussions with the president on the Agency's budget on September 9, 1958, Allen Dulles raised the possibility of transferring the U-2 operations, or their support, to the Air Force. President Eisenhower agreed that savings might be achieved by reducing the number of contractor personnel engaged in U-2 maintenance and other work. Bissell was furious when he heard about the suggestion and called Lundahl. Nobody in the CIA, or elsewhere in the intelligence community, for that matter, wanted Curtis LeMay to be in charge of national reconnaissance. Lundahl suggested that Bissell talk to Goodpaster, and he did. Goodpaster's notes of their meeting indicate that Bissell stated strongly that "the capability [to fly U-2s] should be kept active for as long as there is little chance of interception. It was also felt that the aircraft should be kept in a small autonomous organization, so as to provide security, direct control, and extremely close supervision."[15] Goodpaster spoke to the president, who agreed "that he did not intend for flights to be conducted by military organizations or personnel in peacetime."[16] The U-2 would remain under the control of the Agency.

Lebanon

In March 1957, in response to continuing turmoil and instability in the Middle East, President Eisenhower issued a document that became known as the Eisenhower Doctrine. The doctrine stated that "the United States regards as vital to the national interest and world peace the preservation of the independence and integrity of the nations of the Middle East. To this end, if the president determines the necessity thereof, the United States is prepared to use armed forces to assist any nation or group of nations requesting assistance against armed aggression from any country controlled by international communism, provided that such employment shall be consonant with the treaty obligations of the United States and with the constitution of the United States."

In the fall of that year the Joint Chiefs directed Adm. James L. Holloway III, commander in chief of the Specified Command, Middle East, to update plans "to take into account potential operations as the results of coups in either Jordan or Lebanon." Admiral Holloway and a number of his aides visited the PIC, where, following Lundahl's directive, we provided them with the U-2 images relevant to the situation.

In January 1958 Gamal Abdel Nasser announced that Egypt and Syria were uniting into a new nation to be called the United Arab Republic (UAR). Egypt's propaganda broadcasts to other Middle East nations inflamed pan-Arab sentiments. Eisenhower feared that Nasser's radical Arab nationalism would appeal to people in Jordan, Iraq, and Saudi Arabia and encourage them to revolt against their monarchies.

Lebanon appeared to be under the firm control of President Camille Chamoun until 1958, when Muslim uprisings fostered by Syria and Egypt began occurring with greater frequency. Syria appeared to be on the verge of invading Lebanon. Chamoun called for U.S. intervention but then retracted. In April there was an abortive coup against Jordan's King Hussein. Eisenhower decided that U.S. intervention might be necessary to stabilize the situation in Lebanon and show Nasser that the United States was willing to use force to defend its vital interests in the region.

There was little current intelligence on which to base the effective deployment of U.S. military forces in Lebanon, so on April 19, 1958, Eisenhower authorized U-2 flights over Syria, Lebanon, Israel, and Egypt. Initially, the film was processed in the United States and analyzed at the PIC. A U.S. Army contingent of about thirty specialists in logistics, planning, transportation, and mapping from various military commands, led by Col. Charles Allen, came to the Steuart Building to study the areas where U.S. forces might land and be deployed. They pinpointed power, water, sewage, sanitation, and medical facilities—as well as locations of Muslim radicals or UAR sympathizers—on the images. They also looked for water sources, oil pipelines, pumping stations, and storage facilities so that field commanders could guard the water and oil supplies the troops would need. There were reports that if any U.S. troops were deployed, they would be poisoned, and field commanders wanted assurances that all the water provided to their troops would be of the highest quality.

We assembled all sorts of collateral information on the region from the CIA Library, the Pentagon Library, the Library of Congress, and other repositories. Some of the books were in Arabic, so CIA translators joined the group. All of the information was incorporated in heavily annotated photos and maps. Copies were made for the Joint Chiefs of Staff and for field commanders. When new U-2 missions provided additional information, we made up new map sheets. Our activities were in many ways similar to the preparations for the invasion of Normandy. A copy of the album consisting of aerial photos, updated maps, and text was shown to President Eisenhower, who could now be certain that U.S. commanders in the field had the most current information about the disposition and activity of possibly hostile forces. Targets for bombers, fighters, and artillery or naval gunfire were clearly delineated.

On April 20 the chief of naval operations, Adm. Arleigh Burke, ordered the Sixth Fleet into the eastern Mediterranean in support of Operation Bluebat, which involved sending U.S. Marines to take control of Beirut before Muslim rebels could occupy the city or get support from Syria. Copies of the comprehensive albums of intelligence information created by the Army were sent to fleet commanders. Admiral Burke issued instruction to Adm. Charles R. Brown, commander of the Sixth Fleet, to start unannounced sorties and exercises so that the fleet's unscheduled movements would become newsworthy.

Forces aligned with President Nasser overthrew the government of Iraq on July 4, 1958, and assassinated the royal family. President Chamoun of Lebanon announced that the danger posed to Lebanon's sovereignty forced him to ask for help from Europe and the United States. While France and Britain hesitated, Eisenhower responded to a formal request for military assistance. He consulted with the British government, which decided to send paratroopers to assist the government of Jordan on July 17.

On July 14 Eisenhower invited a bipartisan group of twenty-two legislators from both houses of Congress to attend a meeting in the White House at which the Dulles brothers analyzed the situation in the Middle East. While some of the representatives disagreed with the president on certain aspects of the analysis, Eisenhower felt certain that they would not attempt to impede his actions. At a follow-up meeting at the White House with Allen and John Foster Dulles, Adm. George Anderson, Donald Quarles, Gen. Nathan Twining, Robert Cutler, and Gen. Andrew Goodpaster, Eisenhower said that he was willing to use his power actively in the world and had made up his mind to invade Lebanon. In his memoir *Waging Peace* he wrote: "This was one meeting in which my mind was practically made up . . . even before we met. The time was rapidly approaching, I believed, when we had to move into the Middle East and specifically into Lebanon to stop the trend toward chaos."[17] At the end of the meeting Eisenhower instructed General Twining to tell Admiral Burke to prepare to send in the Marines.

Eisenhower knew that intervention in Lebanon would not receive full support from Congress. Many members felt that it would undo the good that Eisenhower had done with his handling of the Suez War. Further, he had admonished the British and French for invading Egypt and yet was now preparing to invade Lebanon. Eisenhower tried to make a distinction between the two situations by saying that Chamoun had invited the intervention. To stave off condemnations from nations in the area, Eisenhower instructed Henry Cabot Lodge, the U.S. ambassador to the United Nations, to tell the Security Council that the United States was stabilizing the situation until the UN could act. Historians disagree as to why Eisenhower invaded Lebanon, but many think it was a show of force against Nasser's ambitions.

At 9 AM Washington time on July 15, 1958, 3,500 Marines landed on the beaches of Beirut and took control of Beirut International Airport.[18] We prepared briefing boards on these activities and sent them to the White House. The Marines were followed by two Army battle groups from Germany. Additional troops and supplies were later deployed to the area. U-2 missions maintained a vigil over all positions where U.S. troops were deployed as well as conducting surveillance over Egypt and Syria for signs of possible armed intervention. The U-2s also looked for signs that the UAR was preparing to begin a holy war against Israel, Russian arms shipments to Egypt and Syria, fedayeen camps, and Israeli defense efforts. The U-2 missions usually began over Syria and continued over Lebanon, Israel, and Egypt.

Additional troops airlifted from Europe arrived at Beirut International Airport under a protective shield of U.S. Navy fighters. In all, about a division was deployed in Lebanon. The troops were equipped with modern weapons, including Honest John rocket batteries. With U.S. Marines and Army troops deployed in potentially hostile situations, U.S. military commanders wanted immediate information on potential threats. Lundahl's solution was to send photo interpreters to the film-processing center in Adana, Turkey, to do an immediate readout of the U-2 film as it came from the processors. Additional photo interpreters from the PID were sent to Adana to analyze the images and prepare rapid reports for the field commanders and the intelligence community. During the early summer of 1958 the film-processing personnel and the interpreters worked around the clock under abominable conditions in the Turkish heat. Air-conditioned trailers eventually made their lives a little easier.

During the night of July 16, Muslim rebels sniped at a few American outposts and began harassing Marine positions. On July 17 the Navy decided to stage a demonstration of U.S. might and sent fifty-three A-3D Skywarriors, F-8U Crusaders, and A-4D Skyhawks from the carrier *Saratoga* to fly over Lebanon, Syria, and Jordan. A number of U.S. naval combatants were anchored in Beirut harbor or just offshore.

U-2 missions flew throughout the summer of 1958. Photo interpreters looked at military camps, airfields, and ports in Syria and Egypt to identify any possibility of armed intervention. The Navy asked that a close watch be maintained on Soviet W-class submarines based in Egypt and Syria that posed a threat to the 6th Fleet. The Navy was also concerned about the Soviets' deployment of eight diesel attack submarines and a tender to the naval base at Vlore, Albania. Without entering Soviet airspace, U-2s flew ELINT missions along the Soviet border and around the Black Sea. The message to Egypt and Syria and also to the Soviet Union was clear: The United States would protect its vital interests.

Eisenhower wanted U.S. forces to remain in Lebanon only so long as they were needed to stabilize the country. After elections were held in Lebanon on July

31, a new leader was ready to take over. Eisenhower instructed Secretary Dulles that the U.S. forces would leave Lebanon when General Fuad Chebab assumed the presidency. U.S. forces in Lebanon peaked in the summer of 1958 at 14,357: 8,515 Army personnel and 5,842 Marines. By the time the last American troops were withdrawn on October 25, 1958, thirty-six U-2 missions had been flown. Field commanders praised the use of U-2 photography in tactical situations and the analysis of the film by PIC interpreters in the field and in Washington.

When Lundahl showed briefing boards on the troop withdrawal to the president, he remarked, "The troops will never know that they had a guardian angel watching over them." President Eisenhower continued to use U-2s for surveillance wherever U.S. troops were deployed, and the U-2 became affectionately known as "the Angel." Later, in a reference to a popular TV program, the U-2 became known as "Kelly's angel," a reference to Kelly Johnson, its designer. The military made increasing use of the wealth of information being obtained from the analysis of aerial photography by the PIC, and the CIA, Army, Navy, and Air Force increased the number of photo interpreters they sent there. At Lundahl's recommendation, and with the approval of the director of the Central Intelligence Agency, the Photo Intelligence Division became the Photo Interpretation Center in August 1958.

Dimona

Photo interpreters of the U-2 flights over Israel were asked to pay special attention to a large bombing and strafing range south and east of Beersheba where Israeli special forces rehearsed their operations. In particular we were looking for signs that the Israelis were conducting experiments with new antipersonnel weapons similar to those the U.S. Army was conducting at the Frankfort arsenal in Pennsylvania and the Picatinny arsenal in New Jersey. Several people from the PIC, including Ted Clark, a leading military analyst at the center, visited the arsenals. We were shown films of tests of these weapons that were conducted on ranges with unique signatures—either sacks filled with sand or thousands of balloons placed in a circular pattern to record the hits of the fragments. When we examined the images of Israel for such ranges, we found something much more interesting: a new road leading to an installation under construction. The large-scale excavation, massive forms for pouring concrete, and heavy transmission lines were indicative of a nuclear installation. Large construction equipment in the area indicated a possible military link.

Handling information on Israel was always a sensitive situation. We had heard that relations between Eisenhower and Ben-Gurion were not the best. Eisenhower was still smarting from Israel's collusion with Britain and France during the Suez War. We also knew that high-ranking Israeli officials were lying about what was happening at the Beersheba installation. One said that a textile mill was being constructed there. We made a briefing board for the new images and I titled the site the Beersheba Probable Nuclear Installation. Lundahl asked me to show the board to Allen Dulles in his office. In the course of the briefing Dulles asked me if I had seen "the Israeli reports." I responded that I had not, and he replied, "You should see them." I told Lundahl about the conversation, and he told me to call the office of the deputy director for intelligence and request the reports that Dulles had mentioned. My request was denied, even though I held security clearance for very sensitive matters. Lundahl and I concluded that the reports were from American Jewish scientists who knew what was going on in Israel. We thought that one of the scientists was probably Dr. Edward Teller.

When Lundahl showed the Beersheba briefing board to the usually effusive Eisenhower, the president did not say a thing. He merely handed it back. Officials of the Agency's Office of Scientific Intelligence (OSI) also saw the board. Because of the security involved in the U-2 program, OSI prepared an ad hoc requirement requesting detailed information about Israel's atomic energy developments. The requirement was served on the Department of State on March 27, 1958, and transmitted to the U.S. embassy in Tel Aviv. Embassy officials contacted Dr. Bergmann, chair of the Israeli Atomic Energy Commission, who was said to have been perturbed by the request. Israel provided no information on the Beersheba installation.

We continued to follow the construction of the installation, which was now surrounded by a massive fence. U.S. attachés who attempted to get close were stopped—and once even roughed up—by Israeli military police. The terrain was very flat, however, and Lundahl determined that with the right camera the installation could be photographed from the road. Lundahl dug into his voluminous files on cameras and came up with one that could be modified with a long-range lens and special film. All an attaché had to do was press a trigger. Information on the make of the camera and film was passed to the British, and by the summer of 1960 both American and British attachés were photographing the installation regularly and producing good images. After analyzing both the aerial and ground photography we reported that the domed reactor building was nearing completion.

In an attempt to thwart the photographers the Israelis began planting trees around the reactor. The attachés continued their efforts nevertheless, sometimes finding novel reasons to be in the area. One such trip was disguised as a visit to the annual camel sale, at which hundreds of camels were traded and sold. Attachés managed to photograph the reactor both entering and leaving the Beersheba area.

Lundahl placed me in charge of all the sensitive information on the Israeli facility, which we renamed Dimona after the nearest village. A number of reports indicated that the French were involved. I passed the information on to Gordon Heath, the analyst who was interpreting all the photographs of the installation. For comparison we analyzed the excellent aerial and ground photographs of the French reactor at Marcoule. Gordon and I created two large briefing boards based on this analysis, one with ground and aerial photos of the domed building at Dimona and the other with ground and aerial photos of the Marcoule reactor. They were almost mirror images. Clearly, France's contribution went far beyond supplying information and materials. There was no doubt in Lundahl's mind, and in mine, that the Israelis were going for the bomb. Lundahl and I soon learned that while we were to produce briefing boards on Dimona, we were to keep our mouths shut about any collateral information we learned about the installation.

When Allen Dulles and Lundahl briefed Eisenhower on Dimona, he once again shoved the briefing board aside without comment. When Lundahl and I discussed it later, we decided that Eisenhower had known about Israel's intent from the beginning and wanted the Israelis to have the bomb—not only to keep the Arabs at bay but also to serve as a warning to the Soviets.

The U-2 images began to show spoil from an obvious underground effort near the reactor. A number of the PIC's interpreters were World War II veterans who knew about Germany's underground construction projects at the end of the war. After the war the Army had prepared an excellent report on all the German underground installations constructed to evade detection and bombardment; among them were the large missile installation at Nordhausen and an underground oil refinery at Ebinsee. Lundahl began comparing what the Germans had done with what the Israelis were doing. The Israelis obviously knew that we were closely watching their efforts. They planted sod and bushes to mask their activities, but that only highlighted the spots for photo interpreters. The Israelis began to haul away the spoil at night, but we could spot the trucks, which moved about from one mission to the next but always appeared empty. Other intelligence sources later determined that the underground installation was a chemical-processing plant.

President Kennedy was briefed on Dimona when he took office, as was Johnson in his turn, but neither man expressed great interest in knowing what was going on there. We presumed they knew from other sensitive intelligence sources what the Israelis were doing and approved.

Tibet

Isolated by the lofty Himalayas, Tibet had played no role in the major social and political events of World War II. All that changed after the war. India, newly independent from Great Britain, wanted to preserve Tibet as a buffer between China and itself. Prime Minister Jawaharlal Nehru was reluctant to do anything that might upset that delicate balance. Beijing claimed Tibet as an integral part of China. The Chinese Nationalists also regarded Tibet as part of China—which they hoped someday to retake—and that complicated any decisions the United States might make with regard to that part of the world. Secretary of State George C. Marshall also saw China as having de jure sovereignty over Tibet. Few in Washington knew the details or understood the situation, and there was almost no information available on Tibet with which to educate them. Clearly, however, the situation was volatile.

The Chinese Communists moved into Tibet in 1950 with a substantial number of combat and logistical troops. The Tibetans did not accept the presence of Chinese troops, but the meager Tibetan forces could do nothing to stop them. The United States was completely occupied with the Korean War at the time, and as that conflict dragged on, the Chinese Communists had ample opportunity to consolidate their gains without provoking a violent response from India, the United States, or Britain.

By the late 1950s Tibet was attracting widespread interest in the State Department, especially that of Undersecretary of State Herbert Hoover Jr. Tibetan resistance had up to this time been sporadic and disorganized. Border skirmishes between Tibetan and Chinese forces began occurring with increasing frequency and intensity, and hundreds of Tibetan refugees began crossing into India. After a revolt against Communist Chinese rule was crushed during March 13–27, 1959, the Dalai Lama fled to India and appealed to the world to save the Tibetan people and their ancient culture.

With the departure of the Dalai Lama, Eisenhower authorized a dramatic expansion of the program to aid the Tibetans. After returning from a meeting with Bissell, Lundahl called me in and said that Bissell was displeased with the information available on Tibet and was preparing to ask President Eisenhower to approve U-2 missions over the area. He told me to prepare to exploit the images. I sent our researchers to the CIA library, the Library of Congress, and Department of Defense libraries to bring back every map, chart, document, magazine, learned journal, and book they could find on Tibet. They brought back twenty-one books, only two of them relatively new. One of those was *Meine Tibet-Bilde* by Heinrich Harrar, a German who had been detained in Tibet during the war. The other, *Silent War in Tibet*, was by Lowell Thomas, who had been invited to visit Lhasa, the capital city, in the hope that his broadcasts would mobilize support for Tibetan independence.

There were a few other sources, but nothing of real value to us. During World War II, President Roosevelt had asked the Dalai Lama for permission to send two Americans, Capt. Ilia Tolstoy and Lt. Brooke Dolan, to Lhasa to learn more about Tibet and send reports back to him.[19] They arrived in Lhasa in December 1942. We found some of Tolstoy's papers, but they were mainly of a political nature and contained little about the country's geography. Getting ready to exploit the film from Tibet was thus an enormous challenge for us. Normally we would have a whole cart of reference materials, maps, charts, studies, and histories, to help us analyze photography from a new country or area. In this case we had only one archive box filled with old maps and a few books. One of our first priorities was to brief the photo interpreters on the requirements that had been laid on for the mission.

On April 1, 1959, Allen Dulles informed President Eisenhower that plans were being made "within existing policy authorizations" to take advantage of the recent upsurge in Tibetan resistance and the flight of the Dalai Lama, which had resulted in a complete break between the legitimate Tibetan government and the Chinese government.[20] No one seemed to think it possible that the Tibetans would liberate themselves, although there was no doubt that certain groups of Tibetans had the courage to resist. Dulles informed Gen. Nathan Twining of the situation in Tibet and told him he needed the full support of the Air Force. Ever eager to halt the advance of communism by nonviolent means—and based on the recommendations of Bissell, the CIA, and the State Department, particularly Undersecretary of State Hoover—the president authorized U-2 flights over Tibet to assess the situation.

The U-2s would be staged out of Cubi Point, Philippines, and Takhli, Thailand. The first of ten missions was flown on May 13, 1959. PIC photo interpreters were deployed to the field. When the film arrived in Washington, we were amazed at what we saw. The images showed a first-rate 13,000-foot airfield at an altitude in excess of 12,000 feet at Gonggar, about sixty miles from Lhasa. The airfield could accommodate MiG fighters. We spotted Soviet-supplied multipurpose propeller aircraft at hastily constructed airfields near some of Tibet's principal cities. We also saw the Potala (the Dalai Lama's palace) and large lamaseries. Considerable military activity was apparent in Lhasa, where the Chinese were tearing down Tibetan houses and building barracks for their troops. We never saw any tanks in Tibet, probably because the wooden bridges over the many streams would not support them, but we did spot numerous artillery pieces that were being effectively deployed against the Tibetans.

Also surprising were the roads the images showed. For centuries, all transportation into Tibet had been by porters or pack animals. The Chinese had constructed two major roads from China into Tibet—one from the north from Xining, the other from Chengdu leading west over some of the most difficult terrain in the world. The northern route, often referred to as the "Qinghai-Tibet Highway," began at Golmud and extended some seven hundred miles to Lhasa. Chengdu, the capital of Sichuan, was an important road and rail logistical center and the headquarters of an army corps and the command center for forces in Tibet.

Eisenhower was shown photos of all these things. He was most impressed by the roads, which would alleviate the major problem the Chinese faced in Tibet: the logistics of accommodating and supplying their troops. Provisions had to be brought into Tibet to supply the troops, fuel was needed for all the trucks and engineering equipment, and the hundreds of ponies the Chinese had brought with them needed fodder. The roads would also lessen the dependence of the Tibetan economy on India. It was a construction effort similar to the building of the Alcan Highway across Canada during World War II, but far more massive and at extreme altitudes and weather conditions.[21] Hundreds of bridges had to be built as construction of the roads progressed toward Lhasa.

There were stopping points along the road where the drivers could rest, fuel their vehicles, and get their equipment repaired. Some of the images showed several barracks-like buildings along with a motor pool-like enclosure for trucks and fuel carriers. In many of them we could see trucks that probably had been damaged or wrecked along the road. Vince DiRenzo, the chief interpreter of the photography, labeled these "rest and refuel depots." Troops were required to guard the highway, which came under periodic attack from Tibetan forces. On several occasions we saw facilities that had been torched. Traveling for long distances on this arduous road must have been a challenge to even the most proficient drivers. Altitude sickness doubtless made the steep grades, landslides, heavy snow, precipitous switchbacks, and howling winds even more difficult to negotiate. Often we would see where landslides had occurred and people were at work clearing the jumbled boulders from the road. In difficult terrain the road was a single lane, but where the land was more pliable the road consisted of two lanes. Along the roadside, virgin forests were being cut for the timber needed to bridge the many twisting streams. Trucks returning to China most often seemed to be carrying ore and timber.

Deeply impressed with these construction efforts, Eisenhower looked up from one briefing board and asked Lundahl the identity of the Chinese army's Brehon Somervell. (Somervell, a personal friend of the president, was responsible for allocating supplies, equipment, and resources during World War II; many considered him one of the war's dominant figures.) Lundahl could not answer. The president was also shown photos of Chinese mining and forestry activity and remarked there must be an extraordinary wealth of minerals in all those mountains. The aerial photos showed that the Chinese Communists completely ruled the principal cities and had built roads linking Lhasa, Gyangze, and Xigaze, and were proceeding westward along the Brahmaputra Valley.*

Eisenhower listened intently to the information gleaned from the aerial photographs. An expert on military operations, he could not see how the Tibetans could overcome the Chinese and began to question the wisdom of supporting further efforts by the Tibetans to regain control of their homeland.

The U-2 images allowed us essentially to remap Tibet. The World Aeronautical Charts (WACs) of Tibet currently in use were horribly inaccurate. When compared with the U-2 photographs, some of the existing WACs were as much as ten to twenty miles off. Where the WACs showed valleys we found mountains, and vice versa. The Agency had no mapmaking capability during the 1950s, but Lundahl called his friend William Mahoney at the Aeronautical Chart and Information Center (ACIC) in St. Louis, who readily agreed to help make new charts. Sid Stallings, Lundahl's special assistant, flew to St. Louis with duplicate

* In June 2001 the Chinese began constructing a rail line from Golmud to Lhasa, an even more difficult task than building the roads discussed above. High altitudes require special engines that can function with little oxygen as well as pressurized rail cars to keep passengers from suffering altitude sickness. There are now several trains a week to Lhasa. ("China Seeks to Build Highest Railway," *Fredericksburg Free Lance–Star*, July 22, 2001, A-6.)

negatives of the U-2 images. A section of the ACIC was sealed off, and up-to-date charts were produced in round-the-clock operations. The charts received a warm welcome from the planners.[22]

Desmond FitzGerald, head of the CIA's Far Eastern Division, was a mystery not only to me but also to many of those who served under him. After the mapping operation had been completed, Sid Stallings and I were escorted into FitzGerald's office with the results. Stallings unrolled the charts in front of him and showed him a comparison of the existing maps and those created from the U-2 missions. FitzGerald remained expressionless. He did not seem to recognize the tremendous effort that had been involved in the charts' preparation and passed them to an associate without a comment.

Working the Tibetan photographs was one of the most exhilarating experiences of my life. The U-2 photos captured the details of a culture that had existed for centuries and was being systematically destroyed by the Chinese. The scenery was stunning; each frame of photography could have been used as a postcard. The towering Himalayas and the Karakoram Range seemed small from the perspective of a U-2, and we could easily pick out Mount Everest. Looking at stereo photographs of Tibet was a wonderful and awesome experience. Viewed in stereo, the towering Potala with its long staircases seemed to come up and strike the stereoscope. We were entranced—as if we were looking down on the Shangri-La of *Lost Horizon*. A photo interpreter called me over to look at one beautiful scene, which was, he said, "just as God left it." We made a number of briefing boards of Lhasa, the principal cities, the mountains, and the areas inhabited by the Khampa.

The Khampa people were excellent horsemen and fighters, but they had no concept of an enemy who used aerial reconnaissance. We could easily spot guerrilla bands from the air, and we assumed the Chinese were doing the same. The ideal battle plan would have been swift movements from concealed locations to ambush Chinese supply and troop movements, but the Khampa seemed unwilling to adopt that strategy. While the terrain afforded ample opportunities for cover and concealment, the small guerrilla units wanted to live in relative comfort. They would construct their yurts and the corrals for their ponies among the boulders, but then they would string an array of prayer flags that seemed to shout for an observer's attention. Entire families moved slowly along existing roads or paths, accompanied by herds of yaks and ponies and carts of household goods—all of which were easily visible from the air. We could see everything the Chinese were doing as well: roadblocks along the main and secondary routes and increased movement of military supplies on the roads. In the summer, we saw Chinese tents and vehicles appearing in Khampa areas.

The aerial photographs presented many enigmas to the photo interpreters, none more baffling than the structures that appeared to be guard posts situated on roads or trails at the tops of hills and on mountain passes. Mounds or ridges usually flanked these structures, and we initially assumed that they were military strong points with attendant bunkers and protective revetments. A second guess was that the structures constituted some type of toll collection booths. But why would either type of structure be located in such remote areas and exposed to the worst of the Himalayan weather? Our librarian, Dorothy Randolph, solved the puzzle. The posts turned out to be religious shrines, each containing an image of Chenresik, the god who protected travelers from eight kinds of danger. A Tibetan traveler approaching a hill or pass appealed for divine protection by picking up a stone in the valley and carrying it to the shrine. There the traveler made the proper invocation to Chenresik and deposited the stone before the shrine. Over the years, large piles of stones had accumulated at the shrines along heavily traveled routes, accounting for the military appearance.[23]

Vince DiRenzo called me one day when he could not understand a "skinned" area near a village. He thought it might be a playing field of some kind. I asked him if he saw any birds. Yes, he said; a lot of big ones. I knew the answer to that puzzle from one of the Tibetan books I had read. What he was seeing was the site of a sky burial, a Buddhist Tibetan tradition. Tibetans believed the body to be a mere vehicle left behind by the spirit at the moment of death. Dead bodies were brought to these sites, dismembered, and scattered about. Large carnivorous birds would feast on the flesh, leaving only bones. The Tibetan believed giving one's body back to nature completed the life cycle.

CIA operators regarded the situation in Tibet with optimism as it related to U.S. objectives in the region. For example, a memorandum dated March 31, 1959, called the revolt in Tibet "a windfall for the U.S., particularly since it tends to harden Asian neutralist sentiment against the Chinese. Therefore, regardless of other considerations, it would appear to be in the U.S. interest (1) to keep the rebellion as long as possible and (2) to give it maximum emphasis in all public information media. But then added that physical support for the rebels will be extremely difficult, both logistically and politically."[24]

The State Department hoped that Ambassador Henry Cabot Lodge could use the United Nations as a sounding board for the Dalai Lama. Lodge wanted the holy man to make a tour of selected capitals and gain support for an appeal to the United Nations. Eisenhower approved of the idea, but few countries responded to the State Department's proposal.[25]

By April 1959 the Tibetan cause seemed lost. At the National Security Council meeting of April 23, 1959, Allen Dulles reported that Tibetan forces had apparently been defeated by the Chinese. They had been pushed back into a small area, had no food or ammunition, and were asking the United States to intercede with the government of India to permit them to enter that country. Dulles called it "a difficult situation." He said that the Chinese forces, many of them veterans of the Korean War, were "making very efficient use of aircraft." The Tibetan fighters in Khampa "had been pretty well knocked to pieces. The same was probably true of the rebel forces in the Lhasa area."[26]

Defeat followed defeat for the Tibetans, and in February 1960 Allen Dulles briefed Eisenhower on the situation. State, especially Herbert Hoover Jr., was prodding Eisenhower to continue the operation, but Gordon Gray, who was present at the meeting, recorded that Eisenhower "wondered whether the net result of these operations would not be more brutal repressive reprisals by the Chinese Communists who he felt might not find continued resistance tolerable."[27]

The last of the ten U-2 missions over the area was flown on March 30, 1960, by Jim Charbonneaux. After his U-2 flying days were over, Charbonneaux became a training officer at the NPIC. I had numerous conversations with him and showed him photos he had taken of the Himalayas. He, like me, was impressed with the beauty and grandeur of the Himalaya and Karakoram ranges. He took a fantastic U-2 photo on January 13, 1960, of the north slope of the Himalayas, looking south from Tibet toward Nepal. It was later declassified and has appeared in numerous publications.

The U-2 photographs provided the intelligence community with up-to-date information on one of the world's most inaccessible areas. They also showed the systematic and ruthless destruction of Tibetan religion and culture by the Chinese. As an indelible record of a moment in time, they constitute a historical treasure.

Indonesia

President Eisenhower, always seeking to counter Soviet-supported wars of national liberation in former European colonies and underdeveloped countries, began showing increasing discontent with President Achmed Sukarno of Indonesia. Sukarno's concept of "guided democracy" was in essence totalitarianism. He was playing a delicate balancing act between his armed forces and his Muslim citizens and also attempting to forge a "Jakarta–Phnom Penh–Beijing-Hanoi-Pyongyang axis," which many of his officers and political followers resented. Muslim groups feared that the Sukarno government was sliding from "guided democracy" to "communist despotism." Sukarno's relations with the Soviet Union and China were especially disconcerting to President Eisenhower.

The Indonesian military had played a large role in the national revolution that gained the Indonesians their freedom and was deeply involved in the new nation's politics. But the military was not a unified force. Officers in the eastern archipelago and Sumatra engaged in many illicit endeavors. Sukarno feared the power of the officers from wealthy families whose members had served as attachés and representatives in Washington, and in 1955 issued an order transferring these officers out of their home localities. The result was an attempted coup d'état launched during October–November 1956. Although the coup failed, the instigators escaped and went underground, and defiant military officers in some parts of Sumatra seized control of civilian governments. Eisenhower had admonished the CIA to "employ all feasible covert aid" to these rebel forces. On February 17, 1958, while Sukarno was out of the country on a five-week tour, a rebel army and political leaders met in Sumatra and proclaimed a new revolutionary government. President Sukarno returned to Indonesia from Japan and immediately imposed an air and sea blockade on Sumatra and the Northern Celebes and began bombing the rebel-held areas there.

I was summoned to Lundahl's office and told to get ready to exploit images from U-2 flights over Indonesia. When I asked if there was a particular island or islands of concern, he said no—all of them. We were fortunate in having good maps of Indonesia made by the Dutch colonists and oil companies operating in the area.

On March 28, 1958, Agency U-2s were deployed to Clark AFB in the Philippines and began to overfly the entire Indonesian Archipelago. Thirty U-2 missions would be flown, the last on June 7, 1958. Photo interpreters from the 548th Reconnaissance Technical Squadron (RTS) with security clearance and Earl Shoemaker and Myron Kreuger from the PIC were dispatched to Clark Field to interpret the photographs. We bundled up all the maps, charts, and reference material we had and sent them along. The interpretations, which were cabled to us, provided the most current information from the islands. Earle Kniebiebly of the PIC and personnel from Eastman Kodak set up the necessary processors.

Maj. Art Andraitis from the 548th RTS at Yokota grabbed as much collateral material as he could and proceeded to Clark to head up the Air Force team. Close surveillance was maintained on Indonesian airfields, military barracks, and port areas, especially on the main island of Java.

Lt. Gen. Earl Barnes, who would run the air activities, was a major player in the operation. Barnes visited the PIC a number of times. Requirements were levied and detailed studies were made of World War II bomber airfields in Halmahera and the Celebes Islands. Bob Boyd and Vince DiRenzo were given World War II photos of Pitu and Pitu Wama airfields on Halmahera along with the U-2 images to determine if the World War II-vintage aircraft in the area could presently use them. They were also to report on the conditions of the fields' runways, buildings, water towers, and hangars. We also studied airfields in Palu and other airfields in the Celebes. We would later see B-26 Invaders and P-51 Mustangs at some of them. Although he was not trained to fly a P-51, U-2 pilot Carmine Vito took off in one and chased away some Czech-built planes that came too close to the airfield.

On March 12 Sukarno sent a small force of paratroopers to Sumatra, and U-2 images showed roadblocks and bridges and huts burned in the fighting. We made careful note of the oil fields that were owned by American firms but did not see any destruction.

Images made on April 4, 1958, showed extensive harbor activity and trucks and buses at Tanjung Priok, Djakarta's main port. Forty large vessels (most of Indonesia's naval order of battle) were either loading or present in the harbor. This was the tip-off that the central government was preparing to invade Sumatra. The photography was expeditiously flown back to the United States, and briefing boards were made for Eisenhower. The U-2 mission of April 16 found the invasion forces ten miles west-southwest of Padang, Sumatra. During a briefing of Eisenhower on the situation, a State Department expert who had lived in Indonesia stated flatly: "They won't fight; they'll have tea at noon." We looked at images of the main rebel camps, and indeed, every person and every tent was gone. The rebel resistance movement on both Sumatra and Celebes had collapsed. Areas that once had tents were bare.

On May 18, during a bombing mission on Amboin Island, Indonesian forces shot down a B-26 and captured its pilot, Allen Lawrence Pope. At an April 30 press conference Eisenhower had assured the press that U.S. policy was "one of careful neutrality and careful deportment all the way through so as not to be taking sides where it is none of our business." When asked about Pope several weeks later, Eisenhower remarked that "every rebellion . . . has its soldiers of fortune, attracted by the lure of gain or adventure." Pope was released four years later when Robert Kennedy appealed to Sukarno. The U.S. government provided 37,000 tons of rice and four C-130 cargo planes to Indonesia as compensation.

The operation in Indonesia yielded a bonanza of information on Soviet arms and equipment. Sukarno appealed to the Soviet Union for help and soon afterward received some of the newest Soviet military equipment—allegedly from Poland, Czechoslovakia, and Yugoslavia. The Soviets provided Badger medium-range bombers, MiG fighters, Kennel coastal defense missiles, Komar guided missile patrol boats, destroyers, W-class submarines, radars, SA-2 surface-to-air missiles, and even a Sverdlovsk cruiser. The Indonesian military was extremely proud of the new equipment and loved to display it. They were happy to oblige when attachés asked them to pose in front of their acquisitions. Some of the best close-up photographs we ever received of Soviet military equipment came from Indonesia.

Laos and North Vietnam

In 1959 North Vietnam began to infiltrate troops into Laos, hoping to bring down the Laotian government. Although President Eisenhower felt that Laos had little economic or military value, the domino theory prevailed. If Laos fell, South Vietnam, Cambodia, and Thailand would be next. If Thailand fell, the Communists would dominate Southeast Asia. President Eisenhower authorized U-2 flights over North Vietnam and Laos to assess the situation. Missions were flown out of Takhli from January 3 through January 8, 1959, over the infiltration routes leading to the provinces of Xam Nua and Phongsaly. Priority targets were lines of communication and transportation and areas of suspected military equipment and troop concentrations. We were to report on North Vietnam's naval, air, and ground orders of battle.

We found no indications of "foreign troops" in Laos. But the missions overflew rugged terrain covered with dense foliage. Caves under the jungle canopy provided cover for invaders. The porous borders could easily leak arms and reinforcements for the insurgents. Further, the Laotian landscape was covered with trails the inhabitants used in their daily endeavors. President Eisenhower reflected for a long time after he saw our briefing boards detailing these problems. He recalled his personal knowledge of guerrilla operations. Referring to the difficulties the U.S. Army had encountered with the Moros in the Philippines and the Titoist guerrillas in Yugoslavia in World War II, he remarked that "in such terrain, the advantage clearly lies with the enemy." Considering Eisenhower's military knowledge of the conditions that would constrain a war in Vietnam, it seems unlikely that he would have committed a large number of U.S. troops to fight there as his successors did.

In December 1960 royalist and Pathet Lao forces were fighting in the Vientiane area. The Soviets supposedly flew more than 180 sorties into Laos in support of the Pathet Lao. The United States began flying supplies to the royal forces. Eisenhower summoned a conference on December 31 at which Deputy Director Charles Cabell reported that some "fifteen hundred troops, organized in battalions, were moving into Laos from the direction of North Vietnam, though their exact origin was still unknown."[28] Gen. Lyman Lemnitzer reported that an airplane accredited to the Laotian government had photographed Soviet planes airdropping supplies. Eisenhower concluded, "We cannot let Laos fall to the Communists even if we have to fight—with allies or without them."[29] He ordered U-2 flights of the area for operations planning.

U-2s flew seven missions over Laos and North Vietnam from January 3 to January 18 searching for the reported foreign troops. The reconnaissance concentrated on the lines of communications leading from Vietnam and China into Laos. A thorough search of all roads and paths turned up no troops or supply points. All of the North Vietnam airfields were searched for Soviet aircraft to determine the magnitude of the airdrop operations supporting Pathet Lao forces. Interpreters were sent to the Philippines to read the photographs. The photography again did not substantiate the Laotian government's claims.

A detachment of the U.S. Air Force 45th Tactical Reconnaissance Squadron out of Don Muang Airfield in Thailand flew sorties over both Laos and North Vietnam looking for the supposed concentrations of Pathet Lao guerrillas. The images they acquired were flown to Washington and interpreted at the PIC, and again no invaders were found. On January 26 the Laotian government retracted its claims of a foreign invasion.

After the original negatives of these January 16 and January 18 U-2 flights had been thoroughly reviewed, they were placed on a CIA C-47 for transport to the Eastman Kodak facility in Rochester, New York, to be duplicated for military customers. One of the C-47's engines failed on the flight to Rochester. To lighten the load and keep the aircraft airborne, the crew jettisoned forty-three boxes of the film over mountainous terrain near Williamsport, Pennsylvania. The plane made an emergency landing at the Scranton–Wilkes-Barre airport and the pilot reported the incident immediately to the CIA Office of Security. The Pennsylvania State Police sealed off the wooded area believed to contain the film, and Hans Scheufele, the PIC's operations officer, went to the site with a manifest of the forty-three boxes. When we were told that some of the boxes had fallen into a creek, a number of senior officers at the center were fitted with hip boots and were ready to travel to Pennsylvania. Fortunately, we received notice that all forty-three boxes had been retrieved and not one had been broken.

The Soviets' shipment of military supplies to North Vietnam caused increasing concern in Washington. We knew that the North Vietnamese had MiGs, but the big question was whether the Soviets had given them Il-28 bombers. A U-2 mission flown over North Vietnam on August 13 showed a large number of MiG fighters on the airfields but no Il-28s.

France

Relations between the United States and France deteriorated after World War II when Eisenhower refused to support the French in Vietnam at the battle of Dien Bien Phu. France's involvement along with Britain and Israel in the Suez War further strained the relationship. After the Agency received strong intelligence indicating that scientists Frederic Joliot-Curie and Madame Irene Joliot-Curie had Communist Party connections, intelligence officers were warned to be careful what was said to the French about U.S. programs. The Joliot-Curies were outspoken in their opposition to U.S. policies and urged an alliance with Britain to oppose the United States.

France's nuclear program brought new worries in Washington. Reports of a reactor under construction at Marcoule near the Rhône River sent U.S. aerial reconnaissance efforts into high gear and brought the PIC a raft of covert photography of the construction activity. The missions were flown under tight security controls. We analyzed the images and passed on our analysis to Hank Lowenhaupt and the Office of Scientific Intelligence. When construction for a gaseous diffusion plant began at Pierrelatte south of Marcoule, it too was covertly photographed. Eisenhower was briefed on the French program and saw briefing boards of both Marcoule and Pierrelatte.

The French decided to test their new weapons in Algeria and established a base camp at Reggane. The actual test center was about sixty miles south of Reggane.

Aircraft from Wheelus AFB initially overflew the site, which was easy to find because there was only one road leading south from Reggane to the test center near the Mali border, and the photography was kept in the SENSINT system.

When Eisenhower visited France in September 1959, he rode from the airport to Paris in an open convertible with President Charles de Gaulle and was warmly greeted by large crowds along the way. Col. Vernon Walters, Eisenhower's interpreter, later told me that when Eisenhower raised the nuclear issue with de Gaulle, the French president responded with typical arrogance that France had an important role to play in world affairs and that his nuclear energy program was part of France's nationalistic effort. Eisenhower accepted France's entry into the nuclear club, although with some regret, but de Gaulle knew that Eisenhower would not support France's efforts to keep Algeria as a colony. France later signed the Evian Agreement, which recognized the former colony's independence, and agreed to turn over their Sahara bases within five years. Walters told me that the "two old warriors" had pleasant evening exchanges as they discussed current world problems and reminisced about World War II.

Covert flights continued to monitor the Algerian test area, which now featured a test tower more than three hundred feet tall. The CIA was closely watching the area and published regular reports on the French nuclear program.[30] On the early morning of February 13, 1960, the French detonated a plutonium device. An aerial reconnaissance mission overflew the site that afternoon. The covert flights continued, and the analyses of the images were kept under tight security at the center. We prepared a series of highly classified briefing boards but issued no reports. On November 13, 1960, the CIA Office of Scientific Intelligence spelled out the entire French program for the president and the intelligence community.

The independence of Algeria and worldwide condemnation of their atmospheric testing in Africa forced France to seek a new test area. The French chose the Tuamotu Archipelago in French Polynesia, setting up a test site first at Mururoa and later on Fangataufa atoll, about twenty-five miles southeast of Mururoa—out of range of our Corona satellite cameras. It was Adm. Arleigh Burke who first proposed flying a U-2 off a carrier's deck, but only when James Cunningham suggested trials did the CIA accept the idea. In mid-1973 the CIA, in conjunction with the Navy, initiated Project Whale Tale with the goal of adapting several U-2s for carrier operation. Carrier flight tests began in August 1963 on the *Kitty Hawk*, based at the North Island Naval Air Station. Based on the results of those trials, the Navy and CIA modified three U-2s for carrier landings, installing stronger landing gear, an arresting hook, and wing spoilers to smooth the carrier landings. On May 19, 1964, two modified U-2s with carrier capabilities were placed aboard the *Ranger*, which proceeded to the South Pacific. The U-2s photographed the entire Tuamotu Archipelago, including Mururoa. The tracker was processed, and an NPIC photo interpreter conducted a detailed scan to make sure Mururoa had been covered. The film was rushed to the center, and a number of briefing boards and a detailed report were prepared. When Eisenhower was later briefed at his home in Gettysburg on the U-2 carrier flights, he was pleased that another reconnaissance weapon had been developed but smilingly admonished, "Don't let the Navy take over all U-2 flights."

When the French announced their nuclear presence, we had no problem viewing their efforts. We watched them construct eighteen silos for their missile force on the Plateau d'Albion between Avignon and Aix-en-Provence. We observed their Mirage IV supersonic bombers and their missile-firing submarines based outside Brest. France's nuclear efforts were so concentrated that a small fraction of the Soviet medium and intermediate missile force could have destroyed the entire French deterrent. We continued to report the French doing it their way.

Soviet Nuclear Program

President Truman's appointment of David Lilienthal, then director of the Tennessee Valley Authority, to head the Atomic Energy Commission (AEC) in 1947 brought a brewing crisis to a head. The highest levels of government could not agree on who was to have responsibility for intelligence on atomic energy matters. Gen. Leslie Groves, who had hoped to head the AEC, publicly questioned whether Lilienthal could be trusted to handle the commission's intelligence files. The director of the Central Intelligence Group, Gen. Hoyt Vandenberg, made a bid to take over the files and responsibilities. The National Intelligence Authority (NIA), which consisted of Secretary of State George Marshall, Secretary of War Robert Patterson, Secretary of the Navy James Forrestal, and President Truman's military adviser, Adm. William D. Leahy, made the decision. The NIA met on February 12, 1947, and agreed to transfer the AEC intelligence files to the CIA's Office of Research and Reports, which was responsible for creating estimates of Soviet nuclear capabilities and intentions and included individuals with a variety of personality and operational prejudices. On March 5, 1948, the CIA's Nuclear Energy Branch became a part of the newly formed Office of Scientific Intelligence.

Confusion also reigned when it came to which U.S. organization would be in charge of the various devices that detected nuclear detonations. A Long-Range Detection Committee was formed, and three basic objectives for a detection system were developed: (1) determine the time and place of all large explosions on earth, (2) obtain air and water samples from these explosions, and (3) establish the nature of each explosion by chemical and radiological analyses.[31] There was general agreement that the United States should have such a system, but how it would function was another matter. In the end, the Army Air Corps was given the mission. On September 16, 1947, following the instruction of the secretary of war, Army chief of staff Gen. Dwight Eisenhower sent a memo to Gen. Carl Spaatz, chief of the Army Air Corps, instructing him to assume "over-all responsibility for detecting atomic explosions anywhere in the world."[32] The Army Air Corps Air Weather Service, which was already flying long-range missions in areas of interest, formed the nucleus of the new organization. This action led to the formation of the Armed Forces Special Weapons Group, Section 1 (AFMSW-1); its successor, the Air Force Deputy Chief of Staff for Operations Atomic Energy Office, Section 1 (AFLOAT-1); and finally the Air Force Technical Applications Center (AFTAC). Systems were developed for long-range detection of sonic, seismic, and radiological events.[33]

I joined the CIA in March 1948 and subsequently met and maintained a liaison status with all of the members of the Office of Scientific Intelligence. Willard Machle, M.D., was the director when I arrived, but the office was beyond his abilities. H. Marshall Chadwell, his successor, was a lackluster director who tended to hold onto information while he made up his mind on sensitive intelligence issues. He had a number of highly qualified individuals working beneath him, however, including nuclear specialists I. D'Arcy Brent and Henry "Hank" Lowenhaupt; missile specialist Sid Graybeal; aircraft specialist Herb Bowers; naval expert Ernest "Zeke" Zellmer; mining expert Herb Miller; power expert Charles Reeves; and Sam Cummings, who handled intelligence on munitions of all types but especially small arms. Cummings later, as a civilian, headed Interarms and became the world's wealthiest arms dealer and trader. In August 1955 Chadwell was followed by H. Herbert "Pete" Scoville, a brilliant curmudgeon who was always engaged in some bureaucratic war, either within the agency or with the Department of Defense or the Air Force. He had difficulty controlling his emotions and could barely contain his animosity toward the Air Force.

The Soviet nuclear program operated under the tightest security, and we knew very little about it. Aerial reconnaissance was difficult because none of the secret installations appeared on any Soviet map. The NKVD (and later the KGB) played a key role in the construction and physical security of all Soviet nuclear projects. After Stalin's death in 1953, the nuclear program became the USSR Ministry of Medium Machine Building. When the Soviets gained nuclear strike capability, SAC began clamoring for precise site locations. It was clear that an all-intelligence collection capability global in scope was crucial. An undertaking as huge as the Soviets' nuclear program had to have security gaps; we needed means and methods to exploit them. The collection effort would encompass a spectrum of nuclear activities ranging from uranium mining to research and development, to production, to testing, to weapons storage. The range of collection efforts included novel signal, acoustic, and seismic intelligence; covert operations; open sources; information from German scientists and engineers who were involved in Soviet programs; scientific meetings; cultural exchanges; attachés' reports; and photos. Radiological analysis of radioactive residues from Soviet tests characterized Soviet fission and thermonuclear weapons.

It appeared that most of the other Soviet ministries providing construction materials and supplies were not cleared on atomic matters. When trouble developed, the Soviets had a propensity to place blame on others rather than themselves, and this often created a breach of security. When the manager of a cement plant complained to a high official of the Ministry of Medium Machine Building that the Ministry of Transportation was not providing him with the appropriate rail cars to transport the cement, for example, the ministry official admonished him that "heads would roll" if the cement was not delivered immediately. The cement manager sent the cement in open cars that ran into a rain storm and arrived at the destination as concrete blocks.

The collection of intelligence on the Soviet nuclear program involved a high degree of synergism in the targeting, interpretation, and analysis of information. Sometimes the elaborate security measures the Soviets employed played right into the hands of photo interpreters analyzing U-2 (and later satellite) photography. Many of the nuclear-related industries were in forested areas in the Urals and Siberia that stood out against their surroundings and were relatively easy to find. Heavy transmission lines were an additional clue. Double fences with guard towers neatly defined the periphery of the installation and labeled it as strategic in nature. Additional security fences within the double-fenced areas accentuated the importance of the installation within the enclosure. Nuclear-related industries required enormous amounts of electricity. Photo interpreters followed power lines hacked through the wilderness that led to strategic parts of installations and often to critical underground tunnels. New rail spurs often led through one installation to an underground installation. Nuclear installations often had large barracks for security forces, primitive camps to contain the prisoners who were used to construct new projects, and new apartment complexes for staff that contrasted sharply with existing older ones. Atomic facilities required tremendous quantities of water, so imagery searches were concentrated along rivers and lakes.

Lowenhaupt was convinced that the Soviets had to have a research and development organization similar to those at Sandia and Los Alamos in the United States. Such an installation would house military guards, slave laborers, and prominent scientists. For information on the latter he relied on the Biographic Register of the Agency's Office of Central Reference, which maintained files on prominent Soviet and East European scientists as well as institutional histories. One site that piqued his interest bore the names Base 112, Object 550, Yasnogorsk, Kremlyev, Arzamas 75, and Arzamas 16. We could not find any worthwhile information on the city of Arzamas, but we discovered that the nearby town of Sarova was known for its monasteries and had been an important pilgrimage town. It also had housed a small artillery plant that was probably associated with the artillery plant in Gorki.

When we received excellent U-2 photographs of the area in February 1960, we found the installation the Soviets had referred to as Arzamas 16. It was my responsibility to name installations, and I named it the Sarova Nuclear Weapons Research Complex. The U-2 images revealed a large and elaborate nuclear weapons research and development complex, comparable in size to Sandia Corporation in Albuquerque, New Mexico, about three hundred miles east of Moscow and sixty miles south of Gorki. The installation was carved out of a birch forest, and its main mission was determined to be the design and testing of nuclear weapons. The site featured a large new housing area and a number of institutional and production buildings. The whole area was heavily secured with fences and guard towers. Within the complex worked some of the Soviet Union's most brilliant scientists.

Lowenhaupt returned to the Industrial Register when he encountered another enigma. A German POW claimed he had worked in a nuclear installation called "Kefirstadt." By consulting dictionaries, we found that kefir is an alcoholic beverage made from fermented cow's or goat's milk. We went back into our files and found that other POWs had identified the installation as being in the town of Verkhne Nevyansk. It was a gaseous diffusion plant, known as Sverdlovsk 44, about thirty miles north of Sverdlovsk. The site had taken on some of the appearance of the U.S. nuclear complex at Oak Ridge, Tennessee. At Kasli (Chelyabinsk 70), about twenty-five miles from Chelyabinsk, we found a large nuclear weapons research and development center similar to Sarova that we did not know about from other sources. Nearby was a nuclear enrichment plant at Nizhnaya Tura (Sverdlovsk 45). Satellite photography gave us a better look at the plutonium-producing underground plant at Dodonovo (Krasnoyarsk 26), thirty-one miles northeast of Krasnoyarsk on the Yenisey River. We found highly enriched uranium facilities at Zaozerniy (Krasnoyarsk 45) and weapons assembly and storage areas at Yuryuzan (Zlatoust 36) and Penza (Penza 19). A gaseous diffusion plant was found at Angarsk (Combine 820), a uranium fuel plant at Novosibirsk, and a uranium purification plant at Elektrostal, forty-five miles east of Moscow. We also looked at institutes where German scientists had worked: Institute A at Sinope and Institute G at Agudzeri, both near Sukhumi. We followed uranium-mining activities at Joachimsthal and at a number of installations in the Fergana Valley.

Eisenhower's interest in detecting Soviet nuclear testing intensified when he declared a testing moratorium that commenced on October 31, 1958, and the Soviets followed suit. The moratorium precluded nuclear weapons testing in the atmosphere, outer space, or underwater, although underground nuclear testing was permitted. The Semipalatinsk Nuclear Proving Ground was closely watched for signs of cheating. The moratorium would be broken when the Soviets resumed testing in September 1961. With the advent of satellite reconnaissance and frequent coverage of the test site, the PIC was often able to monitor test preparations at Semipalatinsk. We then reported on the impact caused by the test so it could be compared with AFTAC information to determine the weapons yield. When testing took place underground, we reported work on adits and shaft test preparations. The amount of spoil being removed from an excavation was sometimes computed, as were the depth and diameter of subsidence craters after detonations. AFTAC frequently called on us to examine areas of interest. A number turned out to be mines or spots where explosions had occurred at industrial installations. We often detected the firing and testing of large solid rockets.

Over the years the PIC would be asked to locate nonmilitary nuclear areas as well. The Soviets' program was analogous to—but conducted more experiments than—Plowshare, a peaceful U.S. nuclear program. Detection was difficult with the sparse U-2 flights. The Soviets conducted a number of nuclear tests for oil stimulation, to put out oil fires, to create underground cavities for oil and gas storage and water reservoirs, and for geological surveys. Two large events that are now regarded as failures were the attempts to dam the Shagan River and to create the Pechora-Kama Canal.

Soviet Arms Transfers

The Soviets' arms shipments to Egypt and Syria during the Suez War illustrated the insatiable demand that newly independent countries had for arms. Eisenhower did not like the Soviet arms shipments at all, believing they would further damage the relationship between the United States and the Soviet Union. He also believed that emerging countries could make greater progress by spending the money on food and development. He knew, however, that emerging countries were anxious to show their independence—and their military services to demonstrate their power and prestige—and that these countries found a receptive ear in Moscow. The Soviets used arms transfers to pursue their foreign policy objectives. First they would ship small arms, supposedly from Czechoslovakia. If there was no protest from the West and the demand continued, the Soviets were willing to provide a wide range of larger, newer military hardware, regardless of whether the weapons were compatible with a country's terrain or met a clear military threat. The Soviet Union's military supply effort began with its communist allies in Eastern Europe and China.

Soviet arms shipments to Egypt, Syria, and later Indonesia followed a distinct pattern. Initial shipments included small arms, automatic weapons, trucks, and logistical equipment to handle the heavier military pieces that would follow. Armor shipments consisted of T-34 and T-54 tanks, SU-85 and SU-100 assault guns, BTR-40 and BTR-50 armored personnel carriers, and PT.76 amphibious tanks. Antitank weapons included the 57-mm antitank gun and the Snapper antitank missile. Artillery would normally be 76-mm, 85-mm, 100-mm, 122-mm, 130-mm, and 152-mm howitzers and guns; truck-mounted rocket launchers; 82-mm and 120-mm mortars; and FROG (Free Rocket Over Ground) missiles. Naval shipments consisted of P-4 and P-6 patrol boats, Kronstadt submarine chasers, Komar guided-missile patrol boats, and often Gordy-class destroyers and Whiskey-class submarines. Aircraft included MiG-15 (Fagot), MiG-17 (Fresco), MiG-19 (Farmer), and MiG-21 (Fishbed) fighters; AN-2 (Cub) light transport aircraft; Il-14 (Crate) transport aircraft, Il-28 (Beagle) light bombers; and Mi-1 (Hare) and Mi-9 (Hound) helicopters. Antiaircraft weapons included 37-mm, 57-mm, and 85-mm guns; and, later, SA-2 (Guideline) surface-to-air missiles. A variety of engineering equipment, staff vehicles, and special-purpose vehicles would also be sent. On the receiving end of these shipments were such unstable leaders as Idi Amin of Uganda, Muammar Qaddafi of Libya, Pol Pot of Cambodia, Francisco Macías Nguema of Equatorial Guinea, Kwame Nkrumah of Ghana, several Marxist imams in Yemen, and Castro in Cuba. The Soviets often demanded privileges—such as port access—from the receiving countries and usually offered to train selected personnel in Russia.

Soviet merchant ships came under close scrutiny by intelligence collectors. Photographs were taken in Soviet ports; from shore; from other ships; and from aircraft flying at low, intermediate, and high altitudes. Vessels moving through the Bosporus and the Mediterranean were photographed by the U.S. Sixth Fleet and by squadrons stationed in Sicily and Spain. Once the ships passed Gibraltar or left the Baltic, U.S. planes from England and West Germany photographed them. The Coast Guard photographed them if they came near the United States. Covert operatives in ports also photographed them. The PIC received all these photos to analyze. Ed Cummings, a researcher in my branch who became a leading U.S. expert on Soviet shipping, maintained dossiers on all of the ships that transported arms.

When the Soviets began sending more sophisticated arms, they packaged the weapons in special containers. The ships that carried these crates were labeled "special interest ships" and we developed a signature for their identification. Lundahl instructed that the crates and containers be carefully analyzed and measured by photogrammetric means. He labeled the science of measuring, identifying, and cataloguing the crates and their contents "crateology." Bill Crimmins was the division's expert in crate identification, and he worked closely with Thaxter Goodell in the Office of Research and Reports. Protrusions on the crates were carefully analyzed and catalogued. The crates were then further identified as containing such things as fuselages, wings, engines, or rotors. Since most shipping crates containing aircraft were delivered to select ports, periodic photography of these areas made it possible to observe their various components being uncrated. Soviet equipment usually went to the more elite units in foreign countries, which proudly displayed them in military parades that were photographed by U.S. military attachés. When the Soviets agreed to finance large projects, such as the Aswan Dam in Egypt and the Bhilai Steel Mill in India, we monitored shipments of industrial equipment for these undertakings.

Argon (KH-5)

At the start of the Corona satellite program in the late 1950s, only 25 percent of the world had been mapped. Corona largely resolved that problem. Most of the existing maps were old; many had been created during World War II. It was not unusual to pick up a map and see a region labeled “unknown area.” One of the least-known areas in the world at that time was the Soviet Union. Maps and charts of the Soviet Union were under the strictest Soviet military control. Efforts to buy them failed. The Soviets had instituted a deception program for the few maps they did release, which did not show strategic cities or installations. The United States made maps and charts from Luftwaffe GX photos, but the area from the Urals to the Pacific remained a mystery. The only charts available were WACs at the scale of 1:1,000,000. The Urals and Siberia constituted a special problem for targeting purposes. British, Japanese, and Indian geodetic databases along with some Russian data captured by the Germans offered some information, as did accounts of expeditions during the czarist regimes. The towers used in mapping the Trans-Siberian Railroad still remained, but significant data on large unmapped areas of Siberia was lacking. William Mahoney, the chief photogrammetrist at the ACIC, remarked that maps and charts of some areas were wrong by as much as thirty miles. Map and chart makers needed up-to-date photography of every geodetic point on our planet. The ACIC and the Army Map Service (AMS) were clamoring for an independent mapping and charting satellite. What was needed was a system that could photograph vast expanses of Soviet territory and provide images to connect with geodetic data.

Amron Katz described the difference between a reconnaissance camera and a mapping camera as follows: “Mapping photography is designed to give information about the character of the terrain; reconnaissance/intelligence photography is designed to give information about characters on the terrain.”[34] A mapping camera can sacrifice resolution for area coverage; a reconnaissance camera cannot. Even if the world could be thoroughly surveyed and mapped, human-made features would continually change the topography. In order to make the necessary periodic revisions of maps, it was necessary to have geographic positions of fixed points along with the bearing and distance indicated from one fixed point to another in an ever-increasing degree of accuracy and over greater distances. Field Marshal Earl Alexander of Tunis, in an address in London in 1957, said: "The fighting services are very largely dependent in their activities on maps—and when I say maps I mean accurate and good maps. There is no doubt that as scientific development progresses and it enlarges the scope and speed of modern fighting, accurate mapping will be more necessary than ever it was in the past. . . . It is a curious thing to me that so much of the world is still badly mapped or not mapped at all."[35]

The need for accurate maps on the Soviet Union in the late 1950s remained unchanged from the situation in 1941, when German forces commanded by Field Marshal Karl von Rundstedt attacked the Soviet Union. Rundstedt "realized soon after the attack was begun that everything that had been written about Russia was nonsense. The maps we were given were all wrong. The roads that were marked nice and red and thick on a map turned out to be tracks and what were tracks on the map became first class roads. Even railways which were to be used by us didn't exist. Or a map would indicate there was nothing in the area, and suddenly we would be confronted with an American type town with factory buildings and all the rest of it!"[36]

Argon, approved as an independent mapping project on July 21, 1959, consisted of a satellite carrying a 3-inch-focal-length mapping camera along with a camera that would take star images at the same time the mapping camera photographed the ground. The goal was to obtain accurate geodetic locations over large areas of the Soviet Union. Twelve Argon missions were launched between February 17, 1961, and August 21, 1964; six were successful. The first Argon (Mission 9014A) failed, as did the next three. The fifth, flown on May 15, 1962, was a success, as were additional launches in August and October 1963. After six successful Argon launches, we could obtain precise geodetic information on any point in the Soviet Union.

Dr. Claus Aschenbrenner, a noted German expert in all types of photo rectification, solved a nagging problem in the mapping endeavor. Lundahl knew Aschenbrenner through his prewar work in the International Society of Photogrammetry and asked that he be given security clearance to see a frame of Corona film. The Corona cameras were panoramic, and rectified images appeared in the form of a bow tie. It did not take Dr. Aschenbrenner long to come up with the solution. The Aschenbrenner printer, as it would be known, produced a very large, near vertical, photographic reproduction from the panoramic photos. We experimented with the initial model and it proved successful. Additional printers were produced for the AMS and ACIC.

ACIC used data acquired by Corona and Argon satellites to create maps of ever-increasing accuracy that were critical for U.S. targeting for missiles and bombs.[37] ACIC and the AMS began massive programs to create high-resolution maps of the Soviet Union: 1:200,000 charts in the case of the ACIC; 1:250,000 maps for possible ground operations in the Soviet Union on the part of the AMS. Similar charts and maps were later completed on China. Argon's data came at a fraction of the usual cost and time involved in mapping, and without field surveys. The Navy Hydrographic Office used Corona photography to correct and update its nautical charts.

Manned Orbiting Laboratory (MOL)

The Air Force was obsessed with the idea of putting a human in a reconnaissance space satellite. When Eisenhower gave NASA the mission of putting humans in space vehicles, it was a big blow to the Air Force. For one thing, the NASA astronauts did not carry the cameras required for intelligence collection. The Air Force began funding its own programs for a "Man in Space Soonest" (MISS). Lockheed submitted a proposal for a cone-shape manned space capsule. The proposal did not receive a warm reception from the Air Force, which had much grander ideas of what a manned space reconnaissance system should be.

At 9:07 AM Moscow time on April 12, 1961, Yuri Gagarin of the Soviet Union made history. Seven men had already been selected for NASA's Project Mercury, but none would be the first man in space. The Air Force advanced its space plan in September 1961, with a manned space spy station as one of the objectives. In a 1962 congressional hearing, Lt. Gen. James Ferguson described the value of having a man in space: "Man has certain qualitative capabilities which machines cannot duplicate. He is unique in his ability to make on-the-spot judgments. He can discriminate and select from alternatives, which we have not anticipated. He is adaptable to rapidly changing situations. Thus, by including man in military space systems, we significantly increase the flexibility of the systems, as well as increase the probability of manned success."[38] The Air Force began conceptual studies of an ambitious space project in 1963.

The Manned Orbiting Laboratory (MOL), which was to be an elaborate photo reconnaissance vehicle, was controversial from its inception. Shortly after

Adm. William F. Rayburn became the director of the CIA on April 28, 1965, Art Lundahl, John Cain, and I met with him and Cain briefed him on the MOL. Rayburn had gained fame as the developer of the Polaris missile for Fleet Ballistic Missile Systems but had little experience in intelligence. He said he was interested in what the Air Force was doing. When we asked what part he would like the CIA to play, he said, "Keep your foot in the door."

Lundahl told Cain and me that we should help the Air Force in any way that we could. When the Air Force was informed of the DCI's interest, John Cain and I were invited to a meeting on the MOL held at Wright-Patterson AFB that was chaired by Gen. Bernard Schriever. Cain was the center's best-informed person on the project. He described the system as utilizing "the KH-8 camera which would produce strip photography, lateral pairs, and stereo pairs. The film would be developed in flight and transmitted to a receiving station on the ground. Depending on the latitude of the target, it would be possible to receive on the ground a photograph taken as little as 20 minutes before. Other targets might require as much as five days between the time they were photographed and the time that the picture would be transmitted to a receiving station on the ground." Plans called for crews to make month-long stays in the MOL, returning the exposed films to earth in capsules. The Air Force had projected an IOC (initial operational capability) date of November 1968.[39]

At a later meeting at Wright-Patterson, each representative was asked what he could contribute to the program. Cain, of course, offered his photogrammetric abilities. I asked what intelligence training the MOL astronauts would have, and was told none. I said that if the astronauts were cleared and Art Lundahl and Richard Bissell agreed, the NPIC could brief them on the geography of the areas they would be flying over and the high-priority targets they would be viewing. Both men did agree, and a ten-day course that I submitted to Lundahl was approved. It would be conducted under the auspices of the Agency's training division using the NPIC's briefers. Eight astronauts visited the center as civilians to conceal their identity. The astronauts tested well on target identification and appreciated the geography lessons they received on the Soviet Union, China, and the Middle East. They also appreciated the briefings on the Soviet and Chinese missiles, nuclear, chemical/biological/radiological, and aircraft production and test centers that would be their targets.

The MOL program was plagued with large cost overruns and delays. A large launch tower had to be constructed at Vandenberg AFB, and ground stations had to be located. There was friction between the Air Force and the Department of Defense, with the Air Force questioning the DOD management system. The United States now had two expensive—and competing—space programs. Questions were being raised in Congress as to why the project was not a NASA program. The Navy felt left out and wanted its own MOL. The White House was raising questions about the spiraling costs of the MOL. The Land panel prepared a long report to then-presidential science adviser Donald Hornig stating, in essence, that the proposed MOL project could be carried out better and more cheaply with computers than with people. William O. Baker would later remark that the Technological Capabilities Panel "saw the MOL being projected as the answer to the dreams of those who favored very much more extensive space flight with the intelligence function being the primary element of it, rather than some kind of meteorological or astronomical mission. . . . And we just could not find what we were going to get out of it beyond what we were already doing in intelligence."[40]

The cost overruns continued, and Vice President Hubert Humphrey became involved. President Johnson had charged Humphrey with monitoring space technology and wanted an evaluation of the two programs. After a day of briefing, Humphrey was aghast. "Hell," he said, "you are going to have Walter Cronkite looking over your shoulders and how are you going to explain the photography that will be returned?" He admonished the Air Force, "We don't have that kind of money and the president is looking for money for some of his social programs." He announced that he was going to recommend that President Johnson cancel the program. The Land panel reviewed the MOL project and reported to Hornig that the proposed mission could be carried out better and cheaper with computers aboard. The debate continued long after Johnson left office. President Nixon finally axed the program in June 1969.

Tibet, China, and the China-India Border

Prime Minister Nehru of India faced big problems in the late 1950s and early 1960s. He had China on one border and Pakistan on two. Always unwilling to provoke the Chinese, he pondered the wisdom of every move. He remained stubbornly married to the old notion that if he did not bother the Chinese, they would not bother him. But there was always friction on the China-India border. During the summer of 1960 Eisenhower and Nehru discussed China's frequent border incursions. Eisenhower later recalled that Nehru "was remarkably calm in discussing the subject, but did say that all India was determined to protect its territory no matter what the cost."[41] During the summer of 1962, however, relations between China and India began to deteriorate in ominous fashion. The Indians shifted some of their troops and began establishing a series of border posts in disputed territories.

Nehru was not considered a friend of the United States for many reasons; one in particular was his support of China's annexation of Tibet in 1954. He did not protest the Russian invasion of Hungary, either, and many viewed his policy of nonalignment as favoring the Communist countries. Eisenhower was particularly bewildered by Nehru's confidence in V. K. Krishna Menon, India's ambassador to the United Nations. "To many of us," Eisenhower wrote in his memoir *Waging Peace*, "Mr. Menon appeared to have more respect for Communist doctrine than for western culture, government or leaders."[42]

We had just survived the thirteen days of the Cuban Missile Crisis when Lundahl called me into his office and told me to get ready to exploit images from Tibet, China, and the India-China border. President Kennedy had authorized U-2 missions to be flown over Tibet, over the battle areas where Chinese forces were attacking the Indian army in the North East Frontier and in the Aksai Chin region, and also over areas where Chinese strategic weapons might be deployed. As we began our preparations I told Lundahl that we might have problems delineating critical areas because the border area between India and China was not clearly defined. Several maps showed both the border claimed by India and that claimed by China.

The first of four U-2 missions was flown on December 5, 1962. The images we received showed that a number of the Indian border outposts had been destroyed. In the North East Frontier Agency, Indian tents and equipment lay scattered. Chinese forces were about twenty or twenty-five miles inside India. In the Aksai Chin area we spotted small Chinese forces near the border. We could delineate Chinese forces by the Soviet equipment they possessed and the fact that the Chinese made extensive use of ponies over rugged terrain. We made briefing boards of the North East Frontier Agency and the battle areas near the Leh Airfield in the Aksai Chin area.

On top of all these problems for India, Nehru died on May 27, 1964. Many have claimed that his death was hastened by his loss of prestige and self-esteem. He was replaced by the grandfatherly Lal Bahadur Shastri. Hardly anyone in the United States—or India—knew anything about Shastri's foreign policy positions.

Furthermore, collusion between the Chinese and Pakistanis seemed possible, and many feared that Pakistan would move into Kashmir if China attacked India again. Ayub Khan, the prime minister of Pakistan, had made known his displeasure that the United States and Britain had provided military aid to India.

In December 1964 Lundahl notified me that missions would again be flown over Tibet, deep into China, and along the China-India border. The images we analyzed this time showed that Tibet remained the same, but most of the Chinese invading forces had left India. A U-2 mission flew north of the Karakoram Range along the western and northern borders of Xinjiang Province. We saw little or no military activity on the images it returned and did not spot any Chinese strategic installations, but we did see miles-long caravans of sheep, goats, cattle, and ponies. Lundahl asked if they could be moving to support an invasion of India. Dorothy Randolph, our librarian and a very competent researcher, found the explanation in a June 1929 *National Geographic* article. Nomads and their flocks were moving from summer to winter pastures. There were two migrations a year—one in the summer to the high summer grazing grounds, and one in the fall to sheltered regions in the valleys. I showed Lundahl the article, and on one page there was a ground photo depicting almost exactly what we were seeing on the U-2 photographs.

Cuba

President Eisenhower simply could not tolerate Fidel Castro. "By early 1960," he wrote in his memoirs, "there was no longer any doubt in the administration that something would have to be done—the questions were what, when, and under what circumstances."[43] Eisenhower turned to Allen Dulles and the CIA for the answers.

On the basis of covert CIA successes in Iran and Guatemala, the Special Group made a formal decision on January 13, 1960, to overthrow Castro. Eisenhower stressed that only a few people should be informed of the plan, which was named "A Program of Covert Action against the Castro Regime." Although Bissell would handle all covert and clandestine operations, his first concern was training Cuban exiles to invade and retake the island. On March 17, 1960, as the Democrats were denouncing Eisenhower for his "do-nothing" policy with regard to Castro, the president "ordered the Central Intelligence Agency to begin to organize the training of Cuban exiles, mainly in Guatemala, against a possible future day when they might return to their homeland."[44] Bissell briefed Lundahl, who said that the PIC would support him in whatever way he suggested. Lundahl called me in and said, "Get ready. Bissell wants Cuba overflown."

On July 9, 1960, Khrushchev addressed the All-Russian Teacher's Conference. After noting his displeasure at American missiles being emplaced in Italy and aimed at Russia, and at Eisenhower's announcement that the United States would no longer buy sugar from Cuba, Khrushchev said that the Soviet Union "will do everything to support Cuba and its courageous people in their struggle for freedom and national independence." Then he warned:

> It should not be forgotten that the United States is not so inaccessibly distant from the Soviet Union as it used to be. Figuratively speaking, in case of need Soviet artillerymen can support the Cuban people with their rocket fire if the aggressor forces in the Pentagon launch an intervention against Cuba. And let them not forget in the Pentagon that as the latest tests have shown, we have rockets capable of landing on a particular square at a distance of 13,000 kilometers. This is a warning to those who would like to settle international issues by force and not by reason.[45]

Eisenhower dismissed Khrushchev's warning, but in the middle of July said, "As you know, Khrushchev has publicly ridiculed the idea that the Soviet Union would ever put missiles in Cuba when he can launch them from the Soviet Union. But recently a number of large unidentified packages have been brought into Cuba, and one military base has been put out of bounds. It may be that the Soviets are putting up a short-range missile base somewhere on the island. We're watching to see what they are doing."[46]

The planning for an invasion of Cuba went into high gear. The biggest concern was where the troops should land. U.S. Navy aircraft flying into and out of the Navy base at Guantánamo had made covert flights over the rest of Cuba, and we had prepared several reports for the deputy director for plans based on these flights. But as planning for a possible invasion began in earnest, we interpreted the Navy photography "for strike planning, to determine safe areas, and for detailed beach study for planned landings."[47] Bissell called for U-2 photography. The action memo stated that "a requirement exists for complete aerial photographic coverage of Cuba, simultaneously if possible, in support of proposed clandestine paramilitary operations designed to bring about the overthrow of the present regime in that country."[48]

Photographic coverage was needed to determine the air and ground orders of battle, targets, landing zones for airdrops of troops and supplies, and landing areas along the coast for surface operations. Intelligence information was needed on the scope and disposition of expected military air support from Soviet bloc countries, especially on high-performance aircraft, antiaircraft artillery, radar, and tanks. Details were also needed on the current status of selected areas, aircraft and ship deployments and facilities, POL (petroleum, oil, and lubricants) storage, troop concentrations, the status of key sabotage targets, infiltration routes, and drop zone sites. Poststrike reconnaissance would be required after the invasion. When the State Department expressed concern about losing a U-2 during one of the overflights, James Cunningham, the senior U-2 official, was quick to point out that if there was a flameout anywhere over Cuba the U-2 could easily glide to McCoy AFB near Orlando.

Eisenhower authorized the first U-2 flight over Cuba on October 26, 1960. There was heavy cloud cover over the island that day. The mission was repeated the next day, when the weather was better, and again on December 11, giving us almost cloud-free coverage of the whole island. The missions were staged out of Laughlin AFB near Del Rio, Texas, and the PIC sent a team of interpreters under Earl Shoemaker and Gordon Duvall to the air base. After the first two missions the planners realized that flights before 7 AM, before the daily cloud buildup, gave the best results. The film was interpreted as it came out of the processor, and results were cabled to Bissell at CIA headquarters. The photo interpreters were aided by the excellent maps of Cuba that the AMS had prepared during Batista's regime.

Three basic covert operations against Cuba were planned. The first involved the infiltration of agents; the second involved logistical or cache operations (i.e., delivering provisions and equipment for indigenous groups opposed to Castro); and the third involved sabotage operations. Sabotage operations initially were to be against small targets. We would check the resulting damage by examining U-2 photographs. Loss of the Esso oil refinery in Havana and the oil refinery in Santiago de Cuba would have been particularly damaging to the Cuban economy, but they were never struck. The president frequently met with DCI Allen Dulles to keep abreast of the situation. Eisenhower biographer Stephen Ambrose noted that in February Dulles "brought along some U-2 photographs of a Cuban sugar refinery, along with CIA plans to put it out of action by sabotage. Eisenhower scoffed at this puny effort, noting that such damage could easily be repaired and telling Dulles that the CIA had to come up with something better."[49]

Not long after Castro took power, more than a year before the Russians began sending arms to Cuba, unevaluated reports began warning of offensive missile sites being constructed in Cuba. The most persistent rumor both in Cuba and among Cuban refugees in the United States was that the Russians were constructing a missile site in the Zapata swamp. We checked out all reports but did not find any sites. A U-2 mission did not reveal any movement of Castro's forces. The imagery's value lay in the importance of establishing a baseline of data on Cuba from which we would monitor succeeding events.

There was a flurry of activity at the center as we prepared detailed reports on the requirements listed by covert operators. One of the most important was selecting areas where agents could be dropped. Our reports covered Cuba's principal airfields—San Antonio de los Baños, Campo Libertad in Havana, Holguin, Mariél, and Santa Clara. The air order of battle consisted of eighty-four propeller-driven aircraft and seven American-made T-33 jets. The Agency's B-26 bombers were to crater the runways at both San Antonio de los Baños and Campo Libertad so no Cuban aircraft could take off.

We provided Bissell with photos of many of the proposed landing and drop areas. At first it appeared that the Trinidad area on the southern coast of Cuba had been selected for the invasion, but then we heard it was shifted to the Bay of Pigs at President Kennedy's insistence. A number of Navy experts who visited the PIC remarked that the Joint Chiefs of Staff were wary of the Bay of Pigs plan. U-2 missions were flown and information forwarded personally to Bissell. Planning progressed, and there were additional U-2 flights on November 27 and December 5 and 11. Since this was a covert operation, Lundahl decided—and Bissell agreed—that all work was to be the responsibility of a separate cleared unit at the PIC using only CIA photo interpreters working under Zigmund Lenchert and Ray Gripman. None of the military service representatives at the center would be made aware of what was going on regarding Cuba. Later, PIC photo interpreters were dispatched to a base where the CIA was training the covert brigade. Back at the center, we were hearing two opposing views. The JCS, still concerned about the plan to land the Cuban force at the Bay of Pigs, favored Trinidad, a city near the Escambray Mountains about eighty miles from the Bay of Pigs. Admiral Burke opposed Secretary of State Dean Rusk's plan to have the renegades launch their offensive from the Guantánamo Naval Base.

When the Kennedy administration took over, additional problems began to develop. President Ydígoras Fuentes of Guatemala wanted the brigade out of his country by March 1961. The brigade, called "the best army in Latin America" by Gordon Gray, was getting impatient. On February 3 JCS chair Gen. Lyman Lemnitzer outlined many of the deficiencies in the CIA's plan for the invasion. He emphasized that intelligence indicated a lack of popular support among the Cuban populace.

On the afternoon of May 15, 1961, the invasion plan was revised; the invasion would occur at the Bay of Pigs. The landing site was selected because the beach was firm and was surrounded by extensive marshlands. The only approaches to the beach were three causeways and a road that ran along the southern shore of the bay. The idea was that if any of Castro's forces came across the causeways, they would be eliminated by air and ground fire. At the last moment Lemnitzer appealed to Kennedy to allow the U.S. Navy's Caribbean Task Force to provide the Cuban brigade with air cover, but Kennedy would not agree. Later, Admiral Burke pleaded with Kennedy to order the *Essex* air group to defend the beach area, but Kennedy said he wanted no direct American involvement in the operation. Senator Barry Goldwater called the president's refusal to provide air cover gutless.

U-2s flew over the Bay of Pigs both during and after the invasion. The NPIC reported on the unsuccessful landings at Blue and Red beaches. When the landings failed, Bissell asked the center to conduct a bomb damage assessment of the Campo Libertad and San Antonio de los Baños airfields. The two T-33 trainers stationed at San Antonio de los Baños had done considerable damage to the ships of the invading forces. Images of San Antonio de los Baños showed no craters on or near the field. We were later told that the pilots had chickened out and did not bomb the airfield. Bombs did land on Campo Libertad, but on the far end of the runway, and we reported that planes still could take off. We sent Bissell photos of the Bay of Pigs landings and of the burning supply freighters. When it was all over, Bissell sent Lundahl a letter of commendation for the work we had done in our exploitation and reporting. We later aided in an in-depth analysis of the Bay of Pigs operation.

After the mission failed, there were some reports that Robert Amory, the deputy director for intelligence, had no knowledge of the details of the operation. Amory would not take that way out: "I had all the photo interpretation of the agency under my command, and my senior photo interpreter, Art Lundahl, kept me advised on what they were taking pictures of, so I knew informally what was going on."[50]

Kennedy publicly took responsibility for the fiasco but privately sought revenge. The Bay of Pigs had damaged the Agency's image in the eyes of the world, and Allen Dulles resigned on November 29, 1961. Bissell left the Agency on February 17, 1962, and in March became the president of the Institute for Defense Analysis. Lundahl and I agreed that the Agency would have had the finest technological developments in the field of intelligence collection had Bissell remained in the technical side of the Agency.

President Kennedy chose John A. McCone to succeed Dulles. Presidential advisers James Killian and Edwin Land were quick to explain to McCone their strong opinion that the scientific and technical part of the Agency should be a separate entity and not part of the Plans Directorate. On April 15, 1962, McCone established the Office of the Deputy Director of Research and named Herbert "Pete" Scoville as its first director. On April 23, 1962, Ray S. Cline replaced Robert Amory as the deputy director of intelligence. Scoville did not command the standing of Bissell and resigned his position on April 25, 1963, to be replaced by Albert D. "Bud" Wheelon, who was placed in charge of the new Directorate of Science and Technology on August 5, 1963. The TCP was pleased with Wheelon's selection. William O. Baker would comment, "We felt that the CIA was making enough progress—and heaven knows it was slow at the time—and moving away from this culture of people jumping out of airplanes and going into systematic technology and really having somebody there that knew [what to] do with it, which Wheelon did."[51]

Mainland China Flights

As part of Operation Soft Touch, U-2 missions were authorized to fly over the People's Republic of China to reach Russian targets. Communist China became a prime target when it became known that the Russians were aiding the Chinese in the development of both missile and nuclear capabilities. On August 15, 1958, Bissell submitted a recommendation for U-2 flights in the Far East. Gen. Nathan Twining, Secretary of Defense Neil McElroy, and Secretary of State Christian Herter concurred. Andrew Goodpaster's notes of the meeting record that "Mr. Herter further advised Goodpaster that in the field the timing was ripe for such action. The president gave the go ahead for one or two such U-2 flights."[52]

The missions were flown on September 3 and 4, 1958. The images they returned showed the missile test center at Shuang-Cheng-Tzu, which bore a resemblance to some of the missile facilities at the Soviet missile test center at Kapustin Yar. The first nuclear facility imaged was the 1,900-by-150-foot building at Lan Chou on the Yellow River, which was immediately identified as a possible gaseous diffusion plant. The salient question was whether the plant was operational. The key to the answer was power. Transmission lines connected the plant to a thermal electric plant in the city. There was also a transformer yard at the plant. Lowenhaupt and power specialists emphasized the importance of watching the installation of transformers alongside the plant. There were places for thirty-eight, but at the time of the initial coverage only two had been installed.

It was clear that aerial and satellite photography would have to provide the bulk of the intelligence on Chinese nuclear and missile targets because so little information was available from other sources. In some respects China represented a more challenging intelligence problem than the Soviet Union because we had so little collateral information on what was happening there. The Chinese did not have the Soviets' penchant for horizontal security that made strategic targets relatively easy to spot from above. Plant perimeters were not easily identified because the plants blended in with civilian housing. Chinese construction patterns also differed from Western practices. The requirements we received were so vague that we had little guidance regarding what to look for. Photo interpreters decided the best approach was to look for anything that was interesting, different, or new.

In January 1959 the Departments of State and Defense, the JCS, and the CIA concurred that the Air Force could commence training six Chinese Nationalist pilots to fly the U-2. Eisenhower was finally convinced, and in March 1959 Taiwanese pilots were sent to Laughlin AFB in Texas for training.[53] Bissell remained reluctant to let them fly missions because the United States was still flying missions across China and over the Soviet Union, and he did not want an international incident if a U-2 flown by a Chinese Nationalist pilot should be downed. The U-2 flights over China continued until Gary Powers was shot down. That event plus Eisenhower's promise not to overfly Russia had dampened the president's interest in U-2 flights.

Ray Cline, the CIA's chief of station in Taipei, enjoyed good relations with both Chiang Kai-shek and his son, Gen. Chiang Ching-Kuo, Taiwan's defense minister. He not only knew all of the senior Chinese officials but also, according to one observer, had Chiang Kai-shek in his hip pocket. Cline began agitating for the Agency to sell several U-2s to the Chinese Nationalists and met with Eisenhower on a visit to Washington to make the pitch. Eisenhower wanted to know more, and Cline convinced him that the Chinese had good flyers, were being trained to fly the U-2, and would fly missions over mainland China. They were already flying RB-57s over the mainland. Cline told me that Allen Dulles "was hesitant" about pressing Eisenhower for Nationalist U-2 flights and let Cline sell the idea to Eisenhower.[54]

Cline visited the center to determine if we could interpret the film so that he could use the information to brief the Chinese. Lundahl assured him that we could. Although Eisenhower still had doubts, he gave his approval to Cline for the sale of U-2s to the Chinese Nationalists on May 6, 1960. The Chinese would fly over Communist China, and the CIA would receive the original negatives and then make duplicate copies for the Chinese Nationalists. There would be two sets of requirements for each mission, one from the United States and the second from the Chinese Nationalists.

Lockheed sold the Chinese Nationalists three U-2s for $6 million; the price included the services of Lockheed ground crews and technicians. The first two U-2s were delivered in July 1960 to Taoyuan Air Base, south of Taipei.[55] The aircraft had a black velvet finish, and the squadron that would fly the missions became known as the Black Cat squadron. On August 26, 1960, a reluctant Eisenhower and the State Department gave their approval for the transfer of U-2s to the Nationalist Chinese, along with the president's approval for the mission flights to begin in January 1962. The overflights were carried out under the name "Church Door," but they were listed as GRC (Greater Republic of China) missions and given numbers. The missions were planned by the CIA with contributions from Taipei. To my knowledge, Eisenhower never turned down any of the proposed missions. I received advance copies of the flight tracks and conducted pre-Oak briefings similar to those for American U-2 flights and prepared to exploit the film. Eastman Kodak aided the Chinese in processing the film. The film was interpreted at the NPIC, and copies of the film and the results of our interpretation were given to the Chinese Nationalists. Cline was kept in the loop during all phases of the operation.

On September 25, 1963, a GRC mission covered the Lan Chou gaseous diffusion plant. A new wing had been added, and there was an attempt to conceal it through a disruptive pattern painting scheme. Earlier photography from a March 1963 flight revealed a nuclear reactor under construction at Pao Tao in Inner

Magnolia. It was a heavily secured installation. We immediately noted similarities to the Tomsk reactor in the Soviet Union, although the Pao Tao installation was an air-cooled reactor smaller than those at Tomsk. As late as September 1963, analysis of satellite photography indicated that construction was continuing throughout the Pao Tao site, including substantial work around the building housing the reactor. KH-7 photography from March 1964 indicated that major construction was still under way.

When nuclear analysts could not agree whether the Lan Chou and Pao Tao plants were operational, Lundahl proposed using an infrared (IR) scanner to settle the issue. The leading organization on the research and development of infrared scanners was the Texas Instrument Company of Richardson, Texas, which had produced scanners used by the U.S. Air Force and Army. The big question was whether these scanners could be quickly modified and be carried aloft by a U-2.

A prototype scanner was produced, and PIC photo interpreters and technical personnel were dispatched to Texas to conduct the necessary tests. To hide its purpose the scanner was given the name "FFD," for "forest fire detection," as if it were to be used by the U.S. Forest Service. The device was tested using a World War II B-24 at Love Field in Dallas to establish ground truth, with thermal power plants and transformer stations used as targets. The tests were successful for low-level flights, but questions remained about the camera operating at U-2 altitudes. The IR scanner was designed to fit in the U-2's Q bay. A number of daytime and nighttime tests were flown over cities and industrial installations. Lundahl had specifically asked for coverage of power plants, and especially of transformer stations at night. The imagery was scanned at the PIC and the results were good. The plan then was to fly missions over both Lan Chou and Pao Tao.

The flight to Pao Tao was aborted because of equipment failure. When the Black Cat pilot approached Lan Chou on November 26, 1964, the Chinese fired SA-2s at the aircraft. The pilot turned to evade them, so the imagery of the plant was skewed. We still did not know whether the transformers alongside the gaseous diffusion plant were emitting heat. The film was given to an accomplished World War II interpreter, Oliver "Ollie" Wilson. He was a cantankerous individual who hated to be disturbed, so he moved his desk and equipment into an empty film vault. Ollie was an accomplished architect, poet, artist, and electrical engineer. He worked with Texas Instrument officials and got help from Agency scientists. Left alone with U-2 and satellite photographs of the plant and the IR imagery, he was able to reconstitute the images. A large number of the transformers at the

Lan Chou plant were indeed emitting heat, and the plant was therefore probably operational. A nighttime infrared mission that was scheduled to fly over Pao Tao on January 13, 1965, was lost, probably shot down by an SA-2 missile. When the President's Foreign Intelligence Advisory Board saw our analysis of U-2 photographs and infrared images of Lan Chou, they recommended a continuation of U-2 flights over China.

The concern about China's nuclear capability extended into the Kennedy administration. China with nuclear arms would pose a broad challenge to the United States in Asia and could conduct military operations against neighboring countries such as Vietnam. Ray Cline, the former chief of station in Taipei, became the deputy director for intelligence in April 1962. He came to be regarded as the best deputy director the Agency ever had. Lundahl told us that President Kennedy had instructed Cline to explore ways to "rein in" or "take out" China's nuclear plants. With Lundahl's concurrence we made Cline aerial and satellite photos of all Chinese atomic energy installations. On a visit to Washington to meet President Kennedy, Defense Minister Chiang Ching-Kuo visited the PIC to view the images in Lundahl's office. There was talk about destroying some of the nuclear sites by commando raids, conventional bombing, or even nuclear weapons. Lundahl did not like the commando raid idea because without painstaking planning it might entail significant casualties. The effort would probably be mounted from a foreign base, but little thought seemed to have been given to a possible failure or the capture or elimination of the participants. "That's one tangled thicket I hope we don't get involved in," Lundahl said. He later told me that the plan had gone forward. The Defense Department became involved in the preliminary planning, and DOD officials came to the PIC to obtain copies of our photos of Chinese nuclear installations. In our meetings they discussed a number of sorties to damage or delay the construction of the installations. Chiang Ching-Kuo also visited Langley several times, but the director of science and technology was ambivalent about a commando raid. Like Lundahl, he was concerned that it was not a well-planned strategy.

Continued analysis of satellite photographs revealed a suspect atomic energy complex under construction near Yu-men. The center prepared a report on the installation in December 1963.[56] The location was later refined, and the site was renamed the Chih-Chin-Hsia Nuclear Complex (now referred to as Jiuquan). We prepared another, more detailed report on the suspect complex in August 1964 with images, drawings, measurements, and text. The report described one possible reactor building, a large probable reactor building under construction, a possible chemical separation plant, a thermal power plant, and a workshop area.[57] Images and other sources confirmed a facility for research and development at Tuoli, twenty miles southwest of Beijing. It would be later identified as the Institute of Atomic Energy.

When we analyzed images from missions flown over the mainland we began to note many anomalies in plants that had been highly publicized as Soviet contributions to the Chinese. The construction of missile and nuclear installations had slowed, and construction at many of the smaller plants had come to a complete halt. Boxes of machinery lay in yards and were not moved for months on end. Many analysts interpreted the delays as an indication that the Chinese were just slower than the Soviets at constructing things, but actually we were seeing the early signs of the Sino-Soviet split.

We maintained close surveillance with the Corona satellite of all the activities at the Lop Nor Nuclear Test Site in the Taklimakan Desert. An airfield had been constructed there, and we saw many tents, support facilities, and construction equipment. A 340-foot tower was surrounded by a security fence, and an array of cable scars led to a probable control bunker. Tents near the tower had been taken down, and no activity was visible. Lundahl thought that a test was imminent and reported these developments to DCI John McCone. To keep the Chinese government from reaping a propaganda bonanza from the upcoming test, Lundahl proposed that President Johnson steal their thunder and make an announcement about the upcoming test. Johnson deferred to Secretary of State Dean Rusk, who was quoted in the *New York Times* on September 29, 1964, as saying that "for some time it has been known that the Communist Chinese were approaching the point where they might be able to detonate a first nuclear device." Analysis of October 8 Corona photographs showed that all preparations for the test were complete, and workers and equipment had been withdrawn from the test area. There was hardly an international ripple when the Chinese tested a twenty-eight-kiloton atomic device on October 16. The NPIC would report the effects of the test visible on the ground. President Johnson was kept briefed on all developments and praised our efforts.

Friction developed between Donald Chamberlain, the director of the Office of Scientific Intelligence, and Bud Wheelon, the deputy director of science and technology, when Chamberlain would not admit that the nuclear fuel for the Chinese detonation came in the form of U-235 from Lan Chou. Satellite photographs revealed that the Pao Tao reactor had not begun operations until 1964, and was therefore an unlikely source. Some in the intelligence community speculated that the U-235 might have come from the Soviet Union or perhaps even from France. Lundahl cautioned us that our job was to report the facts as we saw them on the images. Later analysis of nuclear debris collected from the explosion indicated that the U-235 had indeed come from Lan Chou.

The CIA needed considerably more information on China's nuclear test program to do its job properly. Wheelon instituted a number of initiatives, in addition to overhead reconnaissance, aimed at this objective. When a plan to drop an instrumented pod near the Lop Nor nuclear test site was in the works, the makers needed to know what color it should be painted. The pod was to be parachuted into the Taklimakan Desert, where it would bury itself and send back data on the Chinese nuclear tests. I received a call asking if we had any information on the predominant color of the Lop Nor area. Bill Culkin, one of our photo researchers, found a few color photos of the area along with old film that showed the terrain to be dark yellow, so the pod was painted dark yellow. A Black Cat pilot flying a U-2 dropped the pod at Lop Nor as planned on May 27, 1967, but it did not transmit any data. Another U-2 flown to interrogate the pod had no luck. A number of subsequent attempts to interrogate the system were unsuccessful as well. When I asked Carl Duckett, later the deputy director of science and technology, what happened, he replied that most likely the sensor pod was on its side or there was a glitch in the communication unit.

The Church Door U-2 flights clearly showed the extent and effects of the past Sino-Soviet strategic cooperation. Among the center's greatest contributions was our discovery of all the plants and the test area associated with the Chinese nuclear program. The information on all these installations mainly came from the interpretation of U-2 and later KH-4 and KH-7 images.

Two events dampened the enthusiasm for covert action on Chinese nuclear targets: President Kennedy was assassinated, and President Johnson decided to avoid any military action that would require pilots to fly deep into China. As well, we began to spot SA-2 missile sites near Chinese strategic targets and cities. We were asked to search proposed GRC flight tracks for possible SA-2 deployments. We had no trouble identifying them, but the Chinese began playing a shell game, moving the SA-2 sites about and even camouflaging them. Paul Dietz, the branch chief responsible for the searches, came to me and demanded to be removed from the operation because the danger of a SA-2 site being moved between missions was great, and he did not want to be blamed if a Chinese U-2 was downed. I agreed, and Dietz and I met with Lundahl, who in turn reported to Agency officers involved with the GRC program that we could no longer be 100-percent sure about where the SA-2 defense would be from one mission to the next.

By 1966 the Black Cat Squadron was experiencing losses from SA-2s that had been deployed throughout China. Imagery obtained from KH-4 and KH-7 satellites eliminated the need for the dangerous missions flown by the Black Cat Squadron. Instead, Bob McCort and I were asked to prepare a yearly series of briefing boards on Chinese Communist efforts that the deputy director of science and technology would take with him to brief Chiang Kai-shek and senior officers in Taipei.

The Belgian Congo Rescue Operation

Among the most interesting missions I was ever involved in was the Belgian Congo rescue operation. The Congo, which had gained its independence from Belgium on June 30, 1960, was a violent and chaotic spot. It was also an area rich in mineral resources vital to European and American industries. Its charismatic leader, Patrice Lumumba, aligned himself with the Soviet Union and denounced Belgium, which had planned to maintain control over the new nation's rich resources through the Union Minière de Haut Katanga. The PIC was asked to search for signs of Russian equipment in the Congo. We found none. We received word in the early fall of 1960 that the CIA "had been told from the highest authority to do something to defeat the growing power of Lumumba."[58] That fall, Lundahl and I had our first meeting with Richard Helms, who ran the Belgium Congo covert operation. Over the following years I gained the utmost respect for Helms.

The PIC began receiving film from an array of reconnaissance missions flown by Belgians, Union Minière pilots, and CIA covert sources. B-26 bombers had a number of Cuban mercenary pilots and Cuban mechanics. Union Minière, the Belgium mining conglomerate, had purchased a number of planes from European aircraft plants and was also flying reconnaissance missions. We had difficulty discerning which organization flew what missions because we generally received a can of aerial photography with no markings or identification.

The chaotic situation in the Congo had the potential to endanger Americans living there, and the State Department wanted an evacuation plan. Lundahl assigned me as the center's representative to the National Military Command Center (NMCC) at the Pentagon, which was to consider various military evacuation options. John Hughes, representing the Defense Intelligence Agency, and I were told to help in any way possible with the task force. At the beginning, none of us knew much about the Congo. The first thing was to determine where American civilians were and what type of activities they were engaged in. For that we needed maps. I asked my map researcher, Nellie Robertson, to visit the CIA Map Library and all the military libraries around the Washington area very quietly and to bring back maps and charts of the Congo. Much to my surprise, she returned with an armful of excellent maps made by Union Minière. I took all the maps to the NMCC, which used them in planning various operations. Things remained relatively calm until Lumumba was murdered on January 17, 1961, and the usual tribal disturbances turned into a civil war. A group of rebels calling themselves Simbas began looting and taking white hostages, killing some. They posed a threat to the pro-Western government in Leopoldville led by Moise Tshombe.

Hundreds of European and American refugees were stranded at Stanleyville, many being held at the Victoria Hotel. Many Americans, including the embassy staff, were being held in the Sabena Guest House near the airport. Other hostages were being held at the Paulis Airfield. The U.S. Air Force was tasked with both airlift and photo reconnaissance responsibilities. The Simbas warned that if any planes were spotted over or near Stanleyville, they would kill all the captives. A C-97 with long-focal-length cameras from the 7499th Support Group in Wiesbaden, Germany, was deployed to bring back the images needed for an evacuation plan. A mobile photo lab from the U.S. Air Force 10th Reconnaissance Wing in France was also deployed.

The planning for an airborne parachute assault now shifted to Belgium. A detachment of U.S. C-130 and 82nd Airborne specialists visited Leopoldville for further planning. During this period we received aerial photography from the Agency-run airline and some unlabeled photography, probably from the Union Minière.

Missionaries are reluctant to leave their flocks during a crisis, and getting them to go to Stanleyville or any other point of refuge was almost impossible. U.S. Air Force planes were dispatched on low-level reconnaissance flights over missionary outposts in an effort to determine the whereabouts of the three thousand or so missionaries scattered throughout the Congo and to assess the condition of their missions. When we looked at the photographs, we were astounded to see that station after station had been looted or destroyed; furniture, papers, and books were scattered throughout the compounds.

As the Simbas seemed on the point of killing the foreigners in Stanleyville, a decision was made to intervene. The U.S. Air Force flew Belgian airborne troops to Ascension Island via Spain as part of Operation Dragon Rouge (Red Dragon), where they waited in secrecy for the command to proceed to the Congo. When orders came, the Belgium troops were flown to Kamina, an airfield in the southern Congo. At dawn on November 24, 1964, the troopers were dropped on Stanleyville after a bomber made strafing passes over the field. When the paratroopers secured the field, the C-130s began landing. More than two thousand hostages were rescued and airlifted to Leopoldville; several were shot by the Simbas. A second operation freed the hostages at Paulis, about 225 miles northwest of Stanleyville, the next day.

The UN Security Council authorized a multinational force to be sent to the Congo. The U.S. Air Force in Europe (USAFE) and the Military Air Transport Service (MATS) began an airlift that was originally designated Operation Safari and later Operation New Tape. MATS crews flying C-124 Globemasters and C-130 Hercules began flying from Chateauroux Air Base in France. Most flights were 1,500 miles or longer, and the planes flew and landed under difficult circumstances. For their role in the rescue operations the C-130 crews received the 1964 Mackay Trophy for the most meritorious flights by USAF aircraft.[59]

Flying reconnaissance at low levels is always hazardous because of the threat of small-arms fire, but on a photo acquired on one of these missions we were surprised and amused to see an unexpected threat: a Congolese man in the act of throwing a spear at the reconnaissance aircraft. I used it on one of the many "funny" briefing boards we prepared at NPIC. I labeled it an "unrevetted surface-to-air missile system" and wrote: "The missile, a Mark 1, Mod 1, has a manual guidance system, a mobile launcher with one-sling power velocity on takeoff, and considerable pucker power on impact. It is, however, of questionable accuracy and has an undetermined C.E.P. The refire capabilities have not yet been determined."[60]

Gen. Marshall Carter, the deputy director of the CIA, included the picture in the Agency's yearly briefing for past presidents. President Truman was delighted with the presentation, although memories of his own service as an Army officer moved him to reflect soberly: "I hope someone has advised the pilots to fly a little higher. Just imagine the effect on a young Air Force pilot if his service record showed that he had been downed by a spear." After a moment's reflection he added with a smile, "I am sure in that case you bastards would make certain that the record identified the weapon as a 'SAM, Mark 1, Mod 1.'"[61] General Carter agreed.

Precise Measurements

The military, especially the Air Force, was always demanding precise dimensions of Soviet missiles. We used the thousands of photos taken by U.S. Air Force, Navy, and Army attachés in Moscow during the May and October parades to ascertain them. Photogrammetrist Chris Mares created a system for determining critical measurements of objects that he called "the Metrical Trap." U.S. attachés stationed in Moscow were cleared into the project. The idea was to determine the three-dimensional shape of an object from a series of photographs taken at different angles, with premeasured objects in the background. Mares and Ralph Pearse tested the system on objects along the Potomac River.[62] During Soviet holidays, surface-to-air and surface-to-surface missiles were paraded in front of the old U.S. embassy across from the Kremlin. Mares had calibrated cameras set up on tripods in the windows of the embassy. Missiles moving along the parade route were photographed against backgrounds that had been precisely measured by attachés. It thus became a simple geometry problem for photogrammetrists to compute the length, width, and height of the missiles. With further refinements, a literal metric grid was established along the whole parade route, and precise measurements could be obtained not only of the missiles but also of their control surfaces, apertures, engines, and receptacles. The size and shape of missile nose cones were of particular interest. To further enhance the measurements' precision, American attachés went out at night and placed chalk marks on the Kremlin wall and measured the distance between them. The attachés also measured windows, doors, and gates along the parade route. Embassy automobiles whose dimensions had been precisely determined were parked along the parade route. Soviet missile troops brought in for the parades parked a number of GAZ and ZIS trucks along the route, and dimensions of the various truck models were obtained either from captured trucks stored at the Aberdeen Proving Ground in Maryland or from those purchased by the CIA's SovMat staff.

When the Air Force wanted to know the capabilities of the Soviets' SA-2 Guideline surface-to-air missile, the PIC used photogrammetric analysis to determine the missile's precise dimensions. The Air Force had a full-scale model created and tested it at the Tullahoma, Tennessee, wind tunnel. Later, captured SA-2 missiles were tested. Research determined that if a pilot saw one of the "flying telephone poles," as they were called, coming, he could evade it by making a specified G turn that the missile could not perform. U.S. pilots used this tactic in Vietnam.

Mares worked closely with Bill Mahoney, the senior photogrammetrist at the Air Force's Aeronautical Chart and Information Center. Mares briefed the Land panel on the "Metrical Trap," and the panel encouraged the use of photogrammetric analysis on similar problems.

The depth of the sea along Russian beaches was also determined through photogrammetric analysis. First, the PIC measured an attaché in a bathing suit—all of him: from head to toe, from nipples to belly button, from belly button to knees, and so on. During the summer, attachés would be photographed as they waded along Baltic and Black sea beaches. This technique provided a wealth of data on key beaches and sea depths that might be used by invasion forces in the event of war.

The SA-2 Threat

The Soviet Anti-aircraft Defense of the Homeland, often referred to by analysts as the PVO (after the acronym for its Russian name), had become the most extensive air defense organization in the world. Analysts at the PIC began to see new Soviet radar being deployed; it was given the NATO designator "Tall King." We first observed the radar installations in the northern reaches of the USSR, but we soon saw them being deployed in areas where the Soviets expected U-2 missions to be flown. The radar controlled an umbrella of SA-2 missiles over the principal metropolitan areas and strategic targets of the Soviet Union—usually four to six missile sites per target.

By 1959, SA-2 missile sites had also been deployed at strategic installations deep in the Urals and Siberia. U-2 flight tracks were adjusted to come no closer than twenty-five miles to such sites. A barrier defense of SA-2 sites also extended along the borders of the USSR, especially in the Baltic and Caucasus areas, where a number of U-2 flights had been conducted. All of the SA-2 sites were plotted and reported. Before a U-2 mission was flown, James Cunningham, who designed the flights, would send a mission track to the NPIC. We would return the track with a plot of every SA-2 site along the flight line. Cunningham would then move the flight line about twenty-five miles from the SA-2 site.

The missile test sites at both Kapustin Yar and Tyura Tam were defended by SA-2s, but surprisingly, the missiles were not fired when U-2s were photographing the sites. The presence of SA-2s and Soviet radar in areas where U-2s were flying generated concern at the White House. At the December 16, 1958, meeting with the Board of Consultants on Foreign Intelligence Activities, President Eisenhower expressed concern that U-2s were being tracked on almost every mission flown west of the Urals and wondered whether the intelligence that was being obtained was worth exacerbating international tensions. He was surprised to learn that the board felt that the intelligence gained was highly worthwhile and the program should continue.[63]

It was generally agreed that the Soviets had no missiles comparable to the Nike, which could reach an altitude of 60,000 feet, or the Ajax, which could reach 75,000. SA-2 sites were being constructed in extremely cold and arid regions where round-the-clock, year-round capability might be difficult to maintain. The Army Missile Command doubted that missiles kept in such regions would be very effective. Be that as it may, Lundahl asked us to pinpoint every SA-2 site on maps, and he made sure that they were sent to Bissell for use in planning future U-2 missions. Early in 1960 Bissell asked experts at the USAF Air Technical Intelligence Center to give him an assessment of the SA-2's capabilities. They replied: "The greatest threat to the U-2 is the Soviet SAM. Although the ATIC analysis concedes a remote possibility that the SAM may be less effective than estimated, their present evaluation is that the SAM (Guideline) has a high probability of successful intercept at 70,000 feet providing that detection is made in sufficient time to alert the site."[64] Bissell showed the memo to Lundahl, remarking that it was the best "hands on your ass memo" he had ever received.

On Sunday, May 24, 1959, Eisenhower was informed of the death of his secretary of state, John Foster Dulles. In a statement issued soon afterward he praised Dulles' "calm approach," adding that "his comprehension of the important factors in every problem, his firm conclusions, and his moral courage were majestic. . . . A lifetime of labor for world peace has ended. . . . We, who were privileged to work with him, have lost a dear and close friend as all Americans have lost a champion of freedom."[65]

Looking for New Methods and New Reconnaissance Vehicles

Eisenhower maintained a deep interest in any program involving new or advanced reconnaissance systems. On February 10, 1959, James Killian, Edward Purcell, and Edwin Land briefed the president on an acoustical system for detecting missiles leaving the atmosphere that was based on the existence of a "sound duct." The minutes of the meeting indicate that "the president asked why this duct exists and Dr. Purcell explained it is because the temperature of the air decreases at a certain altitude and at this level, sound tends to stay in the layer of air. The process is to put a balloon with a listening device in the layer of air. The president asked the height of this layer, and its thickness, and how the balloons could be kept at this height. He thought this might be difficult. Purcell said that the problem is tricky, but that experts think it possible of a solution."[66] Eisenhower gave his approval for the development of the system and directed it be controlled and managed at "a very high level."

Every aircraft that came along was considered for a reconnaissance role. In July 1960 the CIA conducted a survey to evaluate a number of proposed aircraft or existing space systems that might be adapted for reconnaissance missions; among them were the X-15, A-212, the proposed X-20 DynaSoar space plane, the XB-70 bomber, the X-15 research plane, and the GAM-77 Hound Dog missile. The DynaSoar (X-20) was planned as a single-winged manned spacecraft capable of maneuvering in space as a reconnaissance vehicle or as an intercontinental bomber, and also capable of landing like a plane. Art Lundahl, Chris Mares, John Cain, and I attended one of the DynaSoar briefings. After it was over, Lundahl said it was one of the worst half-baked efforts he had ever heard. Defense Secretary McNamara canceled the project on December 10, 1963, in favor of the Manned Orbiting Laboratory.

The CIA looked favorably on the North American B-70 Valkyrie, a high-performance Mach-3 bomber that was planned as a replacement for the B-52 bomber. It was considered an ideal reconnaissance vehicle and was proposed for modification as the RS-70 reconnaissance aircraft. Eisenhower asked George Kistiakowsky to conduct a study of the proposed aircraft. The long memorandum he received in response concluded, "Putting it crudely, it is not clear what the B-70 can do that ballistic missiles can't—and cheaper and soon[er] at that."[67] General Twining pleaded with Eisenhower to continue the B-70 program because a B-70 could be sent over the USSR "to search out and knock out mobile ICBMs on railroads." Eisenhower biographer Stephen Ambrose wrote that "Eisenhower snorted, 'If they think that,' he said, 'they are crazy!' He explained, 'We are not going to be searching out mobile bases for ICBMs, we are going to be hitting big industrial and control complexes.'"[68] Eisenhower canceled the B-70 project because he was not willing to spend lavishly on both ICBMs and bombers.

The cameras that reconnaissance aircraft would carry were another point of contention. General Twining directed that a model be made of every reconnaissance prototype—every multiengine jet, fighter jet, and propeller-driven aircraft along with a chart of their capabilities, cameras, and range. The profusion of cameras for both bombers and fighters sometimes dictated, at least in part, the configuration of new jet aircraft.

As mentioned earlier, the CIA's Directorate of Science and Technology had developed a drone that looked like a large bird and could fly about a thousand miles. The CIA also conducted experiments with homing pigeons with cameras strapped to their chests able to fly over denied areas. When one of the pigeons failed to return, considerable speculation arose as to what had happened to it. It did eventually come home, however, probably delayed because it had to rest several times because the camera was so heavy. The CIA also developed a remotely controlled dragonfly that could land on buildings and transmit conversations taking place inside. The problem was that it could not be launched when there was even the slightest breeze. The Agency also created a remotely controlled catfish.

KH-6 Lanyard

In 1960 and 1961, aerial and satellite photographs revealed a new surface-to-air missile site near Leningrad where construction seemed to be stalled. Another new but different surface-to-air site was identified near Tallinn. The signature of this type of site was unique: four batteries, each with six SA-5 Gammon launchers surrounding a single engagement radar site. Mitch Cwiek, the PIC's defensive missile interpreter, labeled it the "lollypop site." The Air Force immediately announced that the Tallinn site was probably an ABM system. The Corona KH-4 system lacked sufficient resolution to determine the capabilities of the site's radar. In order for the PIC to settle the argument, we needed a camera system with a resolution of five feet or less. In an attempt to get more information on the site, a hastily developed system for targets of high intelligence interest was created using the 66-inch camera that had been proposed for the E-5 Samos program. The Samos camera was refurbished by the Itek Corporation and incorporated into the Corona program. The new satellite was named Lanyard and given the designation

KH-6. Five Lanyard spacecraft were produced. The first launch, on March 13, 1963, failed, as did the second in May. On the third launch, in July, the camera failed after thirty-two hours. The Lanyard was expected to provide a two-foot resolution with a capability of creating a 40× enlargement, but the best resolution it ever achieved was six feet.

Cwiek made a model of the radar that went far toward proving that it was not an ABM system. The Air Force, however, was determined to have the United States deploy an ABM system and was using the SA-5 site to bolster its claim that the Soviet Union already had ABM capabilities. An Air Force colonel from Wright-Patterson AFB brought a senior noncommissioned photo interpreter to view a stereogram and model that Cwiek had prepared. The sergeant began describing the features in such a way that it was apparent to Cwiek that he had a preconceived idea that the site included an ABM system. According to Cwiek, "the colonel was so pleased I thought he was going to wet his pants." The Tallinn problem would not be solved until we received better photographs of the site. A 1966 National Intelligence Estimate stated that the Tallinn system was not an ABM, but the Air Force still argued that it was designed to be an ABM and that it would be effective against medium-range and intermediate-range ballistic missiles.

The President's Foreign Intelligence Advisory Board

President Eisenhower relied heavily on the abilities and recommendations of the President's Foreign Intelligence Advisory Board (PFIAB). Members of the board visited the PIC as part of their yearly meetings, and it was a particular pleasure for me to sit in on Lundahl's briefing and hear their questions. I have been asked which of all the many prominent people who served on PFIAB I found most impressive. General Doolittle is at the top of the list because he was such a great American in so many ways. The woman who impressed me most was Clare Booth Luce. When she made an appearance, all eyes were on her because she was always fashionably dressed and meticulously groomed. She was intelligent, inquisitive, and a very active member of the PFIAB. We frequently put on light table demonstrations so PFIAB members could see what we were seeing on imagery. One time I decided to try to stump Mrs. Luce. We had excellent-quality imagery of the former missionary complex in China where her husband was born. I said, "Mrs. Luce, here's an installation that we have been unable to identify." She peered into the microstereoscope and looked up immediately and said, "That's where my husband was born, isn't it?" I said it was, and she peered into the scope again. Looking at me, she said, "Can I tell him [her husband, Henry Luce] about it?" I looked at Lundahl, who nodded.

General Doolittle was invariably a good listener at PFIAB briefings. He, like Lundahl, had that unique ability to take something highly scientific or complex and make it understandable to a layperson. As the CIA moved into the technical age of intelligence collection, Doolittle's role in the PFIAB became more pronounced. He was always gracious in describing reconnaissance and Soviet technical issues to PFIAB members who were not knowledgeable about such matters. The day after the full PFIAB briefing, Doolittle would always return to the center by himself. After he was given a short briefing by Lundahl, I was usually assigned to take him around to various photo interpretation stations to view what we called our enigmas. It was a special privilege, because I had flown with the 12th Air Force, Doolittle's first major command. While Lundahl was obliging in allowing me to escort General Doolittle, he cautioned me to make sure that everything said to him was the absolute truth. Doolittle would usually visit Eisenhower the following day, before heading back to California, and would report on what we had shown him. Before Doolittle took his leave of us, he would always ask, "Is there anything I can do for you fellows?"

I had noticed a particular behavior of Doolittle's during his days as commander of the 12th Air Force. He would walk out to the flight line and tap one of his bomber pilots on the shoulder and say, "Let's go and play follow the leader." Doolittle had his own B-25 and would begin with basic maneuvers, keeping an eye on the young pilot following him, and then proceed to more complex maneuvers. Then the general would land his bomber, still followed by the young pilot. He would step out his plane and thank the pilot, then go back to the headquarters building without saying another word. This was General Doolittle's way of learning the proficiency of his subordinates. He looked at management and proficiency from the bottom up. I realized that he was doing the same thing when he visited the photo interpreters at the center: he was testing their proficiency in analyzing important and complex intelligence issues. Photo intelligence begins at the lowest level, the photo interpreter; information from his analysis flows to the highest officials, including the president.

While most people ascribe Doolittle's fame to his airborne exploits, he was far more than a pilot. He had a Ph.D. from MIT and was well versed in scientific matters. Of course, we always showed Doolittle photos of the latest Soviet bombers and fighters. He was concerned about a possible Soviet breakthrough in exotic space weapons.

While searching satellite photography in the mid-1960s—and with no collateral information whatsoever that it had been designed and produced—we saw a unique large craft at the port of Makhachkala in the Caspian Sea. Nearly three hundred feet long, it had a stubby wing, four jet engines on each side of the cockpit, and a high tail with electronic pods. It was reported as a possible surface-effect ship that literally flew on a pillow of air a few feet over the ground. The Russians called it an "*ekranoplan*." U.S. analysts first labeled it a "wing-in-ground-effect" (WIG) plane, for which there was no U.S. counterpart. Photo interpreters quickly named it the Caspian Sea Monster.[69] At first there was some thought that the design came from the Beriev Design Bureau at Taganrog Aircraft Plant No. 86, which specialized in large water-based airplanes, and had probably been produced in the Krasnoye Sormovo Plant in Gorki with help from Aircraft Plant No. 21 and transported in sections by barges to the Caspian Sea. Lundahl directed that it be precisely measured and a model made of it. The model showed the craft on a football field. Lundahl could not wait to show the model to Doolittle and Kelly Johnson. Doolittle looked at the model and shook his head. "We learned early that sea spray and jet engines don't mix," he said, then asked if we had seen any armament or missiles on the craft. We had not. He told us about the Martin Company's "Seamaster" bomber, a good-looking plane with swept-back wings and four jet engines. The prototype crashed into the Chesapeake Bay on December 7, 1955, killing four crew members. A second prototype also crashed. Doolittle also mentioned Convair's Sea Dart, a single-seat delta-wing fighter with twin jet engines. It crashed on November 4, 1954. The Navy canceled both programs and ended its interest in such aircraft. Doolittle asked if this Caspian Sea Monster was the only one we had seen. We said it was, and he replied, "It's some kind of experimental craft that I doubt would go far."

When Kelly Johnson was briefed on the Caspian Sea Monster, he asked what role the intelligence community ascribed to the craft. Lundahl mentioned a possible troop carrier. Kelly said, "That's one hell of an expensive troop carrier. You could do better with regular transports." Lundahl added that it could be used as a river passenger carrier. Kelly replied, "That would also be an expensive dog with the eight engines slurping up fuel." There was some discussion about it being an antisubmarine hunter. Kelly pointed out that flying only a few feet above the sea was not the way to hunt submarines. He asked Lundahl if he had a slide rule. Taking the measurements we had made, Kelly said the craft would fly about three hundred miles an hour at about fifteen to thirty feet over the sea. The Soviet Mail seaplane and other submarine hunters in the Soviet inventory flew at a relatively high altitude.

Senator Barry Goldwater was briefed on the Caspian Sea Monster as well. He asked if we thought the Soviets would feature it in the yearly Moscow air show. If it was up to him, he said with a grin, he would fly the thing past the 6th Fleet in the Med, adding that there would have been a lot of yellow Navy laundry in the fleet that day. The Monster crashed in 1980, but we never knew where. Satellite imagery showed parts of it on a barge, indicating that it had crashed at sea and the Soviets had recovered only pieces of it. The Soviets continued to develop WIG aircraft, but they were never deployed with any fleet units.

Doolittle particularly enjoyed our enigmas. I have often thought he looked at them as a test of his own knowledge. When we were not sure of an identification we would use the term "possible" or "probable." After hearing those words several times, he said it would sound better if we used the words "what may be" for "possible" and "what could be" for "probable." We subsequently did use those terms in our reports and also when the DCI prepared his congressional briefings.

Doolittle was intrigued with a facility we had named PNUTS (for Probable Nuclear Underground Test Site). It was a heavily guarded scientific station in the southeastern section of the main Soviet nuclear weapons testing area at Semipalatinsk in Kazakhstan. Initially, a nuclear reactor had been constructed there. Four large holes were dug, and four large steel spheres about sixty feet in diameter were lowered into the holes. Intelligence officials and scientists were unable to agree on the function of the facility. Several scientific panels established by the Agency would go over the information gleaned by Wilbur Dodd and Alfred Johnson, NPIC photo interpreters who studied every satellite photo taken of the installation. One postulation was that the Soviets were working on a nuclear engine similar to the U.S. Project Orion, whose goal was to develop a nuclear-powered cruise missile or bomber.

In the early 1950s the Air Force had looked at the possibility of a nuclear-powered reconnaissance aircraft or missile. The development of the engine was given the name "Pluto," which also came to refer to the device itself. The Lawrence Livermore National Laboratory was given the task to design a nuclear-powered cruise missile with virtually unlimited reconnaissance range. As envisioned, it could cruise below normal enemy defenses in its supersonic dash to Soviet targets. Jackass Flats in the Nevada desert was selected as the testing site. The engine, developed by General Electric, was mounted on a railroad car and moved by a locomotive some two miles from the assembly building to the test site. Twenty-five miles of oil-well casings were arrayed in the desert nearby to store air that would simulate ramjet conditions for the engine. When Doolittle looked at PNUTS, he started talking about the problems the United States was having with the nuclear engine in Nevada. The big problem was the amount of radiation given off by the engine. Doolittle said the Soviets would experience the same problems. “Heck,” he said of the Soviet effort, “they, like us, are going to radiate the whole state.” A number of us visited the Nevada site and were impressed at the extent of the contamination, which included the engine, the train, and the assembly building. As we walked to the tank farm we were mindful of the signs warning of radiation. Although the engine was tested successfully, the Pentagon had doubts about the project and chose instead to support the ICBM for deploying Atlas and Titan missiles. The Technology Capabilities Panel also had a hand in canceling the project. Panel member William Baker later recalled: “Nuclear power aircraft came up, and we spent a lot of time trying to dispose of it because it wasn’t a good idea.”[70] The project was canceled on July 1, 1956.[71]

Some in the Air Force believed that PNUTS was intended to be a nuclear engine for intercontinental missiles. The purpose of the large steel spheres, however, remained a mystery. The Air Force maintained that the spheres were created to contain the energy created by a nuclear device. The power released would be transformed into electrical energy. Doubts were expressed that the tanks could contain a nuclear explosion. Billions of volts would have to be stored in a huge battery facility for a few fractions of a second, but there was no evidence of such a battery.

Another postulation was that low-yield nuclear weapons tests were being conducted at the PNUTS site, which was similar in configuration to the U.S. low-yield test facility at Los Alamos. The Defense Department, but especially Maj. Gen. George Keegan, then head of Air Force Intelligence, argued that the PNUTS facility was being used for pulse power generation to provide the energy for particle-beam weapons that would make the Soviets invulnerable to a missile attack. The scientists often referred to Keegan as “Crazy George” because he had little or no scientific knowledge and his views were not accepted by the CIA and others in the intelligence community. Keegan's favorite phrase was, "All right, if you don't go along with me, prove me wrong."

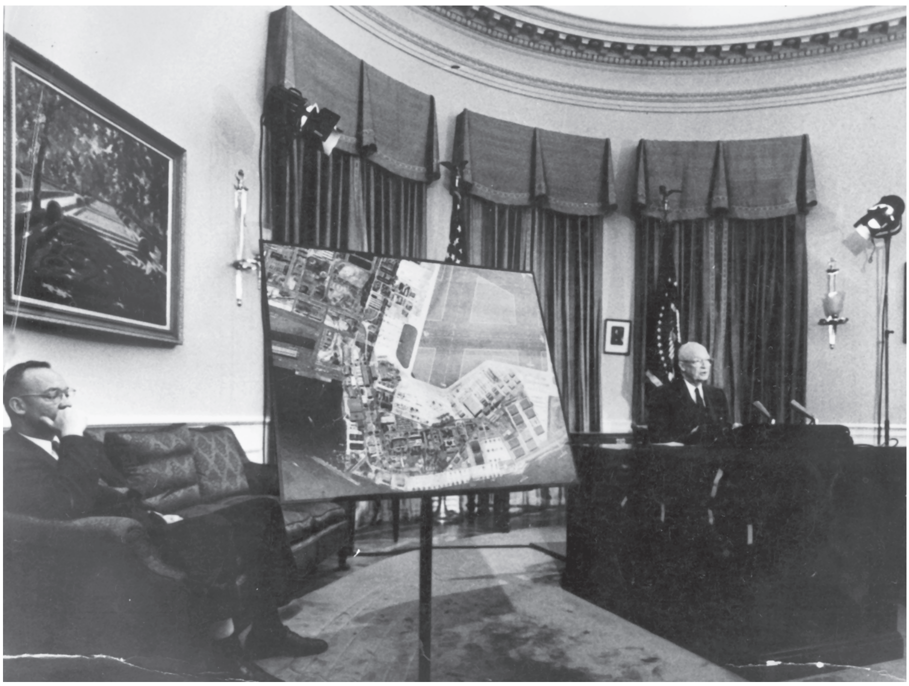
Doolittle's conclusion that the Soviets were working on a project similar to Pluto was closest to the truth. When U.S. scientists visited the facility years later, it was confirmed that the spheres were filled with liquid hydrogen fuel for a nuclear rocket engine under development.

Senator Goldwater, who was on the Senate Intelligence Committee and a reserve Air Force general, would be informed when Doolittle would be visiting our facility and would come by to greet his old friend. They would get together in the center's briefing room and engage in discussions about Soviet aviation and missions. Goldwater, who was proud that that he had flown in every type of U.S. military plane, chided Doolittle for not wanting to fly in either the U-2 or SR-71 even though he had played a role in their development. Doolittle said, "Those days are long gone. Leave it to the young people." The conversation would invariably turn to the capabilities of the Soviet Bison bomber versus the U.S. B-52. Why wasn't the Bison being flown? Why wasn't it being shown? Goldwater was emphatic: "The reason it's not flying is that it couldn't carry a sack of s—— across the street."

We knew that Goldwater was an accomplished photographer and tinkerer who enjoyed assembling televisions and other electronic equipment from kits. On one of Goldwater's visits to the center, Bob Boyd escorted him part of the way to the model shop, then told him to go down a corridor and turn to his left to get to the shop, where they were waiting for him. Goldwater turned to Bob and said, "I've never turned left in my life." Joe Montminy, our accomplished model maker, welcomed the senator and put on a show using the newest techniques for model making, including a quick-acting glue. When I noted that Goldwater was nearly salivating with interest, I motioned to Montminy to offer him a tube. Montminy asked, "Would you like a tube of the glue?" Goldwater quickly responded, "I thought you'd never ask." As Goldwater moved to put the tube in his pocket, I nudged Montminy to give him a plastic bag. Otherwise, if the tube were crushed, the senator would be glued to anything he touched. A happy Goldwater left the center that day.

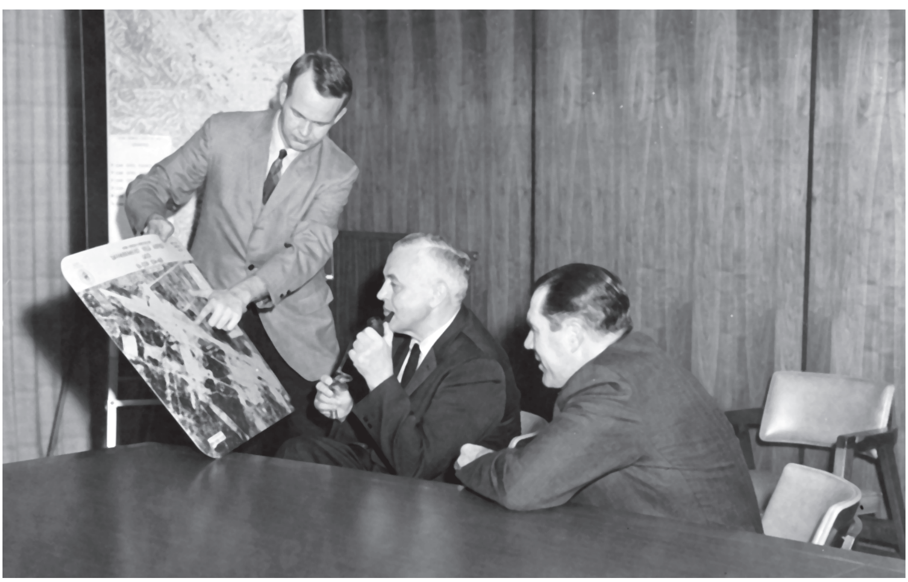
Doolittle left the PFIAB in 1966 but continued to visit the NPIC as a member of the Technological Capabilities Panel. By that time the emphasis was shifting from manned aerial reconnaissance to satellites. Doolittle was the most charming man I have ever met, and his contributions to intelligence were numerous. When he died, there was a wonderful article on him in *Air Force* magazine by his biographer, Carroll V. Glines. I called Glines and complained that he had said nothing about Doolittle's activities in intelligence. Glines answered, "Every time I approached him about his intelligence work, he would say, 'I don't want to talk about it.'"

U-2 photograph of the San Diego Naval Air Station used by President Eisenhower to show the quality of U-2 imagery during his address to the nation. (Dwight D. Eisenhower Library)



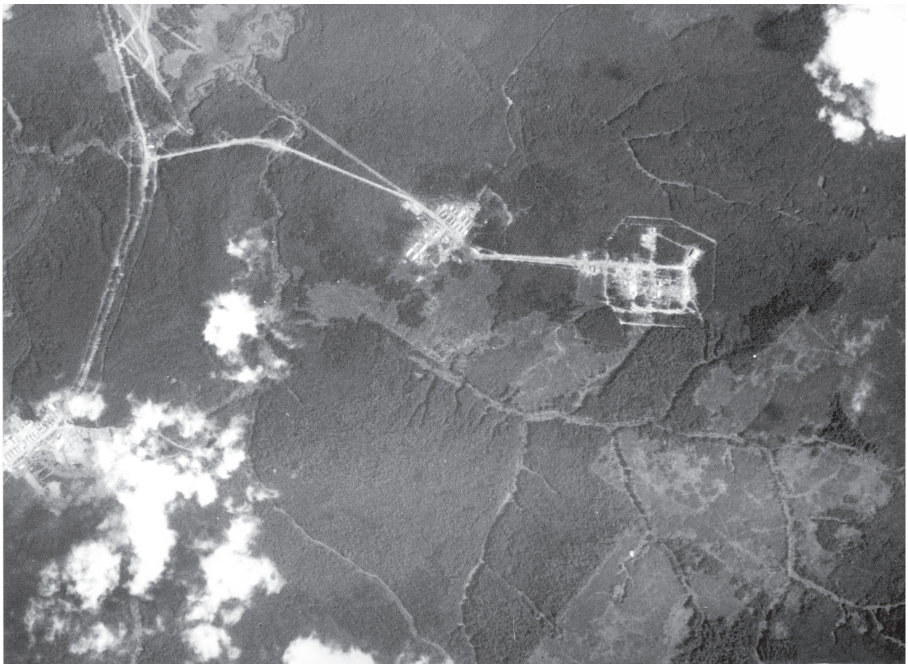
President Eisenhower addressing the nation after the shootdown of U-2 pilot Francis Gary Powers on May 1, 1960. Nearby is John Eisenhower. (Dwight D. Eisenhower Library)

The author, along with Ben Gable, showing Allen Dulles a new interrogation tool for gaining information on Soviet installations from returning German POWs. (Central Intelligence Agency)



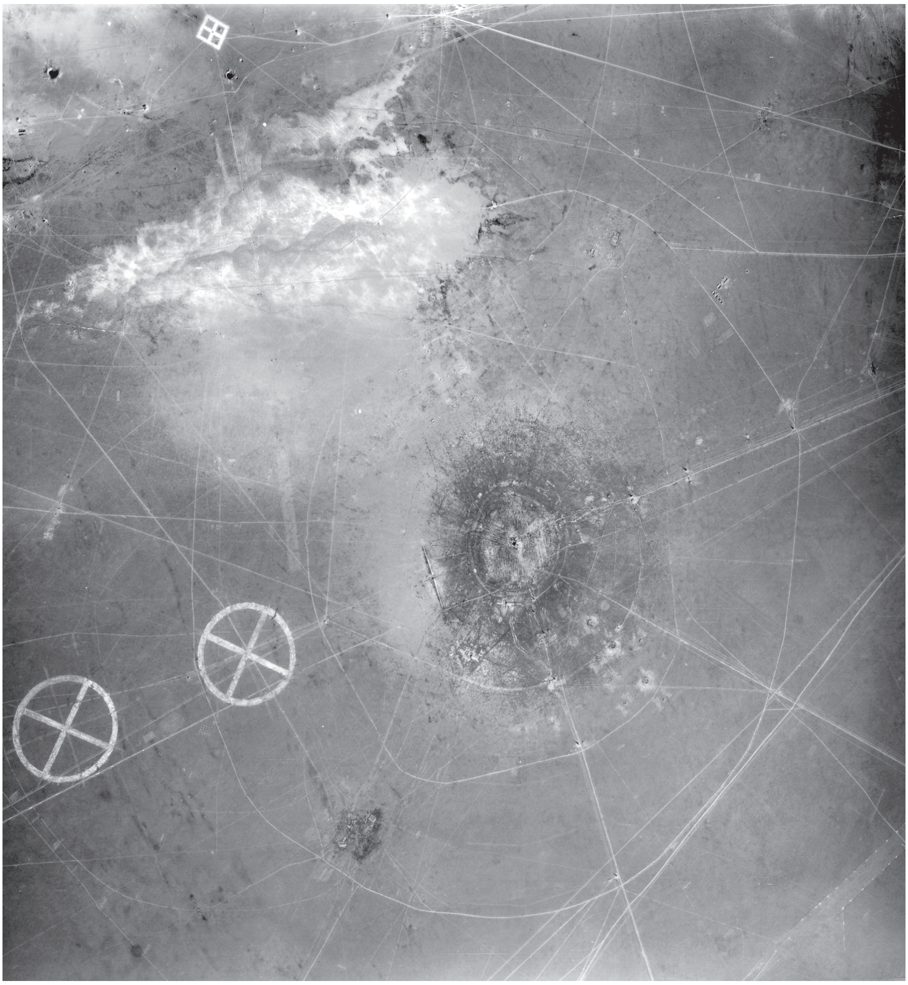
The Briefing Board on Photographic Finds was used to brief presidents and high-ranking officers. A preliminary briefing is being given to Arthur C. Lundahl, director of the National Photographic Interpretation Center (NPIC), and his executive officer, Charles Camp. (Central Intelligence Agency)

The Soviet penchant for horizontal security is typified by the five fences that surround an SS-5 intermediate-range missile site. This type of construction was always a dead giveaway and made the job of locating Soviet strategic installations much easier for the photo interpreter. (Central Intelligence Agency)

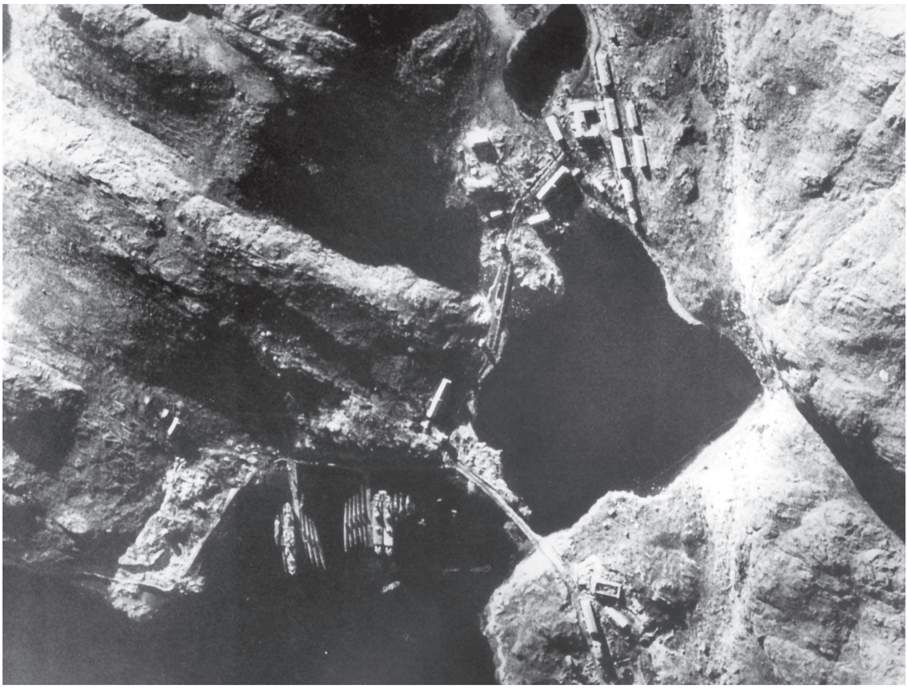


The first Soviet ICBM site was photographed by the Corona satellite on June 17, 1961, at Yurya. It was under construction at the time it was photographed. (Central Intelligence Agency)

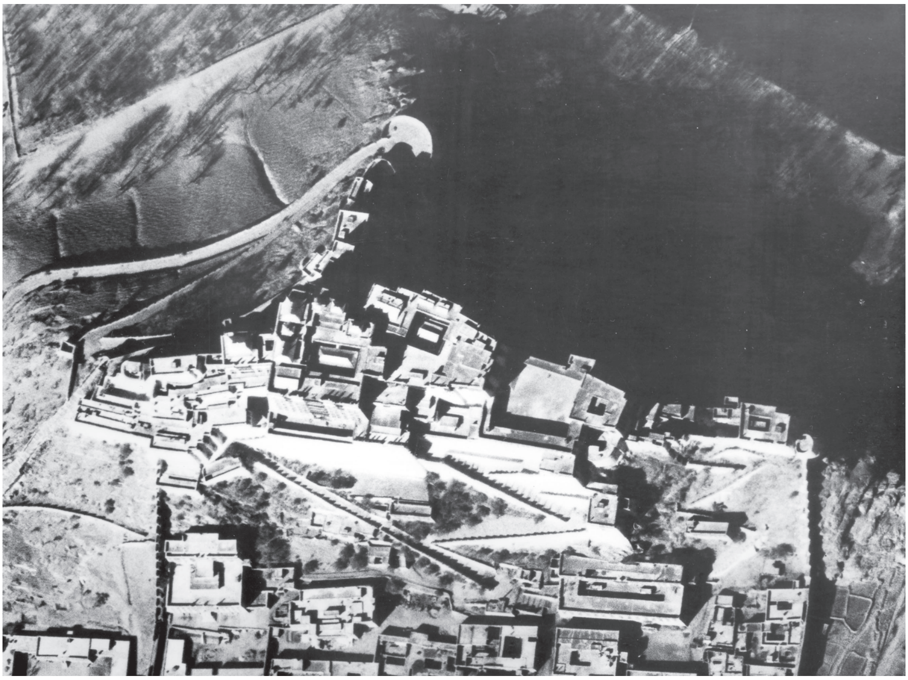
U-2 photograph of the Soviet missile launch facilities at Tyura Tam, along with coverage of rail and road networks, revealed the missile gap didn't exist. (Central Intelligence Agency)



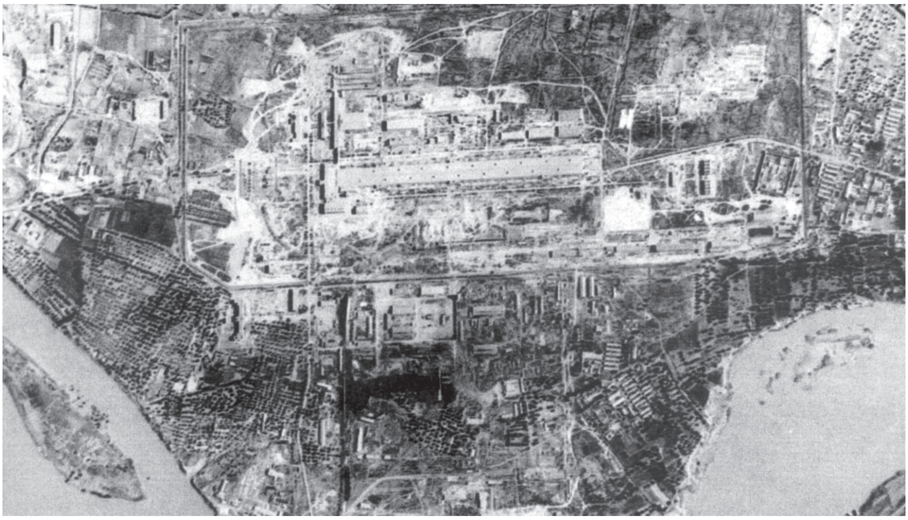
U-2 photograph taken in August 1957 of the Soviet nuclear testing complex at Semipalatinsk in Kazakhstan. The result of a tower shot is shown along with aircraft drop markers. (Central Intelligence Agency)



U-2 photograph taken of the Soviet submarine base at Polyarnny on October 1957 indicated that the Soviet submarine force was essentially a defensive one. (Central Intelligence Agency)

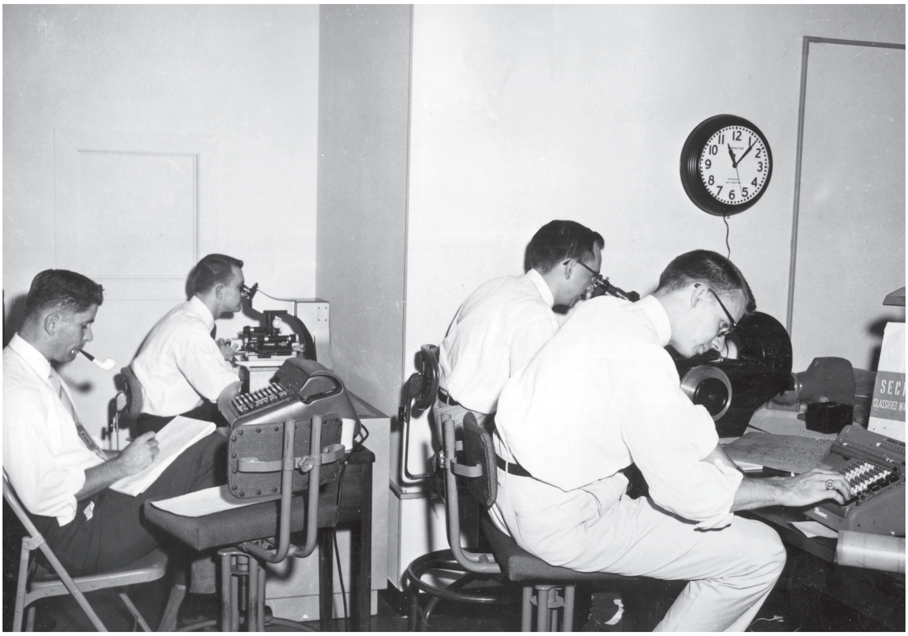


U-2 photograph taken in May 1959 of the Potala Palace of the Dalai Lama, on the western edge of the ancient Tibetan capital of Lhasa. (Central Intelligence Agency)



Greater Republic of China's U-2 Black Cat Squadron's photo of the Chinese Gaseous Diffusion Plant at Lan Chow. (Courtesy of General Yung Pang Tsai)

Ray Cline, the CIA chief of station in Taipei, views U-2 photos taken by the Greater Republic of China's Black Cat Squadron being shown to Chiang Kai-Shek by Colonel (later General) Yung Pang Tsai. (Courtesy of General Yung Pang Tsai)



Before computers in the early 1950s, photogrammetric calculations were accomplished on Marchant calculators. (Central Intelligence Agency)

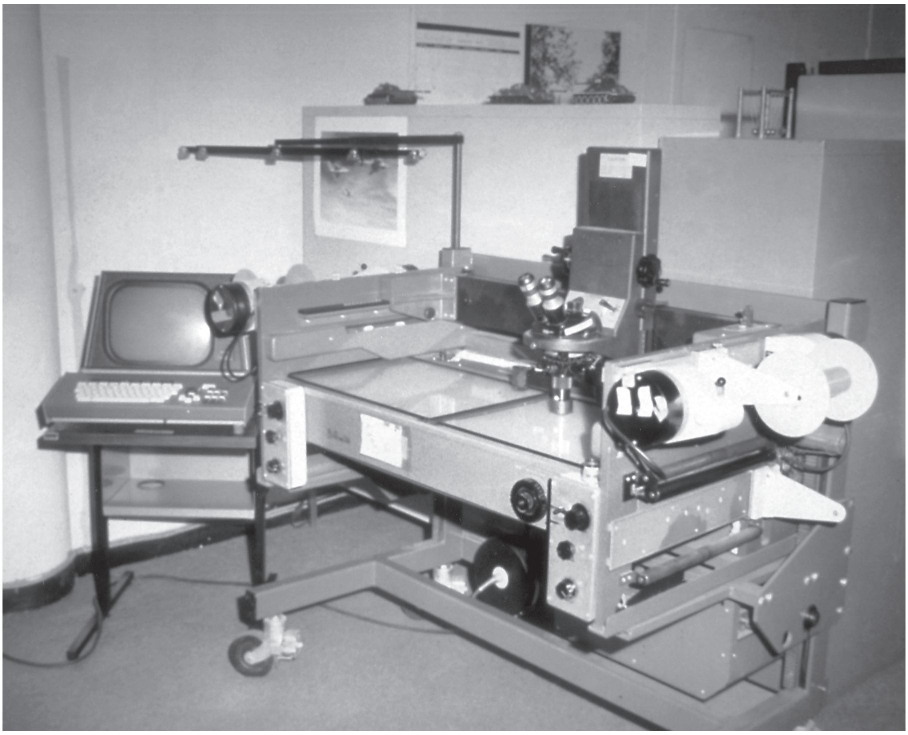


Photo interpreters in the 1980s relied on a light table, microstereoscope, and computer like the ones shown here. (Central Intelligence Agency)

Photo interpreters at NPIC scanning an aircraft mission. Note collateral cart containing maps, charts, and reference information. (Central Intelligence Agency)

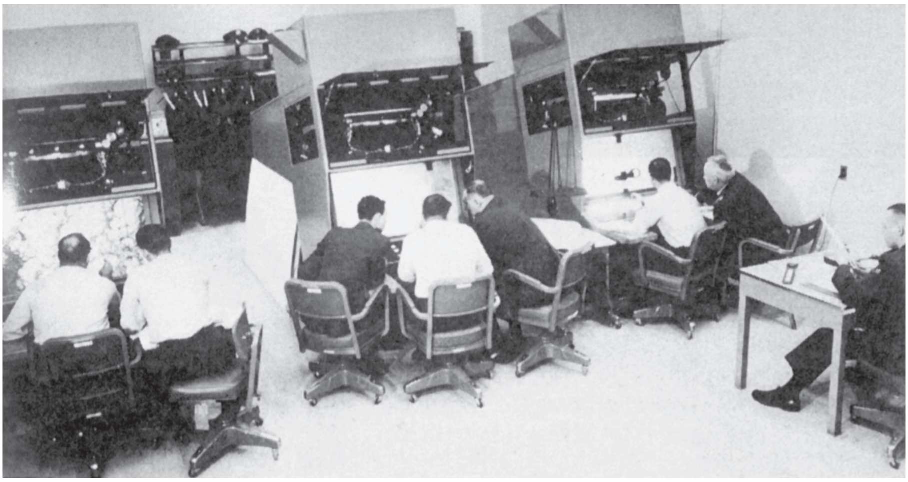
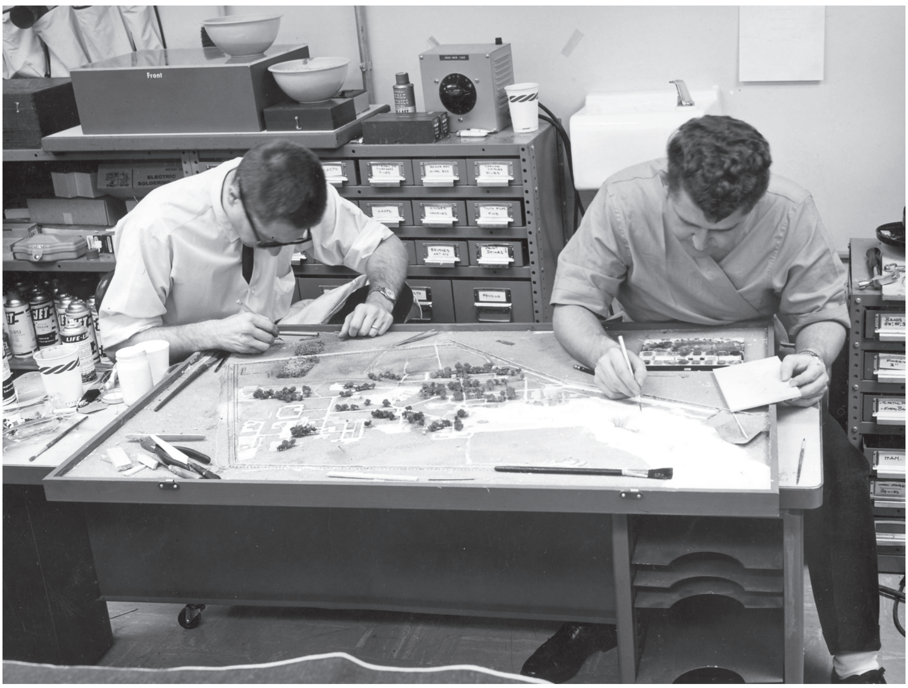


Photo interpreters at NPIC scanning a satellite mission on rear-projection viewers. Arthur Lundahl, the center's director, is at the viewer at right. (Central Intelligence Agency)



The model shop at NPIC. Before the advent of modern computers, models were used to present a 3-D view of key sites for members of Congress. (Central Intelligence Agency)

In the 1960s calculations down to a micron were accomplished on a high-precision stereo comparator (shown here) at NPIC. (Central Intelligence Agency)

The author with his friend and mentor, Arthur C. Lundahl, the director of NPIC. (Author collection)

DCI William Casey presents the pioneer in space medal to the author for his contributions in the development of satellite reconnaissance systems. (Central Intelligence Agency)

In 2002, Dino Brugioni and General Anatoly Gripkov, who supervised the building of missile bases in Cuba, met on the fortieth anniversary of the Cuban Missile Crisis. Brugioni and other NPIC employees provided key intelligence to President John F. Kennedy during the crisis. Here, he shows Gripkov U.S. aerial reconnaissance photos taken of the Soviet installations on the island. Brugioni questioned Gripkov and asked why he thought his work would not be discovered. The general said he warned Moscow to no avail. (Author collection)

There were moments of humor at NPIC. This picture was supplied as part of a brief. "During the Belgian Congo crisis we were surprised to see a Simba rebel in the act of throwing a spear at the reconnaissance aircraft," recalled Brugioni. When he prepared the briefing board, he included this photo, labeling it an unrevetted surface-to-air missile system. He informed his audience that "the missile, a Mark 1, Mod 1, has a manual guidance system, a mobile launcher with one-sling power velocity on takeoff, but considerable pucker power on impact. It is, however, of questionable accuracy and has undetermined CEP. The refire capabilities have not been determined." (Central Intelligence Agency)

THIRTEEN
the missile gap and the gary powers flight

Modern history has become a race between education and catastrophe.

H. G. Wells

The continued success of Soviet space efforts, the media's denunciations of U.S. space efforts, and the drumbeat in Congress that the United States was falling behind the Soviets greatly perturbed President Eisenhower. He tried to deflect the criticism by appointing a commission chaired by H. Rowan Gaither, a West Coast attorney who sat on the boards of the Ford Foundation and the RAND Corporation. On November 7, 1957, the commission issued its report, *Deterrence and Survival in the Nuclear Age*. The report concluded that the Soviet Union was devoting a larger percentage of its economy to defense than was the United States and warned that by 1959 "the USSR [will] be able to launch an attack with its ICBMs carrying megaton warheads, against which SAC will be almost completely vulnerable under present programs."[1] To counter this threat the committee recommended a stepped-up program to expand U.S. offensive capabilities along with a civil defense program.

On January 17, 1958, the president met with Richard Bissell, Robert Cutler, Allen Dulles, James Killian, Andrew Goodpaster, Edwin Land, Secretary of Defense Neil McElroy, and JCS chief Nathan Twining to discuss the report's suggestion "that extraordinary efforts be made to obtain hard intelligence, even at the cost of some risk to the U.S." There had been some talk in Eisenhower's administration about doing a secret study on the feasibility of launching a preventive attack on the Soviet Union with the aim of knocking out the entire Soviet bomber fleet. While it was known that the Soviets had thousands of bombers, however, their locations were not known. The president asked if the Soviets had developed a fighter plane that could operate successfully at 70,000 feet. The U.S. F-104, Bissell noted, could make one pass at a fast plane at that altitude. Dulles pointed out that if the Soviets had such aircraft, they would have to deploy them everywhere U-2s could possibly fly. The president was still concerned about the risk of a U-2 being discovered in flight. Land indicated that work was under way to make the U-2 invisible to radar. The possible use of carriers to conduct reconnaissance missions was also discussed. General Twining said that SAC "was all geared up and ready to go."[2]

Eisenhower would later write: "There was rarely a day when I failed to give earnest study to reports on our progress and to estimates of Soviet capabilities."[3] He was well aware that all of the branches of the armed forces "were out to promote their own programs." He "was more than skeptical: he was unconvinced, challenging repeatedly, what do they base this on?"[4]

Soviet missile developments altered the world's perception of the USSR's relative strategic power. In public and private statements Khrushchev had added emphasis to the claim that the Soviets were outpacing the United States in both production and deployment of ICBMs. Eisenhower could not be certain how to separate fact from fiction. At the 365th meeting of the National Security Council, on May 8, 1958, Killian compared U.S. versus USSR ballistic missile developments. Among his conclusions, the meeting minutes report, was "that in the field of the shorter-range ballistic missiles the Soviets had a larger variety of types and ranges than the United States. With respect to both the intermediate range ballistic missiles and the intercontinental ballistic missiles, the Soviet Union was approximately a year ahead of the United States." Killian also indicated that "ICBMs may be transportable by railroad. If so, this would indicate that the Soviets had developed a storable liquid fuel for their ballistic missiles."[5] After the NSC meeting, the president, his science adviser George Kistiakowsky, and Killian discussed the intelligence material on which the report on Soviet missile developments had been based. Still displeased, on June 25, 1958, the president established the Comparative Evaluations Group to be "responsible for the preparation of comparative evaluations of U.S. and Soviet capabilities in selected weapons system."[6] The selected weapons were, of course, Soviet ICBMs.

Despite the president's reluctance, pressure was mounting on him to use U-2s over the Soviet Union to get a better handle on the growing "missile gap" controversy. A high-level presidential adviser who attended the December 1958 conference of experts from NATO and Warsaw Pact countries in Geneva on the prevention of surprise attacks was told by the Soviet delegate that the USSR had ICBMs in mass production. This information, which could be neither proved nor disproved, was circulated on a tightly held basis. Five days later, Khrushchev asserted that the Soviet Union had an ICBM capable of carrying a five-megaton nuclear warhead eight thousand miles and claimed that the Soviets had organized mass production of ballistic missiles that would give them the ability to deliver a blow to any part of the world. These statements were particularly upsetting because during that same period the United States failed in its first attempt to launch a Titan ICBM.

If the Soviets had produced ICBMs, it was logical to conclude that they had deployed them. The specter of a "missile gap" created near hysteria in the press and would become a prime issue in the 1960 presidential campaign between Richard Nixon and John F. Kennedy. The latter claimed that Eisenhower and his vice president, Nixon, had allowed a missile gap to develop and had done little or nothing to speed up the development and production of U.S. strategic missiles.

In Moscow, Khrushchev knew from his intelligence services that the United States was actually gaining a tremendous lead in strategic forces. In a cunning propaganda move, on January 14, 1960, he announced before the Supreme Soviet a one-third cut of Soviet standing forces, mainly ground forces, in favor of a new strategic missile nuclear force. This further enhanced Americans' fears that the Soviets had deployed ICBMs. Khrushchev said that the "war would begin in the heart of the warring countries" and that "not a single capital [or] major industrial and administrative center would escape the attack . . . during the first minutes."[7] Soviet ground forces started voicing their opposition when party leaders began employing military personnel—primarily from the ground forces—in the civilian agricultural and industrial establishments. Officers complained that using their soldiers as farm laborers not only interfered with training schedules (most taking place in the spring and summer) but also undermined the morale and prestige of the officers; it also raised doubt about the readiness of the conventional forces. The Soviet press, however, was filled with photos of soldiers in uniform helping with the harvests.

The Soviet Strategic Rocket Forces (SRF) was elevated to a status equal to that of the other services. Many of its officers came from artillery and air force units, and the SRF became an elite organization with the mission of controlling medium-, intermediate-, and intercontinental-range strategic nuclear missiles. The SRF did not, however, control the tactical nuclear weapons of the ground forces.

The sole U-2 overflight in 1958 was conducted over installations in the Soviet Far East on March 1, 1958, in a "dirty bird" aircraft. The U-2 flew over the naval base at Sovetskaya Gavan and then followed the Trans-Siberian Railroad for some distance inland. When we analyzed the images, we spotted twelve Bison bombers at the Ukraina airfield and a large, heavily secured facility at Malaya Sazanka that was thought to be the prime nuclear storage installation in the Soviet Far East. It was defended by SA-2 sites. Eventually we found a rather large number of different nuclear storage installations. Later, the intelligence community, in National Intelligence Estimate 11-2A-65, "The Soviet Nuclear Energy Program," took the PIC's catalog of the various types of nuclear storage areas by size and location, and categorized them as storage facilities associated with nuclear weapons production facilities, large national stockpile facilities, or operational and regional storage sites at military bases in direct support of military operations. Malaya Sazanka was carried in the catalog as one of the national stockpile facilities. A thorough search along the Trans-Siberian Railroad did not reveal any strategic missile sites.

On March 6, 1958, the State Department received and delivered an aide-mémoire from the Soviet Union to the White House that protested an overflight of their territory on March 2, 1958. The note indicated that while the flight might have occurred without the knowledge of the U.S. government, it was nevertheless an invasion of Soviet territory. More specifically, the document noted that the flight occurred "when negotiations are being conducted on the holding of a summit meeting which could contribute to an improvement of relations and to strengthening trust between states." Citing messages from the U.S. president and other high government officials, the document stated: "It is known to the Soviet Government that the Government of the USA desires a rapprochement between our governments and improvement in relations between them." Then an olive branch was extended: "Taking into account the present situation, where a summit conference is being prepared, and also the spirit and purpose of the negotiations between our governments, the Soviet Government would not like to make this matter public or subject it to discussion at the UN."[8]

Eisenhower read the memo and told General Goodpaster to inform DCI Allen Dulles that any further reconnaissance operations contemplated "should be discontinued, effective at once."[9] On April 24, at the president's direction, Goodpaster advised both General Twining and Dulles that there were to be no reconnaissance flights by U.S. military or other aircraft over the USSR or other communist countries.

The Soviets obviously had not been fooled by the antiradar devices that the "dirty bird" aircraft carried because the memo gave specific locations that the flight had overflown. The CIA abandoned the use of the antiradar devices at that point and turned to Lockheed to develop paint with radar-suppressant qualities. That project also proved to be unsuccessful; Soviet radar picked up those aircraft too.

On May 29, 1958, CIA officials met with the president at the White House to discuss special intelligence measures regarding critical Soviet intelligence targets. Robert Amory, the CIA deputy director for intelligence, gave an oral report. His briefing covered heavy bomber production, missile development, and production and deployment of those weapons. Of interest was that Bison and Bear heavy bombers were no longer being produced; the total estimated number was put at eighty-five. The main Bison airfield was Saratov/Engels in the Ukraine, and the main Bear airfield was Dolon in Kazakhstan. Amory reported that information from multiple sources indicated that Badger medium bombers were being produced at the rate of thirty a month.[10] There was no bomber gap between the two nations after all.

The U-2s coming off the production lines at the end of 1958 were assigned to SAC's 4080th Strategic Reconnaissance Wing at Laughlin AFB in Del Rio, Texas. The 4080th was made up of two reconnaissance squadrons, the 4925th SRS and the 4028th SRS. The 4925th flew RB-57Ds; the 4028th flew U-2s. In the 1960s the wing was moved to Davis Monthan AFB in Tucson, Arizona, and designated the 100th Strategic Reconnaissance Wing. Later, the U-2s and SR-71s were moved to Beale AFB in California to be part of the 9th Strategic Reconnaissance Wing.

In January 1959 Bissell told Lundahl that he was thinking of taking the position of deputy director for plans, replacing the ailing Frank Wisner. Although some described Wisner as "brilliant,"[11] we had found him extremely difficult to work with. Lundahl tried hard to establish a liaison with the DD/P to keep the Plans Directorate from using assets to collect information we already possessed on photography, but to no avail. Richard Helms, who had been passed over as director of the Plans Directorate, would serve as Bissell's deputy. The hope was that Bissell would infuse new and novel methods into the directorate's staid operations. Lundahl told me that while he would miss Bissell and the direction he had given to new reconnaissance methods, he thought Bissell was being groomed to be the next DCI. Edwin Land and James Killian were not happy when Bissell took the Development Project Staff with him to his new post. Land in particular was concerned that the scientific and technical part of the Agency should remain separate from the Plans Directorate.

Eisenhower was pleased that the U-2 missions had demolished the myth of the bomber gap. Andrew Goodpaster recalled: "We began to have confidence, a great deal of confidence, about our estimates of Soviet military capabilities and their state of readiness. . . . Although [Eisenhower] could not make the means by which he gained this knowledge public, he could base national security policy decisions on what we knew as fact and not act upon speculation concerning the unknown."[12]

But the "missile gap" remained—or did it? We had yet to find a single Soviet ICBM site. In February 1959 Khrushchev warned that the Soviet Union had begun mass production of ballistic missiles that would give it the ability to strike any location in the world. In November 1959 Khrushchev boasted that a single Soviet plant had produced more than 250 ICBMs over the previous year. We knew of three plants that were or could be involved in the production of ICBMs: a large plant in Dnipropetrovs'k; a plant in Kuybyshev; and, possibly, the aircraft plant in Kazan, which could be producing a new bomber and might also be producing missiles. These plants would become targets for U-2 overflights.

Although some hard feelings remained between the United States and Britain after the Suez War, the relationship between the U.S. and British intelligence agencies was quickly healed. Sid Stallings was detailed to both the Air Ministry and the Joint Air Reconnaissance Center in the United Kingdom, and the PIC continued to provide special materials to the Air Ministry to use in briefing the prime minister and the foreign secretary. The air marshal frequently visited the PIC, and center personnel visited British imaging interpretation facilities as well.

Bissell's memoir notes that the goal of having British pilots fly U-2s was accomplished "in 1957 with the approval of President Eisenhower and Prime Minister Eden [*sic*; probably Macmillan]. Bissell "also met with Sir Dick White, the head of MI6 [Allen Dulles' counterpart], and M. L. McDonald, the assistant to the chief of air staff command for British intelligence."[13] A recommendation that three British pilots be sent to the United States for U-2 training got a favorable response, and the proposal was later formalized by President Eisenhower and Prime Minister Macmillan. The British pilots were sent first to the 4080th

Strategic Reconnaissance Wing at Laughlin AFB and then to Groom Lake in Nevada. Eisenhower had pressured Macmillan to have his pilots fly missions over the Soviet Union "as if," Bissell reported, "they were operations initiated by the RAF with the approvals by the British government and the results going to U.K. intelligence."[14] When it came to RAF pilots flying U-2s over the Soviet Union, however, Eisenhower balked. He could not be convinced that the United States would not be implicated if a U-2 with an RAF pilot were downed over the Soviet Union.

The U.S. Air Force hierarchy became perturbed that RAF pilots were being trained to fly over the Soviet Union when their own pilots could not. The Air Force now had its own fleet of U-2s and claimed to have received permission from President Eisenhower to fly peripheral ELINT missions around the Soviet Union. Allen Dulles did not object to the Air Force program, but Bissell was livid. If the Soviets protested the flights, it would be even more difficult to get permission for a penetration mission from an increasingly reluctant president. At about the same time, Gen. Curtis LeMay began another effort to gain control of the CIA's U-2 operations. Bissell was vehement in his protests that to maintain the project's secrecy and enhance plausible denial of U.S. responsibility, the U-2 operations had to remain in the CIA.

The CIA program was producing so much crucial information that LeMay had difficulty rallying the other services to his cause. There was an additional factor: the president had full confidence in the Agency's control of the project and very little confidence in LeMay. The Air Force nevertheless kept a firm grip on its reconnaissance responsibilities. Just as the ICBM missile hysteria was gripping the United States and proposals for U-2 flights over the Soviet Union were being discussed and rejected, the Air Force was given permission to fly both photographic and ELINT peripheral missions along the northern coastlines of the Soviet Union, supposedly to determine if bombers had been deployed to the northern bases. The missions operated under the name "Congo Maiden." Bissell and Lundahl were apprehensive when they heard about Congo Maiden. Both men feared that the Soviet Union would protest the Air Force missions just when pressure was building for Eisenhower to agree to CIA-operated U-2 missions deep inside the Soviet Union.

On March 29, 1959, SAC deployed three U-2s from the 4080th Strategic Reconnaissance Wing to Eielson AFB in Alaska. In mid-March they began flying missions ten to fifteen miles off the northern coast of the Soviet Union. The images the missions returned were terrible. They were oblique shots, and interpretation was hindered by low sun angles, clouds, and snow and ice. We interpreted the photos but found little that was new. The Congo Maiden flights were tracked by the Soviets, and there was one attempt at interception.

As public and congressional concern about the missile gap rose, CIA and Defense Department officials pressed Eisenhower to authorize more U-2 overflights. We needed new information on what was happening at Tyura Tam and at possible deployment areas at Yurya, Polyarny Ural, and Vorkuta. After the February 12, 1959, NSC meeting, Neil McElroy, Donald Quarles, and Nathan Twining stayed behind. The three men pressed the president to authorize additional U-2 missions because they "did not know the location of any launching platforms within the USSR." They assured the president that the Joint Chiefs of Staff were of the opinion that the U-2s would not be shot down. Further, no matter how often Allen Dulles briefed the administration's critics in Congress, they would not believe him without photographic proof.

The president was not impressed. He attempted to blunt their arguments, saying that the plane to replace the U-2 (the A-12) and the Corona satellite were "coming along nicely," and that U-2 flights were to be held "to a minimum pending the availability of new equipment." Quarles pointed out that the Corona program was having a lot of problems and would not be available for at least eighteen months to two years, and the resolution of its images would not match that produced by the U-2s. The president responded that this did not matter because the Soviets would not have a first-strike force of ICBMs in the near future. The president held to the idea that reconnaissance flights were "undue provocations" but conceded "one or two flights might possibly be permissible."[15]

Goodpaster noted that the president had consented to two aerial reconnaissance missions to cover the northern rail network that included Plesetsk, Polyarny Ural, and other highest-priority areas. Twining pointed out that the mission could not be completed until March because of the low sun angle and unfavorable weather. The ideal time to photograph the northern installations was from April through July. Both plans called for the U-2 to take off from the USAF base at Thule, Greenland. The aircraft would fly over Novaya Zemlya and cover Plesetsk, Yurya, the rail lines near Polyarny Ural, then go on to Severodvinsk and Murmansk before landing at Bodo, Norway.

A secret memo dated March 31, 1959, pointed to the critical need for missile intelligence collection:

> Intelligence is ignorant as to whether or not any are now deployed, or are soon to be deployed; we know nothing of the pattern, method or location of deployment. Neither do we have good evidence as to nation and location of production facilities. Thus we are unable to give adequate judgments as to magnitude and timing of the missile threat, or to give data to the Strategic Air Command for its use in attempting neutralization. The Soviets claim that the powers balance vis-à-vis the United States is changing. We believe that if this is true, the missile factor is the key.[16]

This was the view of the U.S. and British intelligence communities as well as outside consultants and the Lawrence Hyland Committee. Eisenhower nevertheless remained skeptical, and there still was no convincing proof that the missile gap existed.

In a meeting with the president on April 3, 1959, the DCI once again broached the topic of the difficulty of getting information on Soviet ICBM deployment. He emphasized, "We do not know whether the ICBMs being deployed by the Soviets will be mobile or fixed, hardened, or soft. The intelligence community considers this about as high in importance as any intelligence we get." But the president was still not convinced that new intelligence from Tyura Tam was critical, or "that our intelligence on this matter must be obtained 'this year or never.'"[17] The president said he still had reservations but would discuss the matter with Secretary of State Christian Herter and raised the possibility that the ICBM sites were concealed.

On April 7 the president told Bissell and McElroy that he had decided not to go ahead with the reconnaissance flights he had given tentative approval to the previous day. Similarly, the president tentatively approved several overflights on April 10 but called in McElroy and Bissell the next day and withdrew the authorization. He gave five reasons: (1) the flights would not be worth the political costs; (2) there was some hope for negotiations; (3) he did not want the United States to suffer in the world's opinion if a plane were downed; (4) programs to provide more advanced capabilities were under way; and (5) the United States had the power to destroy the Soviet Union without further targeting efforts.[18] The fifth point reflected a briefing from the Defense Department that showed the United States had Atlas, Titan, and Minuteman ICBMs with 5,500-mile ranges; Thor IRBM missiles in England and Jupiter IRBM missiles in Italy and Turkey with ranges of 1,500 miles; and Polaris submarines with IRBMs that could be deployed in the Norwegian, Mediterranean, Japan, and China seas.[19]

Eisenhower bristled at administration critics such as Senator Stuart Symington and Senator Richard Russell who were charging that the missile gap would eventually grow even larger. Symington insisted that by the early 1960s the Soviet Union might have a three-to-one advantage over the United States in operational ICBMs. Prodded on by LeMay and the Air Force, McElroy accepted these charges without a single bit of intelligence information. He did tell Congress that the gap would be a temporary one and that in the end the United States would enjoy a technological advantage because it was concentrating on developing the more advanced solid-fueled Minutemen missiles rather than concentrating on liquid-fueled missiles such as those the Soviets had. General Twining was privately espousing an alarmist view of Soviet missile capabilities to select senators. When international banker John McCloy, a former high U.S. official during World War II, visited the Soviet Union in July, Khrushchev told him that "a new ICBM" had been tested successfully.

As the missile gap controversy raged on, the president remained unwilling to consider flights over the Soviet Union. It had been months since we had last seen Tyura Tam, and the Soviets had resumed ICBM testing. Bissell insisted that Tyura Tam was the key to the missile controversy. What we saw there could help in the search for deployed missile sites. Efforts to persuade the president to authorize penetration missions continued. On July 7 Dulles and Bissell pushed the president for a flight over the Tyura Tam Missile Test Center to see if there were any new additions. The president consulted Secretary of State Herter, who agreed with the CIA and told the president that in his view, the intelligence objective outweighed the risks.[20] Eisenhower finally acceded and approved a single mission over Tyura Tam and several cities in the Urals suspected of producing missiles, along with nuclear-related installations.

The mission was flown on July 9, 1959, to cover Tyura Tam, Semipalatinsk, Dolon Airfield, Kyshtym, Verkhne Nevyansk, and Nizhnaya Tura. The images of the Tyura Tam Missile Test Center showed several launch facilities. Pad A-1, which had been completed in 1957, was the launch pad for the SS-6 and all space launches. Pad A-2, still under construction, would be used for research and development. A rail line branching off from Launch Complex A extended to completed Launch Complex C and unfinished Launch Complex D. Launch Complex C, which had two pads (C-1 and C-2), became a center of attention because it was in a soft configuration and we thought that a new missile system (SS-7) would probably be tested there. Since the pads were served by a rail line, there was concern that the missiles could be transported by rail, making them difficult to find.

The experts' initial conclusion was that the Soviets were not engaged in a crash program to overtake the United States. The programs for research, development, and testing were proceeding in an orderly fashion, just as those of the United States were. What we saw at Tyura Tam indicated that the Soviets were not ready for a massive deployment program. Our information supported Eisenhower's contention that the Soviets would not have a first-strike capability for several years.

The Kyshtym Nuclear Complex was covered by clouds on the July 9 mission, as were sections of the Verkhne Nevyansk and Nizhnaya Tura nuclear complexes. On images of Verkhnaya Salda we found a spur under construction (which later led to an SS-7 missile site). We found a large complex at Kasli that was probably concerned with nuclear weapons research and development. We had located what Hank Lowenhaupt was reporting as Chelyabinsk 70, another Sandia-like complex. At Dolon Airfield we observed a complement of Bear bombers and a new type of atomic weapons storage area.

Lawrence A. Hyland, chair of the Hyland Committee, commented that finding Launch Complex C "allows a judgment to be made that the extremely large fixed launching facility is not an essential part of [the Soviets'] operational deployment system."[21] The committee reemphasized the importance of U-2 photography for locating Soviet ICBM launch sites and recommended "early coverage of rail lines in the Polyarny Ural area as the most likely prototype operational deployment facility for Soviet ICBMs."[22]

On September 12, 1959, the Soviets scored another space achievement when their Luna rocket landed on the moon. Khrushchev bathed in the success of the feat as he prepared to visit the United States. As critics of the U.S. space program immediately erupted again, the RAND Corporation was called on to answer two questions: (1) How do we stand technically in our space program? (2) Why are we involved in space programs, anyway? A list of requirements for a viable U.S. space effort attempted to assuage the national feeling that the United States was failing to stay abreast with the Soviets in space.[23]

Eisenhower halted all U-2 flights over the Soviet Union after the July 9, 1959 mission because he did not wish to increase the tension between the two countries, but he intended to take a hard line with Khrushchev on a couple of matters when the Soviet premier visited the United States. In November 1958 Khrushchev had threatened to sign a separate peace treaty with East Germany and to turn over Berlin—including the British, French, and American sectors—to the communist East German government in contravention of all postwar treaties and agreements. It was clearly a move to push the Allies out of Berlin. Reconnaissance flights along the Berlin corridor and East German border increased, and we were asked to review film that had initially been interpreted by the U.S. Air Force 497th RTS in Wiesbaden. The various checkpoints, especially Checkpoint Charlie, became prime targets, but we saw no indications that the Soviets were preparing to take Berlin. We did see Soviet tanks near Checkpoint Charlie on several occasions when tensions arose. The most serious incident occurred on October 26, 1961, when U.S. and Soviet tanks confronted each other; however, we never saw armored units stationed nearby being prepared for a confrontation. The president and the secretary of state would have regarded such preparations as an ultimatum. There was concern in Washington that the Soviets might actually fulfill this threat to counter the continuing U-2 overflights. Eisenhower believed he had to be tough but at the same time keep the Soviets talking.

In the summer of 1959, Sherman Kent, the director of the Office of National Estimates, asked Art Lundahl to visit him at Langley to see if he could shed light on the alleged missile gap. Before he visited Kent, Lundahl asked my division to summarize our U-2 coverage of the USSR. We worked with the Office of Research and Reports and prepared a report that showed the U-2 coverage we had obtained from January 1959 to June 1960, noting areas of possible ICBM deployment. Lundahl read the report and then went to visit Kent, who showed him information that had been compiled from the Office of Research and Reports and the Office of Scientific Intelligence. He called it "an inventory of ignorance." Kent said that after looking at all of the U-2 imagery, Lundahl must have an idea of what missile sites would look like and where to look for them. Lundahl described in detail how photo interpreters work with signatures and said that the best signatures we had were Launch Complexes A and C at Tyura Tam. If we found a launch site, he assured Kent, it would look like one of those launch sites. Lundahl showed Kent a map we had prepared of the areas where we had cloud-free U-2 photographs of the Soviet Union. Large areas north and east of Moscow and the Urals where ICBMs might be deployed remained to be mapped, he said, but we hoped to get that information from future missions.

Kent complained that U.S. intelligence estimates on Soviet ICBMs were "surrounded by uncertainty, disagreements, and postulations." He added, "Hell, we are dialing our navel trying to come up with numbers." Without any convincing proof, Kent was going along with the estimate that said the Soviets probably had 50–100 operational ICBM launchers along with missiles and trained crews. The director of intelligence and research at the State Department estimated 75–125 ICBMs. The intelligence sectors of the Army and Navy estimated that no more than a few operational ICBMs had been deployed. The Air Force consistently credited the Soviets with greater capabilities, so it was no surprise that Air Force Intelligence estimated at least 120, and quite possibly more, operational ICBM launchers in mid-1961. Gen. Thomas Powers of SAC added to the furor when he declared publicly that the Soviets could wipe out the nuclear strike capabilities of the United States within thirty minutes. Eisenhower was infuriated when Senator Symington claimed that the intelligence books had been juggled so that the budget books could be balanced.

Estimates were flying about freely, but not a single ICBM launch site had been found. National Intelligence Estimate 11-8, "Soviet Long-Range Attack Capabilities," for 1960 and 1961 estimated that the Soviet Union had between fifty and one hundred SS-6 Sapwood and SS-7 Sadler ICBMs, all operational, and could have about three times that number by 1962.

The Soviets conducted extensive missile tests during the summer prior to Khrushchev's September 15–27, 1959, visit to the United States. Khrushchev boasted of Soviet missile progress in private conversations with President Eisenhower, but he said nothing about U-2 overflights over the Soviet Union. General Goodpaster told an amusing story about the visit. "Early in the visit Eisenhower offered Khrushchev a helicopter tour over Washington, D.C., to which Khrushchev replied, 'Oh no, no, no. That won't be possible.' Eisenhower said in return, 'Well that is a terrible disappointment because there were so many things I wanted to point out to you.' Khrushchev then responded in surprise, 'Oh, you would be in the helicopter too?' Eisenhower said, 'Of course I would,' and so Khrushchev agreed to the trip, with Eisenhower at his side."[24] Khrushchev was so pleased with the ride that he ordered three helicopters, insisting that each had to be identical with the one they rode in. The next morning, he and his wife embarked on a ten-day tour of the United States.

After touring the country, Khrushchev met with Eisenhower at Camp David for some serious talks. Eisenhower told the Soviet premier that he wanted the

USSR to stop threatening to turn over control of the Berlin corridors to the East Germans. Much to Eisenhower's surprise, Khrushchev argued that it was not really an ultimatum—"the Soviets and the East Germans were simply trying to find some way of preventing the flow of well-trained and educated people away from East Germany into Berlin, where they then crossed into sectors belonging to the Western Allies for a quick transport to West Germany." Eisenhower insisted that the Soviets abide by their agreements regarding Berlin and told Khrushchev that that he would not attend any future summits with Khrushchev unless the threat was removed. Khrushchev agreed but would not let Eisenhower put it in the communiqué issued about their meeting, insisting that their agreement not be revealed until after he returned to Moscow. During the Camp David meeting Eisenhower told Khrushchev that while the United States was developing its own fleet of atomic submarines, we were also "alive to the dangers to us imposed by a hostile submarine force" and "were giving close attention to the problems of contacting and destroying such vessels in the event of an emergency [a clear reference to the SOSUS underwater detection system the United States was then developing]. To this [Khrushchev] simply said, 'Of course—I understand.'"[25]

When people spoke afterward of a "Camp David spirit," Eisenhower would disagree. The aim of a president is to understand the mind and intentions of his adversary, he would say. While both parties decried the immense sacrifice of lives a war would entail, Eisenhower felt that he never could "get a handle" on Khrushchev, even though he was always open to judgments that differed from his own. He hoped that the frank thoughts expressed at Camp David would alleviate the persistent misunderstandings between the two nations. While there were formidable impediments, Eisenhower thought that movement toward peace was possible. He also thought that it had been a good thing for Khrushchev to view firsthand Americans' freedom of expression, worship, and movement, as well as America's industrial might.[26]

His visit to America did nothing to muffle Khrushchev's braggadocio. In November 1959 he boasted to a conference of journalists, "Now we have such a stock of rockets, such an amount of atomic and hydrogen weapons, that if they attack us, we could wipe our potential enemies off the face of the earth." He added that a single factory had produced 250 rockets with hydrogen warheads in a single year.[27] The missile he was referring to was probably the Russian R-16, which was called the SS-7 Saddler in the United States.

Perhaps spurred on by his talks with Khrushchev, Eisenhower continued his efforts to keep the United States safe through intelligence. On November 3, 1959, he laid the cornerstone of the new Central Intelligence Agency building in McLean, Virginia. Probably the most pleased man in the country at that time was Allen Dulles, who had labored hard to gather his people from the old and temporary barracks buildings scattered in and around Washington into a single campus. Eisenhower told the assembled crowd: "The first point is this: the need for intelligence-gathering activities. No one wants another Pearl Harbor. America's fundamental aspiration is the preservation of peace. To this end we seek to develop policies and arrangements to make the peace both permanent and just. This can be done only on the basis of required information. In war nothing is more important to a commander than the facts concerning the strength, dispositions and intentions of his opponent, and the proper interpretation of those facts."[28]

I was among the thousands at that ceremony, and after a half century in intelligence I consider his appeal to the assembled intelligence officers one of the finest I have ever heard:

> Upon the quality of your work depends in large measure the success of our effort to further the nation's position in the international scene. By its very nature the work of this agency demands of its members the highest order of dedication, ability, trustworthiness and selflessness—to say nothing of the finest type of courage, whenever needed. Success cannot be advertised; failure cannot be explained. In the work of intelligence, heroes are undecorated and unsung, often even among their own fraternity. Their inspiration is rooted in patriotism—their reward can be little except the conviction that they are performing a unique and indispensable service for their country, and the knowledge that America needs and appreciates their efforts. I assure you this is indeed true. Ever since the beginning of my administration I have issued directions to gather, in every feasible way, the information required to protect the United States and the free world against surprise attack and to enable [the nation] to make effective preparations for defense.[29]

Eisenhower was not willing to send American reconnaissance pilots over critical targets in the Soviet Union, but he had no objection to the British flying such missions. Squadron Leader Robert "Robbie" Robinson was the first of the British U-2 trainees at Laughlin AFB. He arrived in early August 1958 and completed his training soon afterward. Three other RAF pilots completed their training in early October and were dispatched to Incirlik Airfield in Turkey. Every effort was made to conceal the presence of the British flyers not only from the Americans at the base but also from the Turks. They occupied their own trailers and wore American uniforms. After flying U-2 missions over the Middle East, the British pilots were declared proficient to fly missions over the Soviet Union.

The first British U-2 flight over Russia, flown by Robbie Robinson, took place on December 6, 1959. The targets were Tyura Tam Missile Test Range and three nuclear complexes in the Urals: Kyshtym, Nizhnaya Tura, and Verkhne Nevyansk. Robinson covered Tyura Tam, but Kyshtym was obscured by clouds and only parts of Nizhnaya Tura were visible. The images revealed that two pads at Complex C at Tyura Tam were now completed. The images acquired over Kapustin Yar Missile Test Range showed considerable new missile activity at both the SS-4 and SS-5 surface-to-surface missile test areas. New construction was also observed at the surface-to-air missile area. Robinson's flight also covered a large segment of the Soviet railway in that area, but not a single ICBM, IRBM, or MRBM site was found.

We prepared briefing boards and notes on the British mission, and Lundahl and I met with the RAF commodore to go over them. We knew that the commodore would brief the air marshal and the prime minister. The word we got back was that Prime Minister Macmillan was very pleased with the results of the mission.

Allen Dulles was determined to get permission for more overflights to settle the missile gap question. In a meeting with the president on February 2, 1960, the PFIAB supported Dulles and urged the president to use U-2 flights over the Soviet Union to "the maximum degree possible to solve the missile [gap] problem." President Eisenhower was still reluctant. He had seen indications in his meeting with Khrushchev that a dialogue between the two countries was possible, and he was unwilling to risk destroying that possibility. The president said that while he recognized the importance of intelligence that could be gleaned from such a mission, a summit meeting between the United States, Britain, France, and Russia was coming up in mid-May and he wanted to go into that meeting with his reputation for honesty intact. "If one of these aircraft were lost when we are engaged in apparently sincere deliberations," he told the board, "it could be put on display in Moscow and ruin [my] effectiveness."[30]

General Doolittle, who was still sitting on the PFIAB at the time, stressed the importance of determining how the Soviets would deploy their missiles and urged President Eisenhower to use overflights of the Soviet Union to the maximum degree possible. Doolittle realized that the risks such a mission entailed could only become greater, because sooner or later the Soviets would have a surface-to-air missile or new plane that could down the U-2.

Doolittle visited the PIC after that PFIAB meeting, and Lundahl asked me to show him everything we had on the Soviet missile program. Doolittle spent the entire day absorbing it. Every hour I moved him to different stations occupied by interpreters who were experts on Kapustin Yar and Tyura Tam and to photo interpreters who had searched all the photographs we had received looking for missile sites. Doolittle asked if we would recognize an ICBM site. I replied that we were confident we would, and that it would probably look something like what we had seen at the missile test ranges. Doolittle met again with President Eisenhower and pressed for as many overflights as necessary to settle the issue. Eisenhower had the utmost faith in Doolittle, who had headed his air staff during World War II.

The intelligence community also needed to get a handle on the number of SS-7 missiles being produced and the number deployed. The SS-7 had been developed in missile designer Mikhail Yangel's plant (OKB-56) in Dnipropetrovs'k. It was this plant Khrushchev was referring to when he said that the Soviets were "producing missiles like sausages," and this plant had been placed on a target list for a U-2 mission. The Kuybyshev plant, which was also on the target list, had strong ties with Soviet designer Andrei Tupolev. It produced the Tu-85 Bear bomber, although intelligence indicated that the plant had been converted from aircraft to missile production. The Kuybyshev plant was closely associated with the Korolev NII-88 plant, and there was evidence that it was producing space boosters, space vehicles, or perhaps both.

The success of the first British U-2 mission prompted the president to approve another British mission proposed by Prime Minister Macmillan. The second British U-2 flight was flown by Squadron Leader John MacArthur from Peshawar on February 5, 1960, over the Tyura Tam Missile Test Center and then north to Kazan Aircraft Plant No. 22, a Tupolev-run plant that had produced the Tu-4 Bull long-range bomber but was now producing the Tu-16 Badger medium-range bomber. The pilot was told to place the B camera gap between the aircraft plant and the aircraft engine plant. Unsure that he could be so precise, he deviated from his assigned route, made a 360-degree turn, and flew the gap perfectly. We were surprised when the image showed a new swept-wing bomber with two engines positioned at the base of the tail fin. A drawing was made of the plane along with a report. We would know it as the Tu-22, and it was given the NATO name "Blinder."

The British pilot then flew south to the Dnipropetrovs'k Missile Production Plant, but it was obscured by clouds. He continued on to overfly the Saratov Aircraft Plant, which produced Yak fighters, and Saratov/Engels Airfield. The airfield was the main target. We performed a detailed analysis of the airfield and found sixty-eight aircraft: thirty-seven Bisons, one Bear, twenty Badgers, three Beagles, four Bulls, and three Cubs. This imagery evidence proved decisively that there were fewer Bison bombers than estimated and that the "bomber gap" controversy had for all practical purposes been settled.

When President Eisenhower saw our briefing board, his reaction was, "That's what I was saying all along." Allen Dulles' response was a bit different. Dulles remained a case officer at heart. More often than not, he would revert to the case officer's approach to understand complex intelligence collection and evaluation problems. When Bissell and Lundahl showed him the photo of Saratov/Engels Airfield, he lit his pipe, took several deep puffs, turned to his covert chief, and asked, "How much would you have paid for the information on this photo?" His covert chief thought for several minutes and replied, "About a million dollars." Dulles used the photo often in subsequent testimony before congressional committees, presidential intelligence groups, budget hearings, and other groups; but he never referred to it as the Saratov/Engels photo. We at the PIC always knew what photo he wanted when he or his aides would call and ask that the "million dollar" photo be included in his briefing packet.

In January 1960 Congress was more confused than ever about the size of the Soviet missile force. Secretary of Defense Thomas Gates, Chief of Staff Nathan Twining, and CIA director Allen Dulles each gave different figures in their testimony. Dulles was the most conservative—and probably the most accurate. His number was based on evidence from U-2 overflights, but he could not reveal the fact of the U-2 flights and therefore faced very sharp questions from the committee members.

It was time to prepare the annual estimate on Soviet capabilities for long-range attack, but no ICBM launch sites—other than those at the test ranges—had been found. The SS-6 had been a particular target of previous U-2 flights.

The SS-6 was thought to have a range of 5,500 nautical miles, a payload of 6,000 pounds, a yield of 8 megatons, a circular error probability of 3–5 nautical miles, and a reliability of about 60 percent. Although it had not been seen or photographed, an early estimate based on other intelligence sources indicated that the SS-6 was about 108 feet long and approximately 13 feet in diameter. Because the SS-6 was an extremely large, liquid-fueled missile, photo interpreters and all-source analysts alike believed that it would be deployed near railroads. All of the previous U-2 flights had been along rail lines, however, and we had seen no evidence of the construction of a site for the deployment of SS-6 missiles. Dulles continued to argue that SS-6 installations could be easily detected by flying along railroad lines and proposed missions to overfly the length of the Trans-Siberian Railroad.

The president's continued restriction on the use of U-2 flights rankled Dulles. He sent a memorandum to the National Security Council asserting that U.S. intelligence interests would be better served if the U-2s were given freer rein. The president authorized a flight that took place on April 9, 1960, and covered the Sary Shagan Missile Test Center and the Semipalatinsk Nuclear Test Site and then proceeded to the Tyura Tam Missile Test Center. It photographed pads C-1 and C-2, which appeared operational.

Gary Powers' Flight and the Collapse of the Four-Power Conference

Intelligence from a variety of sources had revealed that the Soviets were building another missile center at Plesetsk. Confirmation came on December 15, 1959, when an SS-6 missile was launched from the Plesetsk area. On April 25, 1960, under heavy pressure from all sides to resume U-2 flights over the Soviet Union, Eisenhower authorized one more flight, "provided it is carried out prior to May 1. No operation is to be carried out after May 1."[31] The Four-Power Conference was scheduled to begin in Paris on May 16, 1960.

More care and planning went into this flight than had gone into any of the earlier ones. The flight track featured a number of turns in order to capture targets as near to nadir as possible. On January 19 an SS-6 was launched from Tyura Tam, not to its usual impact area near Klyuchi on the Kamchatka Peninsula, but close to Johnson Island in the Pacific Ocean. There was no doubt in our minds that if good weather prevailed, we would resolve the missile, nuclear, and nuclear submarine intelligence issues with one U-2 flight. Francis Gary Powers was selected as the pilot for this important mission. At the time he was the most experienced

U-2 pilot flying. Powers had joined the program in May 1956 and had flown seventeen operational missions, including one over the Soviet Union, six along the USSR border, and a number of missions over the Middle East. The flight began at Peshawar, Pakistan, and was to land at Bodo, Norway. Between those two places the flight track would cover strategic missile, nuclear, and submarine targets in the city of Stalinabad, the Tyura Tam Missile Test Center, Chelyabinsk, Kyshtym Nuclear Center, the Sverdlovsk industrial complex, the Nizhnaya Tura Nuclear Complex, the Verkhne Nevyansk Nuclear Complex, the Kirov Nuclear Plant, the Yurya suspected ICBM base, the Plesetsk Missile Center, the Severodvinsk Submarine Shipyard near the White Sea, and the naval base at Murmansk. Of special importance were the suspect missile areas and Severodvinsk, the largest facility in the Soviet Union dedicated to the construction of both nuclear and diesel-powered missile-firing submarines.

On May 1, 1960, just fifteen days before the Four-Power Summit Conference was scheduled to convene in Paris, Gary Powers' U-2 was shot down just as he passed Kyshtym and was approaching Sverdlovsk. Powers' flight was the twenty-sixth—and last— U-2 mission flown over the Soviet Union. The first indication that something had gone wrong came when Powers failed to arrive on time at Bodo. The Operations Center knew that the Soviets had been tracking the plane and had suddenly stopped. Khrushchev was on the reviewing stand for the May Day parade when Marshal Sergei Biryuzov, head of the Soviet defense forces, came up and whispered to him that a U-2 had been downed by an SA-2. But the Soviets remained silent—at least for a while.

Lundahl established a new project at the PIC to gather and evaluate information about Powers' flight. I was put in charge of a damage-control unit to receive and evaluate all the press reports and photographs that the Russians were issuing and forward them to Lundahl. We did not learn the entire story for many years. The Soviets disclosed some thirty years later that they had ordered a new-model Sukhoi fighter to pursue the U-2 in an unsuccessful ramming attempt. In 1990, *Red Star*, the Red Army newspaper, revealed that there had been two casualties on that flight. Soviet ground control and air defense units, believing that the missile that had exploded behind Powers' U-2 had missed its mark, fired a second missile. That missile struck a MiG-19 tracking the U-2, killing its pilot. Powers would later say that there had been an explosion behind him, followed by a brilliant orange light, while he was flying at an altitude of about 70,000 feet. Almost immediately the nose of the aircraft pitched into a steep dive and Powers began procedures to escape the doomed U-2.

The U.S. cover story, implemented on May 2, was as follows: "A U-2 aircraft was on a weather mission originating Adana, Turkey. Purpose was study of clear air turbulence. During flight in Southeast Turkey, pilot reported he had oxygen difficulties. The last word heard at 0700Z over emergency frequency. U-2 did not land Adana as planned and it can be assumed it is now down. A search is under way in Lake Van area."[32] The May 5 NASA news release included the statement, "Since inception of the research program in 1956, the U-2 flying weather laboratories have operated from bases in California, New York, Alaska, England, Germany, Turkey, Pakistan, Japan, Okinawa and the Philippines."

On Saturday, May 7, we received an AP wire photo showing Khrushchev brandishing an aerial photo purportedly taken from the downed U-2. Lou Franceschini and I examined the print. Under high-power magnification it had the unique 9-by-18-inch format of the B camera used in Powers' U-2. With further study we authenticated the clock imprint in one corner. Although the Russians had printed the photo backward, there was no doubt they had positive proof that Powers was on a reconnaissance mission and was not flying a weather research mission that had gone off course, as NASA maintained. We briefed Lundahl, who left immediately to brief Bissell.

While we were still reeling from the shock of the Russians getting hold of the U-2's film, they did a foolish thing. They released a photograph purportedly of the crashed U-2. When I viewed the photo I knew immediately that it was not a U-2 because I could clearly see several rows of rivets on the plane. The photo was forwarded to Kelly Johnson, who held a press conference describing in detail why the plane in the photo was not a U-2 and probably was a Russian Il-28.

On May 7, the day after a State Department spokesman had again denied that any American plane had ever deliberately violated Soviet airspace and said that it would be "monstrous" to claim that the United States was trying to fool the world about the real purpose of Powers' flight, Khrushchev's carefully laid trap was revealed. Khrushchev spoke to the Supreme Soviet: "Comrades, I must tell you a secret. When I was making my report I deliberately did not say that the pilot was alive and in good health and that we have got parts of the plane. We did so deliberately because had we told everything at once, the Americans would have invented another version."[33] Khrushchev demanded an immediate apology from President Eisenhower, which was not forthcoming. Sergei Khrushchev would later write that his father "did not insist upon an apology from President Eisenhower. He understood that it was impossible to ask an American president to apologize openly in front of the press. He expected that . . . once the furor had died down, the issue could be resolved and the two leaders could go together in May to the Four Power discussions in Paris."[34] The State Department stated that Eisenhower would not meet privately with Khrushchev.

In his speech to the Supreme Soviet, Khrushchev said that "a competent expert commission" had been established to examine the plane and its equipment. He grudgingly admitted that "the camera used is not bad; the photographs are very clear."[35] The description of the U-2 camera and its film by Professor Gleb A. Istomin at Powers' trial was so detailed and accurate that it was almost like reading pages from the contractor's technical manual. Istomin also noted that compared with the film used in the "spy balloons," the film in the U-2 had been improved "for a number of specifications essential for high-altitude aerial reconnaissance of military, industrial, and topographic objects."[36] While he was participating in the December 1960 Pugwash meeting between American and Russian scientists, Amron Katz of RAND was asked by a prominent Soviet scientist about the kind of film used in the U-2. When Katz asked the reason for the question, the Soviet responded, "They were damn good pictures."[37]

The revelation that Powers had been captured completely demolished the U.S. cover story and put the president in a very angry mood. Goodpaster would reflect on the shoot-down: "I have to tell you that the handling of that critical international situation—and it was critical—was about as clumsy in my opinion as anything our government has ever done. We had absolutely failed to consider the many 'what ifs' of the U-2 overflights in a thorough, realistic and searching manner. The shoot-down was a lesson that was burned into us by the way we mishandled it." Goodpaster called the entire affair "a particularly grievous setback to Eisenhower's hopes and goals." The Soviets quickly withdrew an invitation to visit Russia to which Eisenhower had looked forward eagerly for both personal and foreign policy reasons.[38] The incident also caused considerable doubt as to whether the scheduled Four-Power Conference in Paris between the United States, the Soviet Union, Great Britain, and France would be held.

It has been the custom throughout history for governments never to acknowledge intelligence activities, especially clandestine operations, in order to permit the normal conduct of international relationships without embarrassing interruptions when a spy is caught. The U-2, however, was no ordinary spy, and failure to acknowledge it was out of the question. The big question was whether or not President Eisenhower would admit personal complicity in U-2 operations. Some in Congress advocated attempting to salvage the summit conference by maintaining silence in Washington and leaving the matter to the usual exchange of angry diplomatic notes. Others called for the cancellation of the entire U-2 program. Adlai Stevenson, the unsuccessful Democratic candidate for president in 1952 and 1956, was extremely critical, charging that Eisenhower had given Khrushchev "the crowbar and sledge hammer to wreck the conference."

A number of irate congressional and national leaders recommended that Eisenhower punish, either by reprimand or dismissal, selected officials who had been intimately involved in the U-2 operations. Allen Dulles had already offered Eisenhower his resignation. Eisenhower refused to lay the blame elsewhere.

> To deny my own part in the entire affair would have been a declaration that portions of the government of the United States were operating irresponsibly, in complete disregard of proper presidential control. And it would have been untrue. Moreover, to enter into a discussion with Khrushchev when he could refer in pity to my inability to control important matters in our government and scornfully dismiss any argument of mine on the ground that I obviously could not speak authoritatively for my government was out of the question. Finally, to pretend, by taking punitive action against subordinates—when all involved in the operation well knew of my personal approval—would have been to do a glaring and permanent injustice to whatever person or persons could have been designated as guilty. I rejected the whole notion out of hand.[39]

At a May 9, 1960, NSC meeting at the White House, Eisenhower brought up the U-2 incident as the first order of business. He later wrote, "I advised the group that Allen Dulles was meeting that afternoon with congressional leaders to explain our reconnaissance work 'fully but without apology.' I reviewed the long and successful history of the flights, and a few reasons for my unequivocal acceptance of personal responsibility for the over-all conduct of the U-2 program."[40]

Allen Dulles called Lundahl and told him to prepare for the upcoming congressional briefing on the Powers affair by focusing on the benefits derived from the U-2 program. Lundahl was told that he would be allowed precisely thirty minutes and that this should be the briefing of his life. Lundahl gave us the task of organizing the effort, and I carefully reviewed all the contributions that the U-2 missions had made to the estimation process and the many global crises in which U-2 intelligence had been employed to resolve policy issues. We created a number of exceptional briefing boards, and Lundahl rehearsed extensively to ensure that he could effectively deliver the information within the allotted thirty minutes.

Lundahl and Dulles entered a chamber filled with stern senators, many clearly angry. Dulles, wearing one of his usual English tweed suits, introduced Lundahl. He then stoked and lit his curved pipe and settled back to enjoy Lundahl's stellar presentation, which provoked a standing ovation on completion. Dulles was so surprised by the senators' reaction that his lighted pipe tumbled into his lap and set his tweed coat on fire. Lundahl, equally surprised, did not know whether to stand there and accept the senators' acclaim or find a glass of water to throw on his flaming director.

In case of capture, Gary Powers' instructions had been to admit promptly what the Russians were bound to find out anyway. His superiors reasoned that sophisticated interrogation methods could force any prisoner into far more damaging statements than the simple truth.[41] Prime Minister Harold Macmillan was aware of those instructions and was not sure whether Powers had told his Soviet captors about Britain's role in the U-2 program. When the inevitable question about Her Majesty's position on the incident came, Macmillan answered, "But for the grace of God it could have been one of our boys." It was a response that admitted nothing and yet was entirely true.[42]

We were alerted by the U.S. embassy in Moscow that Powers' U-2 was going to be displayed in Moscow. We almost chuckled when we heard that the showing was going to be in Chess Hall, "chess" being the code word for U-2 photography. Marvin Kalb and a *Life* magazine team were in Russia doing a story on the Volga River, providing a perfect opportunity to get photos of the downed plane. CIA officials took precautions not to get involved with the media, however, and could not ask the *Life* team to take the photos. Lundahl told us that New York attorney William H. Jackson, a former CIA deputy director for intelligence, was asked to call Henry Luce, publisher of *Life*, and request that he send the Volga photographer up to Moscow as soon as possible to photograph Powers' U-2. Lundahl passed along instructions for the photographer to take a photo of an object and then move slightly to the left or right to take another photo. This would provide for stereo viewing. The U-2's camera and recording gear were of special interest to us. The photo crew sent us many photos of the plane and of Khrushchev visiting the hall to see it. The lens of the camera was visible, along with the recording gear and aerial photos developed from the film. It was all too clear that the Soviets had all the evidence they needed to prosecute Powers for espionage.

Powers was held in Lubyanka Prison in Moscow and was interrogated for ten to sixteen hours a day for sixty-one days. In August the Soviet authorities staged a highly publicized trial. Powers was sentenced to ten years and transferred to a prison in the city of Vladimir. Eisenhower considered the sentence unnecessarily severe.

Although a number of photo interpreters who had been sent to Adana for the Middle East crises had become friendly with Powers, we at the PIC were told to keep our mouths shut. Lundahl told us that Powers' fate was in the hands of the Dulles brothers, and indeed, Allen Dulles began pursuing the possibility of exchanging Powers for Soviet spy Rudolph Abel, held by the United States. On February 10, 1962, Powers walked across the Glienke Bridge into West Berlin as Abel crossed in the other direction. The CIA extensively debriefed Powers when he returned, and I was present at some of the debriefings. Powers later appeared in an open hearing before the Senate Armed Services Committee chaired by Senator Russell in March 1962 and was praised for "performing well in a dangerous job." He was awarded the CIA's Intelligence Star for Valor and the Air Force's Distinguished Flying Cross. On August 1, 1977, Powers died in a helicopter crash. His wife, Barbara, and his CIA friends campaigned to have him buried at Arlington, a request that President Jimmy Carter approved.

In Paris, President Charles de Gaulle, after being reassured that the head of each of the participating states would attend, announced that the Four-Power Conference would go on as scheduled. Eisenhower meanwhile asked to be briefed by the Agency on the status of the A-12 and the Corona satellite reconnaissance development program. He was told that the A-12 would not be ready for at least another year, while the satellite program was on schedule.

Eisenhower arrived in Paris on May 15, 1960, and called on de Gaulle that same afternoon. De Gaulle told him that Khrushchev had already been to see him, was highly agitated about the U-2 flights, and was demanding an apology from President Eisenhower. Eisenhower said it would not be forthcoming. De Gaulle agreed: "You obviously cannot apologize and I will do everything I can to help you."[43] That same evening President de Gaulle invited Prime Minister Macmillan and Eisenhower to join him for a discussion of Khrushchev's note. Eisenhower wrote in *Waging Peace*: "I frankly admitted to the Western members of the conference that the U-2 work we had carried out was both distasteful and disagreeable, but there was no recourse. Both understood my reasons and appeared to be sympathetic. By no means did I intend, at the forthcoming conference, I told them, to raise my hand and swear that we would never again do anything in the field of espionage. I would not permanently tie the hands of the United States government for the single purpose of saving a conference."[44] Eisenhower emphasized that it was his job as president to ascertain the Soviet threat to the United States—and to world peace—and that there was no way other than using the U-2. De Gaulle agreed.

Eisenhower decided that de Gaulle should see some of the images the U-2s had acquired over the Soviet Union. Washington was notified. We prepared a briefing package, and that afternoon Lundahl and James Cunningham, Bissell's executive officer, were on their way to Paris. Lundahl, Cunningham, and a translator were driven to the Elysée Palace and escorted to de Gaulle's office. De Gaulle was alone. Lundahl opened the package of briefing materials and moved toward de Gaulle to brief him at his desk, but de Gaulle rose and asked him to place the graphics on a large conference table where he could look down at them. Forewarned of de Gaulle's poor eyesight, Lundahl handed him a large magnifying glass. De Gaulle asked a number of questions about the focal length of the cameras and the speed and altitude at which the photography was acquired. Frequently, as Lundahl explained details depicted in the briefing boards, de Gaulle would take the magnifying glass in hand and lift the board to carefully scrutinize the photographs. "*Formidable! Formidable!*" was his response. When the briefing was over, de Gaulle thanked Lundahl and after a moment's reflection said, "This is one of the most important programs the West is certainly involved in, and it is something that must continue." De Gaulle assured Lundahl and Cunningham that he would so inform President Eisenhower.[45]

The Four-Power Conference was held in the Elysée Palace on May 16, 1960. De Gaulle waited to walk in with President Eisenhower. He whispered his thanks for the briefing and said, "Now I see why Khrushchev is so mad."[46] As the meeting convened, de Gaulle explained that since Eisenhower was the only chief of delegation who was a chief of state as well, he should be allowed to speak first. Khrushchev, clearly agitated, demanded that privilege for himself. Eisenhower nodded assent to de Gaulle. Khrushchev read a long protest about the overflight, launched into a strident attack on the United States, and demanded an apology from President Eisenhower. In his reply Eisenhower stated that the overflights had been suspended and would not be resumed, but he refused to make a formal apology. Khrushchev again demanded that Eisenhower apologize for the U-2 overflights, accusing the Americans of surreptitiously sending spy planes over the Soviet Union and, indeed, the world.

De Gaulle had listened patiently, but his patience had worn thin. He looked directly at Khrushchev and said, “You’re making too big a fuss about the matter.” Khrushchev drew back in surprise. De Gaulle continued, “There is probably a ton of Russian iron [referring to Russian satellites] coming through French space every day without my permission. I have no idea what is inside those satellites and you have not told me. But I am not making a big fuss.”

Khrushchev replied, “My hands are clean. We do not do things like that.”

“Then tell how you took some of the pictures of the Soviet Union taken from a satellite that you are so proud of.”

“In that satellite, we had cameras.”

“Aha, in that one you had cameras,” de Gaulle continued. “But you are not sure if all of them had cameras.”

Khrushchev broke in to say that he was talking about airplanes, not satellites. De Gaulle drew himself up to his full six feet, five inches and said, “I understand.”[47]

Eisenhower, aware from a recent briefing that a Corona satellite was about to be launched, lifted one eyebrow and doodled, “Most interesting.” Bragging about their accomplishments would make it harder for the Soviets to object when American satellites flew over their territory.

Eisenhower responded to Khrushchev’s rage with temperate words, patience, and dignity. He calmly explained that reconnaissance was a necessity—that it was vital for the United States to know what went on behind the Iron Curtain.[48] The conference collapsed because of Khrushchev’s intransigence on the U-2 issue. The end of the summit marked the end of Eisenhower’s hopes to visit the Soviet Union.

On his return from the aborted conference Eisenhower decided to reassure the nation that he knew what was going on in his government. Here was an unprecedented opportunity to show the spectacular U-2 aerial photographs to the American people and the world. A stick-it-in-their teeth atmosphere prevailed at the White House. Robert Montgomery, the famous actor and producer—then assistant to the president for television presentations—envisioned a series of highly descriptive briefing boards attached to the walls of the Oval Office. As the president spoke, the television cameras would focus on first one board and then another. Lundahl had placed me in charge of preparing the materials to be displayed, and I decided that the president might like to show a comparison of U.S. and Soviet installations. I met with Lou Franceschini, who was in charge of the domestic U-2 training flights, and together we created forty regular briefing boards and ten boards comparing U.S. and Soviet long-range bomber airfields, shipyards, nuclear installations, and missile and aircraft plants. I included a briefing board of the San Diego complex for comparison with facilities in Leningrad.

Lundahl took the briefing boards to the White House, where he met with Robert Montgomery, Eisenhower confidant Robert Cutler, and the president's press secretary, James C. Hagerty, who had been informed of the U-2 program. Cutler had served as a special assistant to the president on national security affairs during the late 1950s when the U-2 program was initiated. The three presidential aides were shown the briefing boards, and all agreed that both the quality of the photography and the subject matter depicted on the boards were spectacular.

Hagerty selected the boards to show the president but returned in a few minutes saying, "The boss has decided against using these because it would probably make our relations with the Russians much worse than they are." Rather than releasing photographs of Soviet installations for public display, the president had selected the single briefing board I had prepared of the San Diego Naval Air Station showing the airfield, aircraft hangars, and runway markers in great detail. The president said that the American people could understand and relate to such a picture. When I went to the White House to pick up the remaining boards, I was surprised to find Hagerty showing the entire package to noted newspaper columnist Walter Winchell, a staunch supporter of the Eisenhower administration.

In his televised address Eisenhower emphasized the need for good intelligence: "Our safety, and that of the free world, demand, of course, effective systems for gathering information about the military capabilities of other powerful nations, especially those that make a fetish of secrecy." He added, "Aerial photography has been one of many methods we have used to keep ourselves and the free world abreast of major Soviet military developments. The usefulness of this work has been well established through four years of effort. The Soviets were well aware of it. Chairman Khrushchev has stated that he became aware of these flights several years ago. Only last week, in the Paris peace conference, he confirmed that he knew of these flights when he visited the United States last September." To clear the air, he added, "First, our program of aerial reconnaissance had been taken with my approval; second, this government is compelled to keep abreast, by one means or another, of the activities of the Soviets, just as their government has for years engaged in espionage activities in our country [and] throughout the world."[49] Then Eisenhower showed the photo I had suggested for comparison. "This is a photograph of the North Island Naval Station in San Diego, California. It was taken at an altitude of more than 70,000 feet. You may not perhaps be able to see them on your television screen but the white lines in the parking strips around the field are just six inches wide."[50]

Eisenhower's public admission that he authorized the U-2 flights was characteristic of a man who always had the courage to act on his convictions. It was the first time a nation had publicly admitted that it was engaged in espionage. The incident also served to emphasize the vital importance that world leaders in the twentieth century attached to aerial reconnaissance.

Prior to the U-2 flights, the Soviets had been quite successful in keeping their industrial and military establishments secret. The U-2 had effectively compromised much of that secrecy. In *Waging Peace* Eisenhower would write: "Technically, the entire program was a success. The information acquired did much in influencing the size and character of our security structure, in revealing the pattern of Soviet industrialization, and in locating military establishments of greatest threat to us in the Soviet Union. Armed with U-2 knowledge, which supplemented the strength of our Armed Forces, we were better able to plan our own political-military course."[51] To critics of the U-2 program Eisenhower would pose a question: "Would you be ready to give back all the information we secured from our U-2 flights over Russia if there had been no disaster to one of our planes in Russia?" No one, he said, answered yes.[52]

The country reacted well to his address, and the president decided that henceforth, his press secretary should immediately be informed if something went wrong on a secret project. At the time, such projects included "authorizations to use atomic weapons; the 54-12 group and activities; certain nuclear experimentation that does not constitute nuclear tests; the Transit satellite with its extra equipment instrumentation; the Discoverer satellite in certain of its applications; [and] airborne alert training operations involving flying with nuclear weapons."[53]

Eisenhower informed U.S. officials that U-2 flights over the Soviet Union would be discontinued and gave two reasons: (1) the utility of the U-2 was limited because of new Soviet SA-2 surface-to-air missiles; and (2) considerable progress was being made in satellite photography. The Russians began threatening dire reprisals to nations where they knew U-2s had been stationed if they allowed a

U-2 to take off from their territory and fly over the Soviet Union again. Twenty-five successful U-2 missions had been flown over Russia. Each covered about 130,000 nautical miles, or only about 15 percent of the Soviet Union, but it was strategically the most important part of the country—the industrial heartland and a great portion of its railroads.

Although he forbade future U-2 flights over the Soviet Union, Eisenhower was reluctant to end the program altogether. U-2 capability might be crucial in an emergency. On July 7, 1960, the CIA prepared a long memorandum for the president presenting substantial arguments for keeping the program going.[54] The memorandum pointed out if the program were deactivated, it would take three to six months to reconstitute it. With regard to use of foreign bases, up to five U-2s could be modified for in-flight refueling, reducing the need for foreign bases. The president decided to keep the program within the CIA. The U-2s stationed in Japan would be brought home. Of the remaining five U-2s, two would be brought back to the United States and the remaining three would stay and be prepared for redeployment. When the president asked for statistics relating to the U-2 program, Dulles prepared a memo that listed 38 missions over the USSR and Soviet bloc countries covering 1,752,322 square miles; 13 missions over China and Tibet totaling 1,061,292 square miles, and 239 missions over non-bloc nations totaling 12,310,019 square miles.[55]

Eisenhower would later sum up his own opinion of the U-2:

> During the four years of its operations, the U-2 program produced intelligence of critical importance to the United States. Perhaps as important as the positive information—what the Soviets did have—was the negative information it produced—what the Soviets did not have. Intelligence gained from this source provided proof that the horrors of the alleged "bomber gap" and later the "missile gap" were nothing more than imaginative creations of irresponsibility. U-2 information deprived Khrushchev of the most powerful weapon of Communist conspiracy—international blackmail—usable only as long as the Soviets could exploit the ignorance and resulting fears of the free world.[56]

Although President Eisenhower had seen many photos of the U-2 and knew all about its operations, he had never seen the aircraft in person. In October 1960 he flew to Laughlin AFB to meet with the president of Mexico on the bridge linking Del Rio, Texas, and Ciudad Acuña, Mexico. The two presidents signed an agreement to construct a dam on the Rio Grande that would create a large lake north of the towns to irrigate thousands of acres of arid land. Helicoptered back to Laughlin, he and senior aides were ushered into a hangar and shown the U-2.

Others who had been involved in the U-2 program or made use of the data it produced offered high praise for its accomplishments. Sherman Kent, director of the Office of National Estimates, remarked that he looked on the intelligence acquired from the U-2 program as he would look on "a holy miracle."[57]

Allen Dulles gave his own summary of the U-2's contributions during congressional testimony in August 1960:

> It is extremely difficult for me to sum up in words the significance of this effort to our national security. I do not wish to exaggerate, nor do I wish to belittle other vital intelligence programs. The photographic coverage and the data derived from it are an inseparable part of the whole national intelligence effort. But in terms of reliability, of precision, of access to otherwise inaccessible installations, its contribution has been unique. And in the opinion of the military, of the scientists and of the other senior officials responsible for our national security it has been, to put it simply, invaluable.[58]

CIA director Richard Helms believed that "the U-2 overflights of the Soviet Union provided us with the greatest intelligence breakthrough of the twentieth century. For the first time, American policy makers had accurate, credible information on Soviet strategic assets. We could evaluate in real time the other side's strengths and weaknesses, keep current on their state of preparedness, their research, and development, their priorities in defense spending, the state of their infrastructure and the disposition of their most important military units. . . . It was the greatest bargain and the greatest triumph of the cold war."[59]

Lt. Gen. Eugene F. Tighe, a Defense Intelligence Agency director, agreed with Helms: "For one who had known the dearth of intelligence on the Soviet Union during B-36 days, the sudden appearance of so much imagery of so great detail was an indescribable windfall. A hundred years from now our historians must credit the great thinkers and planners of the Central Intelligence Agency and the Air Force and the remarkable genius of Kelly Johnson and others at the Lockheed Skunk Works for one of the most extraordinary watersheds in U.S. foreign affairs."[60]

The Olmstead-McKone Flight

The U-2 flights had been canceled, but SAC's ELINT-COMINT collection flights were continuing. On July 1, 1960, just two months after Powers' flight, an RB-47H with a crew of six from the 55th Strategic Reconnaissance Wing on a routine ELINT-COMINT flight from Brize Norton, England, was shot down over international waters along the Soviet Union's northern border. Capt. Freeman B. Olmstead and John R. McKone were the only survivors. The Soviets' immediate protest of an incursion infuriated President Eisenhower. He ordered an investigation to see if the plane had actually crossed into the Soviet Union as the protest note indicated. The initial investigation revealed that the flight was over international waters about seventy miles north of the Soviet border when it was shot down. The international standard for international waters was three miles from a country's borders; the USSR's standard was in some instances twelve miles and in others twenty-five miles. SAC ELINT flights had orders to go no closer than fifty miles to Soviet borders. Khrushchev refused to return Olmstead and McKone as a protest of the U-2 and other overflights.

All Soviet reconnaissance flights were temporarily discontinued after the RB-47H was shot down. The Joint Chiefs of Staff pressed for the continuation of the ELINT-COMINT flights, but the president was concerned that the downed flight might mark a major change in Soviet attitude. On the other hand, it might be the act of an overeager pilot who misunderstood or disregarded instructions. The Soviets were unpredictable, however, and it was safest to assume that they had adopted a new policy. In a memo to the president the JCS indicated that the Air Force ferret program "constitutes a vital portion of the national as well as the military intelligence effort." In addition to providing indications of imminent hostilities, these flights were "uniquely able to ensure that U.S strike planning is optimized for penetrability and survivability of delivery vehicles."[61]

On August 9 the president summoned Allen Dulles, Livingston Merchant, General Twining, Gen. John Persons, Gen. Robert Breitweiser, General Goodpaster, and Col. John Eisenhower to discuss the resumption of COMINT-ELINT flights. While the president agreed that the flights were necessary, he said that he did not want to "get into the position President Wilson did in 1916 in which he responded to every incident by writing a new note." He also disliked "the idea of sending air crews out to take risks of magnitude of this type."[62] Twining and Dulles reassured the president of the value of the missions, and the president approved the resumption of the flights. As a result, COMINT missions were flown on August 16 and 17, with the normal Soviet reaction.[63]

Still concerned, however, the president called another meeting at the White House on September 6 to review the COMINT-ELINT flights. He was told that the Soviets had approached within thirty miles of ELINT-COMINT flights on some occasions and within two to five miles on others, as well as flying parallel to the aircraft and keeping pace with it. While the president commented that the "missions were legal, they provided the Soviets plenty of reason to be annoyed in a worldwide psychological struggle." Eisenhower thought there was insufficient command oversight of these intelligence-gathering flights and told General Twining to increase the level of supervision of all such flights. Twining "assured the president that the Soviet reaction to each flight would be carefully analyzed before proceeding to the next, and that great care would be taken to ensure that the flights are no more provocative than necessary."[64]

The president was still not satisfied. Before he left office he decided to pull all the Air Force, Navy, and special reconnaissance activity together under the Joint Chiefs of Staff to provide effective and unified operational control and coordination of all flights. The Joint Reconnaissance Center was formed to monitor all reconnaissance operations conducted by the military. Approval authority for all military reconnaissance, whether peripheral or overflight, was assigned to the Joint Chiefs of Staff, and the Joint Reconnaissance Center became operational before Eisenhower left office in January 1961.

Although the Eisenhower administration made overtures for the release of captured flyers Olmstead and McKone, Khrushchev refused to release them because he was still smarting from the U-2 incident. He told his son, Sergei, that "he didn't want to talk with Eisenhower anymore." Henry Cabot Lodge came to Moscow and attempted to gain their release, but Khrushchev told his son "that he decided not to do this because it would support the Republicans."[65] Several Americans who attended the 1960 Pugwash Conference in Moscow pressured the Soviets for the release of the two airmen, to no avail. On January 21, 1961, Nikita Khrushchev released the men as a goodwill gesture to the newly inaugurated John F. Kennedy.

I was a member of the Air Force Office of Special Investigation team that questioned McKone and Olmstead when they were released. We determined that they were some seventy miles north of the Soviet border city of Ponoy when they were shot down. They were rescued by the Soviets at sea and taken to the port of Ponoy, later flown to KGB headquarters in Murmansk, and still later were taken to Lubyanka Prison for intensive interrogation. I prepared a report using U-2 and other photography on places they had seen and been confined. The Soviets were well aware of the 55th Strategic Reconnaissance Wing and its mission, but they never admitted that the SAC aircraft was beyond the ten-mile limit when it was shot down. The conclusion drawn after the interrogation was that an overeager MiG pilot had shot down the plane.

FOURTEEN

the corona program gets under way

Satellite photography has a tremendous amount of information that has to be put together and analyzed before it is worth a dime to anybody.

Clark Nelson

Satellite reconnaissance changed the field of intelligence gathering in enormous and sometimes unexpected ways. Bud Wheelon likened the Corona missions to "an enormous floodlight . . . turned on in a darkened warehouse."[1] We were at the threshold of a momentous, and for many a traumatic, change, and we were ecstatic. Lundahl later wrote: "Astronomers tell us that the further outward we look into space, the further backward we reach into time. Photo Interpreters tell us that the more often satellite[s] look downward to earth, the more data we accumulate for projecting the images of the future on earth."[2] Photo interpreters suddenly had to become familiar with the geography of millions of miles of the Soviet Union, China, and other territories. We had to create our own training programs to meet our specialized needs, and we eventually had to plan for around-the-clock exploitation efforts.

The depth and complexity of space reconnaissance depends on the camera. The camera was the heart of the Corona program, and it was the task of Walter Levison and his crew to place it into orbit. To do so they had to deal with a number of issues. First, could a satellite system be placed in the proper orbit? Would the camera be rugged enough to survive the shock of the launch? Could it be sufficiently stabilized to take images while traveling at a speed in excess of 18,000 miles per hour? Would the film sustain damage from radiation or solar phenomena, or crack from the cold? Would the satellite eject the film at the right spot so that a strategically placed aircraft could catch it before it fell into the sea? The satellite would travel through the trapped-particle environment of the earth known as the Van Allen radiation belts. Would this radiation pose a serious problem to the film and electronic components?

The CIA–Air Force team built, tested, and launched twelve Corona satellites—*Discoverer I* through *Discoverer XII*—between February 1959 and August 1960. Each failed for one reason or another. One film capsule disappeared somewhere on Spitzbergen, another in Latin America. After each failure, Lundahl would call me into his office to tell me, and I would shut down the preparations to exploit the imagery.

Bissell called it "a most heartbreaking business. If an airplane goes on a test flight and something malfunctions, and it gets back, the pilot can tell you about the malfunction, or you can look it over and find out. But in the case of a reconnaissance satellite, you fire the damn thing off . . . you never get it back. . . . So you have to infer from the telemetry what went wrong. Then you make a fix, and if it fails again you know you've inferred wrong. In the case of Corona it went on and on."[3]

It is a fact that nothing ever works out quite the way program managers intend or expect it to. Those involved with the Corona program were disappointed at the failures but never resentful or angry. On one mission the acetate-based film broke. Fortunately, Eastman had developed an ester-based film that performed well. The problems on one launch were identified and corrected in the next. Experience was gained with each attempt, and there was a constant effort to improve the satellite recovery vehicle.

Eisenhower gave the satellite program his full support despite the many failures. He knew that all those involved were devoted and highly motivated people who would persist until they got it right. "Let's not worry about the failures," he would say. "Let's stay with it. . . . We need to keep going with it."[4] There was a tremendous letdown at the PIC when we got word of a failure. We had been without new imagery to exploit since Gary Powers was shot down. We occupied ourselves by preparing detailed third-phase reports on the U-2 coverage, but we knew that work could not last. There was a constant fear that if the failures continued, the program might eventually be discontinued.

Allen Dulles established the Committee on Overhead Reconnaissance (COMOR) on August 8, 1960, with Jim Reber as its head. COMOR, which superseded the Ad Hoc Requirements Committee, was charged to coordinate the development of intelligence requirements for reconnaissance missions over the Soviet Union and other denied areas. The committee was given added responsibilities to create the Talent-Keyhole security control system—Talent for the U-2 flights, and Keyhole for the Keyhole flights.

On August 10 *Discoverer XIII* was launched atop a Thor-Agena rocket. It carried diagnostic equipment rather than a camera and film payload. All of the instruments aboard were devoted entirely to examining the satellite's performance. After seventeen revolutions, when it was over Alaska, its controllers triggered the reentry sequence of procedures. The space vehicle oriented itself into the proper position and fired the nose cone carrying the capsule into the atmosphere, and the capsule began its earthward descent. After a failed recovery attempt by an Air Force C-119, the capsule fell into the ocean approximately 330 miles northwest of Honolulu. Helicopters launched from the satellite recovery ship, USS *Haiti Victory*, flew to the scene. A Navy frogman jumped from a helicopter, swam to the capsule, and attached a line to it, and it was hauled aboard the waiting helicopter. Maj. Ralph Ford, an Air Force officer attached to the Corona project, sent an encrypted message to the CIA: "Capsule recovered undamaged." There was a lot of pride both in Washington and on the West Coast, because this was the first known recovery of a human-made object that achieved orbit and then withstood tremendous heat in its descent through the atmosphere. GE engineers examined the capsule closely, and their report was encouraging. They saw no significant problems or deterrents to future flights.

The flight and the successful recovery marked a significant milestone in space exploration. The capsule was brought to the White House on August 15, 1960, with great fanfare. The publicity gave credence to the cover story that *Discoverer XIII* was just part of an experimental space program and not a reconnaissance effort. Eisenhower was photographed inspecting the capsule (which is now on display at the Smithsonian's National Air and Space Museum). A new era of reconnaissance had begun.

On August 18, 1960, at 12:57 PM, *Discoverer XIV* (Photographic Mission 9009) was launched from Vandenberg AFB into an orbit with an apogee of 500 miles and a perigee of 120 miles. It carried a 24-inch panoramic camera whose angular coverage was restricted to 70 degrees. The mission consisted of eight north-south passes over the USSR, Soviet bloc countries, and portions of China. It was a monoscopic mission with a scale ranging from 1:300,000 to 1:450,000, or an average ground resolution on the order of twenty to forty feet on a side.

The reentry vehicle contained exposures of more than a million square miles of Soviet territory. The eighty-four-pound capsule was ejected over Alaska on the satellite's seventeenth pass. Bringing the capsule down in the desired area was a difficult task. A recovery area was established north of Hawaii. Called "the ball park," it encompassed a 200-by-600-mile rectangle. Six C-119 flying boxcars and one C-130 from the 6493rd Test Squadron based at Hickam AFB in Hawaii flew within this area. Three other C-119s from the squadron patrolled the "outfield," which embraced an additional 400 miles. All aircraft flew assigned patterns. At 3:46 PM on August 19, a C-119 piloted by Capt. Harold E. Mitchell and his nine-man crew snagged the parachute and the capsule in midair in the outfield at an altitude of 8,500 feet and reeled it in. "Until we could do this," Lt. Gen. Bernard Schriever commented, "we were only partially on the road to space."[5] Gen. Emmett O'Donnell, the Pacific air commander, praised Mitchell and his crew for a job well done. The capsule was flown to Moffett Naval Air Station in California and then to a Lockheed facility in Sunnyvale, California, to be opened. The film was rushed to Eastman Kodak's Hawkeye Film Processing Facility in Rochester, New York, for developing. The eight passes produced some three thousand feet of exposed film. With the initial success of the Corona mission, the president laid the foundation for the United States to fully exploit space for intelligence, military, communication, and other civilian and scientific purposes.

The PIC sparkled with life again. Our people at Eastman Kodak told us that about 50 percent of the mission was obscured by clouds. CIA headquarters furnished me with the coordinates of the start and stop of each pass and its approximate width. We laid each pass over WACs on which intelligence community priority targets were pinpointed and began listing the priority targets that would be covered. Analysts from throughout the intelligence community gathered at the Steuart Building. I opened a curtain revealing the map showing the passes and gave a pre-Oak briefing describing the targets that may have been imaged. Analysts took copious notes. I said that approximately 25 percent of the coverage was entirely cloud free, and light to heavy clouds covered the remainder of the photography. Compared with the resolution of the U-2 imagery, the level of detail was disappointing: two and a half feet for the U-2 versus twenty to forty feet for the KH-1, and stereo for the U-2 versus monoscopic for the KH-1.

We began to analyze the film, which covered 1,650,000 square miles of Soviet territory. A number of influential people came to the center to see the images.

Lundahl took special pride in showing Corona project manager James W. Plummer the ultimate result of his endeavor. Viewing the satellite images was an overwhelming joy. We were in the advance guard of intoxicating discoveries as we gained a panoramic view of the world. The thrill of discovery was a genuine force in our lives. Each day and each frame of film brought a new and highly rewarding adventure. We knew that our interpretation and analysis had to be precise because we were only a step away from the president, his policy makers, and Congress.

Before the NSC meeting on August 25, 1960 began, Allen Dulles, Gordon Gray, James Killian, Dr. George Kistiakowsky, and Dr. Edwin Land met with the president. On entering the Oval Office, Land unrolled a reel of developed film across the carpet toward the president and said, "Here are your pictures, Mr. President." It was an epochal moment—the greatest achievement yet of reconnaissance. The president was impressed and gave the go-ahead to develop more advanced satellite systems.

At the PIC we began the "search" process: looking at each frame to find, identify, and classify the vast range of activities the images would show. The first priority was to report on the COMOR highest-priority targets. The U.S. targeting system divided the Soviet Union into areas suitable for the deployment of ICBMs (about 4,764,000 square miles of the Soviet Union's 8,647,000 square miles). There was general agreement that the Soviet ICBM system would depend very heavily on rail transportation, and that railroads would also be the primary means of logistical support. We had seen enough of the Soviet Union to know that the roads, especially in Siberia, were in such poor condition that it was unlikely that missiles would be deployed miles from the rail lines.

Our main objective was to confirm or deny the existence of Soviet missile superiority. As the search continued, we catalogued and reported hundreds of newly identified installations and activities. They ranged from missile activity to sensitive strategic nuclear storage facilities, military installations, airfields, shipyards, communication facilities, and industrial installations. Thousands of linear miles of Soviet railroads were searched for spurs or activity within ten to fifteen miles of each line. We "negated" areas that were deemed of interest but where nothing new was found. This information was reported to the intelligence community and to military planners to assist in planning passes of the next Corona satellite to be launched.

The ground resolution for most of the film was about twenty to thirty feet. The entire area of the Kapustin Yar Missile Test Center was covered, as was the

Sarova Nuclear Research and Development Center. The feverish construction of SA-2 sites continued in the Soviet Union. Twenty new SA-2 sites, and six others under construction, were imaged in the vicinity of critical industrial and military centers. We searched the rail lines but found no ICBM, IRBM, or MRBM sites. About thirty important military installations and forty-three military airfields were reported.

We created about twenty briefing boards and briefing notes for Art Lundahl. Bissell came over to the Steuart Building to review the boards, and then he and Lundahl went to the White House to show them to the president. Eisenhower was elated at the mission's success. His first question was, "Did you find any ICBM sites?" Lundahl explained that we did not, but the mission had not covered the areas of concern. Eisenhower asked Bissell if the problems that had plagued previous missions had been solved. When Bissell replied that he thought they were, the president sent his compliments to those involved with bringing the satellite mission to fruition. Eisenhower commented on the interpretability of the photographs, and Bissell assured him that the interpretability would improve.

When he returned from the White House, Lundahl held a staff meeting and told us that the president was enthusiastic about the results of the first successful satellite mission and was ready for more intelligence information from future missions. Lundahl rubbed his hands together and said, "It's like having a baby, and that baby is going to grow."

Lundahl, like the president, was not satisfied that we had not found a missile site. Missile analysts Mark Baker, Walt Fertig, Bill Fitzgerald, Tom Hardy, Ken Keegan, Arthur Little, Tom Logan, John Parash, and John Rooney were all familiar with the Soviet missile test centers at Tyura Tam and Kapustin Yar, and Lundahl ordered them to rescan the entire mission. They did, and still they found no offensive missile sites. Thinking that the sites might be well hidden, Lundahl asked us to review the major camouflage and deception efforts of World War II. We looked at the British wartime publication "Evidence in Camera" and at all the photo interpretation keys on camouflage and concealment that had been prepared during World War II. The U.S. Army Corps of Engineers provided us with reports and aerial photos of camouflaging and concealment efforts at U.S. aircraft plants. We reviewed Soviet books and publications on deception and visited Army engineers and scientists at Fort Belvoir, Virginia, to learn about their latest camouflage and concealment techniques. Army efforts at the time concentrated on field camouflage using nets, painted patterns, and camouflage uniforms. The Army personnel knew of no U.S. effort on strategic camouflaging or concealment.*

Eisenhower had come to see satellite photography as a means to limit and control armaments, and thus to defuse the tension between the Soviets and Americans. At an August 25, 1960, meeting, Eisenhower directed that henceforth no American reconnaissance photographs would ever be released publicly. The following day he issued a presidential directive: "I hereby direct that the products of satellite reconnaissance and information of the fact of such reconnaissance revealed by the product shall be given strict security handling under the provision of a special security control system approved by me. I hereby approve the Talent-Keyhole Security Control System for this Purpose." He asked that each cabinet or agency head read and initial his memorandum. "Within your Agency you shall be personally responsible for the selection of those personnel who will have access of the information and for determining the scope of that access. Access to be on a 'must know' basis related to major security needs."[6]

The list of those cleared for the Corona and Talent programs was controlled by James Reber, chair of COMOR. A copy of the list was provided to the PIC, and we sent information only to people on that list. A total of 1,352 people were cleared for access to the program; 164 of them were PIC personnel.[7]

Lundahl called us all together and imposed a ban on speaking about a photographic satellite to anyone—even our immediate families. Anyone who revealed information about the satellite could be fired and face a prison term. He also warned that newspaper reporters were probing to learn more about what was happening in the intelligence community and that we were not to have any contact with them. If we did, the contact had to be reported to our security officer.

The fact that no missiles had been found on the first satellite mission prompted the Air Force to try to get into the act by flying their U-2s over the northern areas

* The search for Soviet concealment and deception efforts continued. In the late 1960s the Soviets did prepare dummy missile silos at several locations. We identified a number of dummy silos at the Kartaly SS-9 ICBM Complex on Corona photography of October 7, 1970. After analyzing comparative coverage, we determined that the sites had been completed in about three months instead of the usual eighteen. There were no supporting structures at any site, and the dummy roads constructed to the sites had no bridges or culverts where the roads crossed over streams or ditches. We also saw a display of mainly tactical camouflage and concealment efforts at Belaya Tserkov Airfield, which appeared to be a show-and-tell situation as to what could be done rather than what was being done. Khrushchev had ordered the USSR's Ministry of Defense to design and build false missiles and submarines. But it was too late. We had already established a database on all Soviet strategic installations. When the Soviets later deployed a dummy submarine at one of their bases, we quickly identified it. With repetitive coverage we learned that the submarine had suffered some damage and was bent in two. It soon became known in the intelligence community as the Soviets' "rubber duck."

of the Soviet Union where it seemed likely that ICBM sites might be located. The Defense Department presented a request to the president for approval to fly U-2 aircraft under SAC command over the Soviet Union. Andrew Goodpaster, who reviewed the request, advised the president against sending U.S. military planes that close to the USSR, and the president agreed.[8]

Eisenhower was reluctant to reveal the existence of the new photographic satellite system for fear that first the Russians and later other nations might object to being viewed from overhead. There was also some fear that the Russians might attempt to shoot down our satellites. Even if the international community did not formally protest, Corona would set a precedent for reconnaissance satellites that other nations would surely follow. In fact, the Soviets already knew about our photo satellites. Soviet space-related publications had identified the Discoverer program as spy technology. Khrushchev promised that the Soviets would shoot down spy satellites just as they had shot down a U-2.

A paper published in the November 1960 issue of the Soviet magazine *International Affairs* claimed that the Soviets had "everything necessary to paralyze United States military espionage both in the air and outer space." The author, G. Zhukov, noted that "the main purpose of space espionage is to increase the efficacy of a surprise attack, making it possible to knock out enemy bases at the very start and thereby avoid a retaliatory blow."[9] The Soviets later tried to pass a resolution in the United Nations banning espionage from space. Although they and other nations originally considered satellites a violation of their national sovereignty, the Soviets stopped complaining when their own satellite reconnaissance program got under way.

The CIA kept Eisenhower well briefed on the Soviets' attempts to develop a space photo reconnaissance system. *Luna 3* had photographed the dark side of the moon in October 1959, and many believed that the Soviets' reconnaissance vehicle for viewing the United States would be an advanced Luna satellite. The Soviets' first successful recovery of an object from space occurred on August 20, 1960, just eight days after the recovery of *Discoverer XIII*. The new system, launched with an SS-6 ICBM, incorporated the same module that would be used by the Soviet cosmonauts. The first Soviet photo satellite, a Zenith-2, was launched from Tyura Tam in late 1961 but failed. The second launch, in August 1962 and also from Tyura Tam, produced the first Soviet reconnaissance pictures. It was a film-return system, and the cameras and film capsules parachuted to earth on Soviet soil. The Soviet system returned a larger film load than the Corona.

NASA officials who dealt with the Soviets were encouraged to feel them out regarding reconnaissance satellites. Dr. Hugh S. Dryden, deputy administrator of NASA, attended a Geneva meeting with the Russians on peaceful uses of outer space and reported on a Russian scientist's presentation: "As far as we were concerned, his main point was that there was no coordinated effort on the part of the Russians to attempt to attain an effective ban on satellite reconnaissance as a precondition for negotiations either in the legal subcommittee or the technical committee in Geneva."[10]

The entire nation watched John Glenn's historic launch into orbit on February 20, 1962. The successful launch brought new concerns. Both the State Department and the CIA were afraid that photos taken by NASA astronauts might breach security and reveal the success of the Corona program. Glenn's report of seeing thousands of what looked like butterflies caught the fancy of the press. We were quick to report to NASA that we had seen the same phenomenon: a shower of ice crystals that dislodged from the Agena when the sun heated its surface. Glenn did take some color stellar slides that were of interest to the PIC, and NASA was asked to continue to take stellar pictures on subsequent missions until the Corona cameras could be equipped with stellar cameras. Photo interpreters and members from the PIC's Image Evaluation Branch and Department of Defense representatives visited NASA's Houston facility after a NASA mission and helped to screen all terrestrial photography taken by the astronauts "to ensure that the photography does not compromise information vital to the United States or other sovereignties."[11] Of special concern were Area 51, overseas bases where U-2s were deployed, Israeli and Arab airfields, and Israel's missile defenses and nuclear installations. There was a continuing effort not to stir up problems that would compromise what the Corona missions were returning.

The existence of a U.S. photographic satellite was classified until President Lyndon Johnson, speaking to a group of educators at the governor's mansion in Nashville, Tennessee, on March 16, 1967, said that he did not want to be quoted on it, "but we have spent thirty-five or forty billion dollars on the space program. And if nothing else had come out of it except the knowledge we've gained from space photography, it would be worth ten times what the whole program had cost. Because tonight we know how many missiles the enemy has, and it turned out our guesses were way off. We are building things we didn't need to build. We were harboring fears we didn't need to harbor."[12] The U.S. government did not officially acknowledge that it used satellite systems and imagery for intelligence purposes until Edward Kampiles, a disgruntled CIA employee on a foreign visit, sold the KH-11 manual to the Soviets. He was tried for espionage, convicted, and sentenced to a forty-year prison term. In 1978 President Jimmy Carter announced that classified satellites "have played, and will continue to play an important role in the national security of the United States." The Corona program was not openly talked about until the twenty-fifth anniversary celebration.

No treaty governed space at the time, but Eisenhower was adamant that the United States had to maintain freedom of space. He also knew that if the Soviets learned that the United States was developing an antisatellite system, they would attempt to achieve that same capability. Eventually, both the Soviets and the United States developed orbital antisatellite (ASAT) weapons. In the late 1950s, under Project SAINT (SAtellite INTerceptor), the United States began to develop two highly classified antisatellite systems that began operations in 1963; both remained in operation for at least a decade.

The Soviets developed and tested an earth-based antisatellite interceptor in 1968. We carefully watched its separate launch area at Tyura Tam. In early 1976 the Soviets began testing a new version—a co-orbital ASAT missile. As the interceptor approached its intended satellite, it would destroy it with shrapnel fired from a shaped charge. The Soviets succeeded in eleven of twenty-two attempts against test targets. Though technically not a violation of the SALT I treaty, the interceptor caused some consternation at the CIA and the White House. President Gerald Ford instructed the CIA and the Defense Department "to prepare an action plan and submit funding requirements for new technology that would provide advance warning of an attack on critical U.S. satellites, verify any interference with or attacks against them, and ensure for these satellites a balanced level of survivability against a range of possible threats."[13]

On January 18, 1977, President Ford signed NSDM 345, "U.S. Anti-Satellite Capabilities," which called for the development of a new satellite interceptor. A wide range of defensive measures for our own satellites were considered. Almost twenty years later Bud Wheelon wrote: "We considered inflating and deploying balloons in orbit as decoys for the primary spacecraft. This suffered a fundamental flaw in that the balloons would periodically reunite with Corona because of the law of celestial mechanics. We also considered orbital adjustment maneuvers that could change the predictable arrival time over defense installations. None of these measures were implemented—primarily because they required a good deal of weight. We opted each time for increased film loads and hoped that the Soviets would see the mutual benefit in such activities."[14]

There was a general feeling that any attempt to destroy a satellite would presage an impending surprise attack or an attempt to conceal a buildup of strategic weapons. Fortunately, after the signing of the SALT and ABM agreements and the demise of the Soviet Union and the Cold War, both the United States and Russia began to cancel ASAT efforts. Secretary of Defense Robert McNamara canceled two space weapons that could be used against satellites. One was *SAINT II*, a manned interceptor, and the other was the manned DynaSoar, which could be considered both an interceptor and a reconnaissance vehicle.

Corona Performance Evaluation

Because the satellite camera was not returned after each mission, the performance of the mission had to be evaluated from the photography obtained. Lou Franceschini headed the Performance Evaluation Team (PET) that prepared postmortems of each satellite mission. Both Dr. Land and General Doolittle asked that the camera-to-imagery-to-camera loop be closed. Each camera system had its own peculiarities, and the PET was entrusted with investigating all anomalies. The postmortem team consisted of PIC experts, scientists, camera manufacturer representatives who reviewed camera malfunctions captured on the film, and Eastman Kodak experts who reviewed anomalies in the film itself. Photographic image quality, image suitability for measurement, and geographic coverage were reviewed in each postmission session. The Photographic Evaluation Report (PER) was a technical publication expressing the photo quality and problems of a mission. PERs were used to secure system modifications to better satisfy PIC needs. The PET on the first Corona mission reported fogging due to coronal discharge (glow from static discharge), the presence of some uncontrolled light leaks, uncontrolled changes in thermal environment, and the effects of varying atmospheric conditions on the mission. The closing of the technical loop allowed the difficulties and anomalies encountered on a mission to be corrected on subsequent missions. The scientists and contractors also listened when photo interpreters and photogrammetrists expressed their needs. While the first missions were good for pinpointing installations, they left a lot to be desired for interpreting and measuring installations or objects. Improvements were needed in seven areas: (1) increase the resolution of the cameras, (2) acquire stereo capability, (3) increase the film load, (4) increase the development and printing of positive transparencies, (5) improve optical capabilities for photo interpreters, (6) install stellar and horizon cameras and fiducial markings on the film, and (7) develop faster measuring and computing techniques.

Photogrammetry is the science of obtaining reliable measurements of objects from photographic images. Once the scale is known, anything on a vertical photograph can be measured. Precise measurements of the location, altitude, and mechanical performance of the vehicle and camera system at each point of exposure are fundamental to photogrammetry. Chris Mares and John Cain, our photogrammetry experts, pointed out a lack of ephemeral data (the satellite's height over the target), and there were problems trying to determine the position of the camera in space; that is, was it pointing straight down or at a slant? Fiducial markings on the film, horizon camera, ephemeral data, and a stellar camera would position the camera in space. The stellar camera would also allow determination of the precise geographical position of critical Soviet targets.

Experience gained from U-2 imagery told us that there would be a greater call for precise mensuration not only of industrial plants but also of individual objects. Lundahl wanted a system that would allow us to measure the accuracy of the dimensions we were providing to the intelligence community. Because the resolution of the early satellites was in the range of twenty to forty feet, requirements were primarily to measure industrial installations. Photogrammetrists spent thousands of hours obtaining dimensions, heights, geodetic positions, and azimuths of Soviet strategic research, development, and production facilities. From this data we estimated the floor space of various buildings, and that was used to estimate production.

Chris Mares came up with the idea of having the satellites fly over U.S. installations whose dimensions were known and to compare those dimensions with the ones the photogrammetrists derived from the photographs. A number of military camps and cities in the United States were overflown, and Chris would come to me for engineering drawings of the ones he selected. Chris' usual selection would be of a military complex with a number of both large and small buildings for which the resolution of the photography was excellent. He would ask me to procure precise dimensions of a specific number of the buildings at that camp. I would contact Val Bauer, a senior official at the Army Map Service with security clearance, and he would send a cleared Army officer to visit the base engineer at the camp to obtain a copy of the blueprints. Our request for dimensions of a number of buildings at Fort Jackson in South Carolina had unexpected repercussions. The base engineer became excited and immediately notified the commanding general of the base, who then invited the AMS officer to have dinner with him and his staff. It seems that the general had sent a request to Washington to demolish some of the older buildings at his base and replace them with new ones, and he thought the officer had come in response to that request. The AMS officer sat through a two-hour briefing on what the reconstruction would look like and was handed a large roll of blueprints and proposals to take back to his commanding officer. Afterward, Val Bauer called and laughingly asked me to come over and get the proposals.

Once we had identified targets on Corona photography, the intelligence community asked for measurements that were sometimes difficult to provide. What we needed, Lundahl said, was a rifle in the sky—a high-quality photographic satellite that could "shoot" specific targets. With the approval of President Eisenhower, in August 1960 the Air Force began developing a new high-resolution satellite that was designated the KH-7. Lundahl and those who visited Eastman Kodak were impressed with Eastman's optics proposal for the new satellite. A "spotting" rather than an "area" satellite, it would provide a maximum resolution of about two to four feet that would allow photogrammetrists to obtain precise measurements of missiles, aircraft, electronic installations, and research and development establishments. The KH-7 satellite was launched by a powerful Atlas booster and carried a single large-format camera that operated in either a single frame or long strips monoscopically, or in a mode aimed by ground command at angles out to 35 degrees from the vertical. The oblique photos allowed the interpreters to see the sides of a building—and even the inside if large doors were open. The focal length of the camera was 77 inches and the film width 9.5 inches. The KH-7 would operate in a lower orbit than the KH-4. While a KH-4 frame covered 1,075 nautical miles, the KH-7 covered only 120 square nautical miles.

Corona Leaks

George Kistiakowsky was worried when he learned that word was leaking about a new U.S. photo reconnaissance satellite, because he knew that Eisenhower was concerned with the security of the entire program. He discussed the situation with the president on September 8, 1960. The president told Kistiakowsky that the United States could not deny its interest in satellite photography, but he "felt strongly that the really high-resolution projects should be kept 'black.'"[15] Eisenhower emphasized that security was essential for the entire satellite reconnaissance program. He remembered Khrushchev's comment to his Open Skies proposal: "As long as arms exist, our skies will remain closed and we will shoot down anything that is there without our consent." Eisenhower was afraid that the Soviets might also employ countermeasures or engage in political wrangles at the United Nations. He knew that the Corona cover story—that it was part of the Discoverer series to explore environmental conditions in space—would wear thin, and he was among the first to recognize that the Soviets would identify the Corona missions and predict their orbits. Corona satellites emitted signals that could be easily tracked. He was correct. The Soviets quickly saw the real purpose of the satellites. A 1962 article in *Soviet Patriot* spelled it out: "With the aid of the spy-satellites, US military circles hope to determine as accurately as possible in peacetime the coordinates of intercontinental ballistic rocket launching sites, strategic airfields, naval bases and moorings, positions of anti air and anti rocket defense weapons, radar stations and their basic characteristics, and to detect large military installations and other military targets."[16]

Missile Gap Controversy

The missile gap controversy became an election issue during the 1960 presidential campaign. Democratic Party candidate John F. Kennedy insisted that the United States was lagging behind the Soviets in missile technology. He further charged that the Soviets had made a breakthrough in missiles and by 1963 would have a larger arsenal than the United States did. The intelligence community was projecting that the Soviets could have as many as five hundred ICBMs by 1963. Eisenhower knew, however—as did Kennedy—that reliable technical intelligence on the Soviet Union was almost completely lacking. The estimate was based on inflated opinions and judgments that were presented as facts to both the president and the Congress. Kennedy further claimed that the Soviets were surpassing the United States economically as well. JCS chair Gen. Nathan Twining and Senator Stuart Symington publicly expressed alarmist views that the Soviets could strike the United States at any time because the United States did not have a missile defense system. CIA historian John Helgerson noted that DCI Dulles had been told to pull "together a collective view of this intractable problem of collecting and analysis, but everyone, including Eisenhower, knew the Agency did not have the detailed technical intelligence or the bureaucratic clout to referee the contentious issue."[17] The National Intelligence Estimate published early in 1960 claimed: "Our analysis leads us to believe that if the US military posture develops as presently planned the USSR will in 1961 have its most favorable opportunity to gain a decided military, political, and psychological advantage over the United States by the rapid deployment of operational ICBMs."[18]

Wherever he turned, Eisenhower was confronted with the charge of a missile gap. He insisted there was no gap. Historian Stephen Ambrose noted that Eisenhower "cited history to make his point: 'Only three or four years ago,' he said, 'there was a great outcry about the alleged bomber gap.' Congress appropriated nearly a billion dollars more than Eisenhower had asked for to build new American bombers. Subsequent intelligence investigations, however, showed that the estimate was wrong and that, far from stepping up their production of bombers, the Soviets were diminishing it or even eliminating that production."[19]

On July 18, 1960, Eisenhower sent a telegram to the Democratic nominees offering them briefings by the CIA. Senator Kennedy promptly accepted the offer and was briefed on world affairs at his vacation home in Hyannis Port, Massachusetts, on July 23. Dulles reported that he "put heavy emphasis on Soviet issues, including Soviet progress in strategic delivery capabilities, missiles and bombers, and discussed the nuclear testing issues." He did not mention briefing Kennedy on the Corona or U-2 program.[20] Senator Johnson, the vice presidential nominee, was briefed at his ranch in Texas on July 28. Kennedy was briefed again by DCI Dulles on September 19 at his Georgetown home. The two discussed trouble spots in the world that might arise during the campaign as well as the Soviet space program.

On September 25 Dulles sent a memorandum to Goodpaster reporting that Kennedy and Johnson had separately inquired about intelligence techniques or capabilities to replace the U-2. According to Helgerson, "Dulles was clearly uneasy about the security hazards in these questions" and replied only in a general way, indicating that research and development work on advanced aircraft was progressing "with reasonably satisfactory prospects." Dulles added, "Unless I hear from you to the contrary, I shall not give any more detailed briefings on this subject."[21]

Photographs from Corona satellite mission 9009 had been thoroughly analyzed by early September 1960, and some in the intelligence community were concluding that there was no missile gap after all. Both Eisenhower and presidential candidate Richard Nixon were informed about the intelligence findings, but Eisenhower was adamant that no references were to be made to satellite reconnaissance.

November 8, 1960, was Election Day. Eisenhower was depressed when the results were announced; he felt that Kennedy's victory represented a rejection of everything he had accomplished in the past eight years. President-elect Kennedy and his family went for a vacation at the Kennedy compound at Palm Beach, Florida, after the election. On November 18, 1960, Bissell and Dulles briefed him there on the Agency's worldwide covert operations. The plans to invade Cuba—as they existed in mid-November—were a major topic, according to Bissell, who warned Kennedy that the "Cuban operations had gained considerable momentum and couldn't be turned on and off."[22] For some thirty to forty-five minutes Bissell outlined the plan to Kennedy and told him what the CIA hoped would happen. Records indicate that Goodpaster had informed Dulles that CIA covert operations were to be disclosed to Kennedy on a case-by-case basis. Goodpaster confirmed that Dulles was to inform Kennedy on the progressing plans related to Cuba as well as on "certain reconnaissance satellite operations of a covert nature." No other subjects were specifically approved.[23]

Accounts describing a meeting between Dulles and Kennedy on November 29, 1960, at which Kennedy was supposedly briefed by Dulles and gave his approval to carry on with the plan to invade Cuba, conflict in some areas.[24] Certainly Kennedy was aware of the plan. Eisenhower continued working with the CIA planners even though he knew the operation would take place after he left office. On December 5, 1960, Eisenhower held a comprehensive meeting at the White House to discuss the entire planning effort against Cuba. Minutes of the meeting indicate that he had many questions: "Are we being sufficiently imaginative and bold, subject to not letting our hand appear? Are we doing the things we are doing effectively? Should we be prepared to take more chances? . . . Would it be useful to have an individual executive to pull the whole Cuban situation together who would know precisely at all times what State, CIA, and the military were doing and who could answer directly?"[25]

On December 6, President-elect Kennedy visited President Eisenhower at the White House for a discussion of responsibilities. Eisenhower was pleased with the first meeting: "I must confess to considerable gratification in this visit with the young man who was to be my successor. He conducted himself with unusual good taste. Resisting any temptation to flood the White House with his own retinue, he came riding in the back seat of an automobile by himself."[26]

Eisenhower directed that the president-elect be briefed by Lundahl and Bissell on all photographic intelligence systems. I remember some consternation on

Lundahl's part as to how Kennedy should be briefed because he doubted that Kennedy would be well informed on reconnaissance. He decided to begin with a tutorial and then lead into the major issues. The briefing was held during an evening in the Executive Office Building, with President Eisenhower in attendance. Eisenhower wanted to make sure that Kennedy understood the scope, depth, and importance of our aerial and satellite photographic efforts. He told Kennedy about the various arrangements made with foreign governments for sharing intelligence from the collection systems. Lundahl said that Kennedy became intrigued with the whole process of photo collection and interpretation. President Eisenhower interrupted the briefing frequently to emphasize how valuable photo intelligence had been in his decision making.

Eisenhower and Kennedy shared an insatiable craving for knowledge about their Soviet adversary, and photo interpretation became a prime source for satisfying that craving. When Eisenhower talked about reconnaissance, there was an enthusiasm in his voice quite different from when he talked about political matters. Eisenhower told Kennedy triumphantly that "the enemy has no aerial photographic system like ours." When he returned, Lundahl held a staff meeting and spoke glowingly of Kennedy. "We have a winner," he said. He and Kennedy would hit it off famously, which was especially important during the Cuban Missile Crisis. Lundahl later recounted that "some months later, when Kennedy was President and Eisenhower was back in Washington on a visit, I was again at the White House, briefing them on the latest accomplishments. Dwight E. not only had guts to start pre-hostility recon, but kept track of it all during his administration and during the years after he left public office."[27]

Lundahl also told of briefing Harold Macmillan when the prime minister was visiting the Kennedy White House. "This time I had late photography of all forms of Soviet weaponry. After Kennedy walked Macmillan to the door, he came back and said to me, 'Well, that was a fine briefing, but I think you scared the hell out of him.' I said, 'I am very sorry Mr. President. I didn't mean to do that.' He chuckled and said, 'That's exactly what I hoped you would do.'"[28]

Corona launches on September 13, October 26, and November 12, 1960, all failed, but the Soviets seemed to be having no better luck. U.S. attachés attending fall diplomatic events in Moscow heard that a disaster had occurred in October at a missile launch site in Siberia. Their information was cabled to the Defense Department, with a copy coming to the PIC. I discussed the cable with Lundahl, and we immediately knew that the missile launch site had to be Tyura Tam. From other sources we knew that the disaster had occurred on October 24, 1960. We also knew that something had happened to Marshal M. I. Nedelin, the tough-minded artillery commander who had been made the first commander of the Strategic Rocket Forces. When the Russians announced that he had died in an airplane crash, we immediately became suspicious. Tyura Tam became a priority target for the next Corona launch.

The next successful Corona mission was flown on December 7. When we received the film, John Rooney, a Navy photo interpreter assigned to the center, immediately grabbed the can that contained the Tyura Tam photography. Although the resolution was not good, he could detect a large black scar on one pad at Complex C and a smaller one on the adjacent pad. Clearly, an SS-7 missile had blown up on the pad. We also noted a large new grave in the city of Leninsk, the main housing area of the missile launch complex. Lundahl briefed Eisenhower, Killian, and Land. Lundahl said that Eisenhower, on seeing the briefing boards said, "I am glad that other people are having trouble with their missiles."

The same mission returned images of the Plesetsk Missile Center in northwestern Russia. Although the resolution left a lot to be desired, extensive construction activity was visible. A road pattern emanating from a central area terminated at three heavily scarred areas, which were later designated "Possible Launch Areas 1, 2, and 3." Because of their size and configuration we determined they were for the SS-6 ICBM. Later, we saw a fourth launch area under construction. These would be the only field-operational SS-6 ICBM sites in the Soviet Union.

The search for ICBM sites in the early 1960s still centered on the Soviet railroad system, the principal means of transport and logistical support throughout the USSR. Our objective was to confirm or deny the presence of missile-related activity within ten to fifteen miles on either side of the railway. All new spur lines were followed for any indication of a possible ICBM site. Coverage was also obtained of Polyarny Ural, the highest-priority target in the USSR for ICBM deployment as determined from communications intelligence. When no missile sites were found at these locations, the competency of the photo interpreters came into question. That was unjust; they were looking at monoscopic images with a resolution of twenty to thirty feet.

Other intelligence linked Vorkuta with the Soviet missile program. We looked there as well but found no missile sites. The missile gap still remained a matter of bitterly contested national estimates. SAC was allowed at that time to contribute to discussions involving national estimates, and used every opportunity to advance its own interests. SAC commander Curtis LeMay encouraged brainstorming sessions on intelligence information that might benefit SAC. He was known to spin or embroider the truth, and every time he saw an opening in the estimating process he would rush in and with sheer bluster try to get the estimate swayed his way.

When we received imagery from August and December 1960 satellite missions, we concluded that the Soviets did not have operational missiles in some of the areas that were considered most likely to have them. General LeMay had officers on his intelligence staff look at imagery of areas where COMINT sources indicated missiles could be deployed but had not been found by the PIC. A SAC intelligence officer came up with an elaborate presentation of a large suspected missile base at Vorkuta. We were provided with a copy in order to defend ourselves. At a Pentagon briefing the SAC officer presented maps, drawings, and estimates of the missile sites supposedly at this ICBM complex. He pointed out good roads radiating outward from central Vorkuta ending at "launch sites." It was a classic illustration of the kind of mistakes that can result from lack of knowledge and research. I worked with Col. David S. Parker, the deputy director of the PIC, prior to the briefing and showed him hundreds of documents recounting interrogations of returning POWs that I had obtained from the CIA's Industrial Register. The documents indicated that what the intelligence officer was calling launch sites were coal mines. Our librarian, Dorothy Randolph, also found a number of Russian documents detailing the coal-mining activity and including diagrams and photos of the mines. Colonel Parker, an eloquent briefer, methodically demolished SAC's so-called proof that the intelligence community had missed important evidence. The Air Force was so embarrassed that SAC was henceforth not allowed to present information to the Office of National Estimates that had not first been cleared by the Air Force high command.

After the December 1960 satellite mission, Eisenhower expressed even more concern about the security of the program. He was particularly worried that any slackness in the system might allow the inadvertent release of a satellite photo. The CIA had instituted strict regulations on the control of all satellite film and photos, and these were distributed to all organizations that received photographs. Henry Thomas, the security officer in charge of the Talent-Keyhole program, was concerned that one of the military services (SAC in particular) might divulge the existence of the program. I went with Thomas when he made a three-day inspection of SAC headquarters in Omaha at which he unleashed his outrage over their lax handling of the Talent-Keyhole materials. He walked into a cleared unit, grabbed a KH photo, and took out a stopwatch to time how long it would take the unit to provide the control sheet that had been established for that photo. Often he would grab a control sheet and demand the photographs. With a stopwatch again, he asked me to demand a target dossier that I knew would probably contain Keyhole material; then he asked to see the control sheets for all KH photos contained in the dossier. He notified SAC's director of intelligence that SAC had failed the inspection and that under the presidential directive they could not only be denied any future materials but also would have to account for every can of Talent-Keyhole film or print in the command. SAC was given a week to set up a system similar to that used by the PIC. If it did not institute an acceptable system, it would be denied TKH materials. LeMay was furious and called Thomas a "chicken shit bastard." Word got around about Thomas as he made trips to Navy and Army installations with the same startling effect.

The missile gap controversy died down after the 1960 election. In *Waging Peace* Eisenhower would write: "By January of 1960 new intelligence reports narrowed almost to negligibility the extent of the Soviet lead. Nevertheless, in the 1960 campaign, the charge of a missile gap remained a useful piece of demagoguery. But within a month after my successor took office, word conveniently leaked out of the Pentagon that the 'missile gap' had been closed. The non-existent missile gap had been suddenly closed by unabashed partisan politics."[29]

Gen. Joseph Carroll was selected as the new director of the Defense Intelligence Agency in January 1960, and he selected Lt. John Hughes as his special briefing assistant. Hughes had served as a photo interpreter at the PIC and had been groomed by Lundahl on the finer points of presenting photo intelligence. General Carroll sent Hughes to the center to review all imagery materials that had been shown to Eisenhower because he wanted Robert McNamara, the new secretary of defense, briefed. At the meeting with Hughes, Lundahl and a number of us discussed not only the highest-priority areas for possible ICBM deployment but also the fact that no missile sites had been found. Hughes was also briefed on missile construction activities at Tyura Tam and Plesetsk.

In a press conference on the evening of February 6, 1961, McNamara acknowledged that the new administration had found no evidence of a missile gap. The next day, however, White House press secretary Pierre Salinger said, with the president's approval, that the reports that there was no missile gap were wrong; no such study had been completed and no such finding had been made. When Salinger's comment caused some concern among the press, President Kennedy held a news conference and said it was premature to tell whether there was a missile gap favoring the Soviets. That judgment would be made after the Defense Department completed its review of U.S. strategic and tactical weapons. Senator Richard Russell, chair of the Senate Armed Services Committee, claimed on February 8 that a missile gap did exist but the United States was rapidly closing the gap.

The statements by McNamara and Kennedy brought on an attack from GOP Senate leader Everett M. Dirksen, who charged on February 9 that Kennedy had criticized Eisenhower during the campaign for allowing a "missile gap" and on becoming president could not find the gap. Senator Stuart Symington came to Kennedy's defense and stated—incorrectly—that the Eisenhower administration had made a calculated effort to prevent Kennedy from having such information. On February 11, Representative George H. Mahon of the House Appropriations Subcommittee on Defense Spending said that the missile gap was real, but the United States had superior military strength overall.

In the budget he proposed to Congress on March 28, Kennedy stated, "It has been publicly acknowledged for several years that this nation has not led in missile strength." McGeorge Bundy wrote in an April 1963 *Foreign Affairs* article that "it was with honest surprise and relief that, in 1961 [the president] found the situation much less dangerous than the best evidence to the Senate the year before."[30] Kennedy never recanted his election-year speeches condemning the missile gap.

In his book *Countdown for Decision*, Maj. Gen. John D. Medaris, former commander of the Army Ballistic Missile Agency, departed from other military commanders in denouncing the view that the United States lagged behind the Soviet Union: "We already possess or have committed to production more than adequate retaliatory capability to inflict unacceptable damage upon a potential enemy. We are needlessly wasting resources and duplication and enlargement of that capability at the expense of more useful and therefore more important objectives."[31]

National Security Council Intelligence Directive 8

In 1960 former senior CIA official Lyman Kirkpatrick headed the Joint Study Group on Foreign Intelligence Activities, which was formed to take a hard look at various intelligence programs and report its findings to President Eisenhower. Among the programs the group reviewed was overhead reconnaissance. The group's report included the following statements:

> A third major source of foreign intelligence is photographic and other visual-aerial observation. This probably is the most precise form of intelligence collection inasmuch as photography provides accurate information. The U-2 program provided what was probably the greatest amount of valuable information obtainable from any single source, and the Study Group heard consistent requests that this program or something similar to it be resumed at the earliest possible date. The Study Group has spent many months discussing the problem of processing and interpreting aerial photography for intelligence purposes. The CIA, with active participation of the Army and Navy, is administering an expanding operation, which is not in effect a photographic intelligence center of common concern. However, this center is still operated today on a basis of informal arrangements. There is agreement within the Community that when the raw film is chemically processed, the photography should be distributed immediately to all parties of interest. There is also agreement in most of the Community that a central photographic intelligence center of common concern should be established.[32]

The development of reconnaissance vehicles involved a great deal of sensitive intelligence information. There was also a penchant on the part of the services to seize and protect turf that would be economically and politically valuable. Within days after the first successful Corona flight, President Eisenhower ordered the creation of the Office and Missiles and Satellite Systems to coordinate the U.S. space reconnaissance effort. He wanted to bind in one organization—to be controlled by the president—major elements of the intelligence community, the military services, and research and industrial firms. Central control was a must. Turf battles between the various services were hindering the effort. Eisenhower was supported by Land, Killian, and other officials in his desire to formalize the space reconnaissance program. On September 6, 1961, the National Reconnaissance Office (NRO) was created and charged with "the research and development, production, and operation of satellite and aerial reconnaissance systems used in overflights of the Soviet Union and other nations." Undersecretary of the Air Force Joseph V. Charyk and Richard M. Bissell, the CIA's deputy director of plans, were named the NRO's co-directors.[33]

The National Security Council made two important decisions on January 12, 1961, at its 474th meeting. The first, which Eisenhower approved, was NSC

5918/1, "U.S. Policy in Outer Space." The policy approved "specific military space applications (reconnaissance first, then early warning of missile attack, weather observation, communications, mapping and geodesy, inspection, control and navigation)."[34] It called for the use of reconnaissance satellites as soon as was practicable to enhance U.S. intelligence efforts. The use of reconnaissance satellites and their operation would be ensured by establishing in international law that outer space was available for exploration and use by all countries.

There was a spirited discussion at the NSC meeting on the establishment of a central clearinghouse for photographic intelligence. Gen. Lyman Lemnitzer immediately asserted that such a center should be under the direction of the Defense Department. Allen Dulles pointed out that the existing Photographic Intelligence Center was a joint enterprise consisting of slightly more civilians than military personnel: 140 CIA officials, 100 Army officers, 10 Navy officers, and 7 to 15 Air Force officers. Further, he said, the existing Photographic Intelligence Center had been a joint operation for five years and had handled mostly U-2 photography. He went on to point out that the PIC had developed a group of career officials who intended to make photo intelligence their lifework. If the center came under the control of the military, in contrast, rotation of officers would be a standard policy. Eisenhower felt that rotation would be fatal to an operation of this kind. He expressed strong belief that an expert career staff should operate a new organization. Lundahl was surprised to learn that Gen. Graves B. Erskine, assistant for special operations to the secretary of defense, backed Eisenhower, stating that if World War II had taught us anything, it was the need for an expert career staff in intelligence. Eisenhower was also adamant that there should be only one photographic center and that no service would establish a separate one.[35] Kistiakowsky joined in, stating that he "felt the existing Center was a revolution in photographic intelligence" and that operating such a center "required expertise."[36] When Maurice Stans, the director of the Bureau of the Budget, raised the possibility of joint CIA-DOD management, Dulles allowed that in time of war the DOD would operate the new organization, but only then. The president said he disliked divided responsibility.[37] According to an account told to Lundahl,

> Eisenhower sat drumming the table and turned to Kistiakowsky and said, "What do you think about this, George?" Kistiakowsky said, "Well, Mr. President, I've been over to the Steuart Building and I like what they do. They're young—the average age is 29, they're intelligent, and they've served

> me well when I've been over there. I think the field is so new, so esoteric, and so complex, that I'd like to see these young specialists grow and stay with the field. At 29, I think there's a good chance they will continue. I have no argument with the military, but a military officer usually cannot confine his career completely in intelligence; he might be a good intelligence officer for a few years, and then might have to go to Germany or Guatemala, and we cannot have these interruptions." Eisenhower thought about this and with that he rapped the table and said, "All right, that settles it." He turned to Allen Dulles and said, "Allen, this is going to be yours."[38]

Dulles said he would like to have Arthur Lundahl as the director, but he also wanted one of the three military services to provide a deputy director. The Army had been a strong supporter of the Photo Intelligence Division, the Navy had made a modest contribution, and the Air Force had provided little support at all. Eisenhower, on Erskine's suggestion, said the Army should provide the first deputy director, with the position rotating among the three services every two or three years.

On January 20, 1961, just a few days before he was to leave office, President Eisenhower signed National Security Council Intelligence Directive 8, which established the National Photographic Interpretation Center under CIA administration, with multidepartmental staffing and with Lundahl as director and Col. David S. Parker as his deputy. The directive gave the CIA "the right, duty, and responsibility to operate the National Photographic Interpretation Center (NPIC) with the options open to the military services of the United States to the degree and extent of their interest." The director was to be selected by the director of the CIA with the advice and consent of the U.S. Intelligence Board and the secretary of defense, who would "state clearly to NPIC their particular requirements."

As he neared the end of his presidency, Eisenhower became more and more worried about the wildfire growth of the military-industrial complex, whose influence was infiltrating Congress. The chronic overestimation of Soviet capabilities was fueled by the military. In a conference with Killian, Purcell, Land, and Goodpaster the president expressed his concern. Goodpaster's notes of the meeting indicate that Eisenhower

> commented on the way irresponsible officials and demagogues are leaking security information and presenting a misleading picture to our people.

> Some of our senators in particular seem to be doing this. In turn, the munitions makers are making tremendous efforts toward getting more contracts and in fact seem to be exerting undue influence over the Senators. Killian observed that where we have a strong central laboratory, for example in the atomic energy program, we have made excellent progress, where research and development has been dispersed over industrial firms such progress has not been achieved. The president cited the instance of Senator Symington being accompanied in various official conversations by a man who is a Vice President of Convair.[39]

In his farewell address to the nation on January 17, 1961, Eisenhower stressed that information obtained from aerial and satellite reconnaissance showed that the actual balance of strategic power was strongly in favor of the United States and was moving forward to an even greater degree. President Eisenhower implored his audience not to "return to the crash-program of the past, when each new feint by the Communists was responded to in panic. The bomber gap of several years ago was always a fiction, and the missile gap shows every sign of being the same." He warned, "In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist. Only an alert and knowledgeable citizenry can compel the proper meshing of this huge industrial and military machinery of defense with our peaceful method and goals." States with large defense industries were influencing the political policies of the nation. "The potential for the disastrous rise of misplaced power exists and will persist. We must never let the weight of this combination endanger our liberties or democratic processes."[40]

According to General Goodpaster, Eisenhower wanted to make sure that some of the missile collection activities that had revolutionized intelligence would continue. On January 18, hours before he was to leave office, he issued National Security Council Directive 6108, "Certain Aspects of Missile and Space Programs," which reaffirmed his belief that satellite reconnaissance programs should be given "the highest national priority above all others." Eisenhower was still concerned that the U.S. satellite programs not be disrupted in any manner. He was acutely aware of the many and varied values of satellites and placed a strict restriction on all U.S. efforts that involved possible testing of antisatellite measures, or any discussion or public attention directed at this effort. He specified that "any test which involves destroying a satellite or space vehicle shall not proceed without specific presidential approval."[41]

January 20, 1961, was John F. Kennedy's inauguration day. After the ceremonies, Dwight and Mamie Eisenhower slipped out through a side entrance, attended a luncheon in his honor, and then proceeded to Gettysburg.

FIFTEEN
the missile gap is solved

> The new estimate of Soviet ICBM strength is now in the range of 10–25 launchers.
>
> *National Intelligence Estimate*

Corona mission 9017, which was launched on June 16, 1961, exploded the "missile gap" theory forever. More than one hundred people from across the intelligence community came to my pre-Oak briefing on the mission. I told the assembly that we had gotten reports from our team reviewing the film at Eastman Kodak that "the weather was clear and the quality was good and that we should be pleased with the mission." I then proceeded to show the tracks of the mission, noting that many were over the areas where ICBMs were thought to be deployed.

When the film arrived at the NPIC, it was portioned out to scan teams. Soon afterward Dale Heintzelman, who was scanning the imagery, called to say that he had found very suspicious activity near Yurya. There was an abundance of popcorn clouds over the area, but between them Heintzelman circled five areas for further study. The film was given to Tyura Tam experts Mark Baker, Tom Logan, and John Rooney. They identified two soft SS-7 ICBM launch complexes as Launch Area A and Launch Area B, each consisting of two launch pads. The launch complexes were in a soft configuration and were about three miles apart. Two other areas in the initial stages of construction activity would become Launch Area C and Launch Area D. When the installation was completed there would be eight launchers in four pairs. Each pair of launchers had checkout and ready buildings capable of housing at least one and possibly two missiles for each pad. There was also a rather large area of support facilities. It was estimated that the construction of the complex began in the autumn of 1959, concurrent with or shortly after the construction of Launch Area C at Tyura Tam. The construction of the sites and the installation of equipment would probably be completed early in 1962. The SS-7 was deemed to be propelled by liquid fuel, but it was not known at the time if the fuel was storable or nonstorable. Several SA-2 sites were also located nearby protecting the complex.

Lundahl came up and peered into the stereoscope. After agreeing with the assessment, he told us to prepare briefing boards immediately. All information on the mission was to be placed "on hold." Nothing was to leave the NPIC until he approved it. That was the usual practice with anything we thought of critical importance on U-2 or Corona imagery—anything that could have an impact on the president and Congress. Lundahl would brief the DCI or the deputy director of intelligence, and he in turn would inform the president. No photography or cables could be released until we received the president's permission. After President Kennedy was informed about the Yurya complex, we were given permission to release a cable on our find that evening. We were told that Dulles also informed Eisenhower, who expressed pleasure with our efforts.

We now had the "signature" of what an ICBM site looked like. There were a number of requisites for an ICBM complex, including a rail-to-road transfer facility and a checkout installation. First-class roads were necessary to move missiles from the checkout facility to the pads or silos. These roads would have to be wider than ordinary roads with wide-radius turns to accommodate long transporters. Heavy security measures were also essential at each site.

The search for additional missile sites continued. The railroads became an important element in the search as we followed spurs from main lines to their destination. The search revealed a pair of launch pads under construction at Yoshkar-Ola, about four hundred miles northeast of Moscow, and another complex under construction at Verkhnaya Salda in the Urals. A fourth complex in the initial stages of construction for two pads was noted near Kostroma, about two hundred miles northeast of Moscow. These large, fixed complexes with multiple pads and extensive support facilities were rail served. Neither Kostroma nor Yoshkar-Ola was on the COMOR suspect list of targets. It was estimated that site construction would take two years, although construction time could be reduced to eighteen months as experience was gained.

As the search continued, MRBM (NATO-designated SS-4 Sandal) sites were identified in the western USSR. Dave Doyle, the NPIC's medium-range missile expert, began receiving calls from photo interpreters scanning the imagery and we began picking up MRBM sites from the Baltic to the Ukraine. Fourteen were found on the first day. The sites were obviously aimed at NATO targets in England, Western Europe, and Turkey. We had a strong feeling—which turned out to be accurate—that more launchers would be found in the Trans-Caucasus and in Kazakhstan and Central Asia, from which the Soviets could strike Middle Eastern targets from Suez to Pakistan. The Soviets would likewise deploy MRBMs in the Soviet Far East where they could bring Japan, Korea, and Okinawa under fire. Each missile site was pinpointed and named to the nearest town. Coordinates were registered to the nearest second, and a Bombing Encyclopedia number was assigned to each site. Military targeters moved into the NPIC to update their target lists. Dave Doyle had photographs made of all the sites and pinpointed each on a map. As more and more sites were found, David roamed the building recording whether or not each was a new site. All of the sites were of the fixed variety, screened from ground observation by fences, and from aerial observation by trees. Each site had four launch pads and was defended by at least one SA-2 site.

The SS-4 was a single-stage, medium-range offensive missile propelled by storable liquid fuel; it was capable of delivering a reentry vehicle containing a nuclear warhead anywhere within its 1,100-mile range. Flight testing of the SS-4 had begun at Kapustin Yar in June 1957, and deployment began in late 1958 and early 1959. It was obvious now that the deployment of the SS-4s was a stopgap measure while the SS-7 was being produced, tested, and deployed. The Soviets began an ambitious program of deploying nearly six hundred launch pads for SS-4 MRBMs and SS-5 IRBMs around the periphery of the USSR. We made a series of briefing boards along with maps. Lundahl had us scribe range circles from each MRBM site to targets in Europe and from each ICBM site to targets in the United States.

NIE-11-8, "Soviet Capabilities for Strategic Attack," issued in February 1960, indicated that the Soviet ICBM program would have on the order of 140–200 ICBMs on launchers by mid-1961. In August 1960 that estimation was modified to 50–200 ICBMs on launchers by mid-1961. Previous Corona missions and U-2 overflights had found only fifteen ICBM launch positions in the USSR: four at Tyura Tam—two for the SS-6 and two for the SS-7; three positions for the SS-6 and two for the SS-7 at Plesetsk; two positions under construction at Yurya for the SS-7; two positions at Verkhnaya Salda under construction for the SS-7; and two positions under construction at Kostroma. The ground support equipment, including rail service direct to the launcher, was correspondingly large. Sherman Kent asked Lundahl to brief the Office of National Estimates as soon as we had completed searching the mission's images.

Based on imagery intelligence information the NPIC provided, a supplement to NIE-11-8-61 was published on September 21, 1961, indicating that "new information, providing a much firmer base for estimates on the Soviet long range ballistic missiles, has caused a sharp downward revision in our estimate of present Soviet ICBM strength but strongly supports our estimates of medium range missiles. The new estimate of Soviet ICBM strength is now in the range of 10–25 launchers from which missiles can be fired at the United States and that this force level will not increase markedly during the months immediately ahead." Our discovery of the MRBM sites made that estimate more precise. The new estimate concluded "that the USSR now has about 250–300 operational launchers with 700 and 1,100 N.M. ballistic missiles."[1]

When word of the success of mission 9017 reached the Vandenberg launch base, personnel associated with the Corona program were also elated. We were told a story, but I cannot vouch for its accuracy. When 9017 was about to be launched, one of the couplings on the Thor failed to kick off, and a sergeant with a sledge hammer went out and knocked it off. This gave rise to a superstition, and before each subsequent mission the sergeant had to go out and give the coupling a tap.

With three successful Corona missions we had vaulted ahead of all other collection systems in providing analysts and estimators with critical strategic and current information. We were also gaining a comprehensive knowledge of the Soviet Union shared by very few in the intelligence community. Large areas of Siberia had been imaged, and we had not seen any missile sites. This negative information allowed us to concentrate on areas where missiles could be deployed. When Dulles was informed that satellite reconnaissance had determined that the missile gap did not exist, he said to Lundahl, "You're taking all the fun out of intelligence."

Oleg Penkovsky

Col. Oleg Penkovsky was a dissatisfied Soviet intelligence officer with celebrity credentials and an insatiable sexual appetite. His official assignment with the Chief Intelligence Directorate of the Soviet General Staff gave him access to military secrets. He was a close confidant and protégé of Marshal Sergei A. Varentsov, chief marshal of artillery in charge of Tactical Missile Forces, and of Gen. Ivan Serov, who became chief of military intelligence in 1958 and was also a friend of Marshal Varentsov. Penkovsky was thus well placed in Soviet circles. When permitted to travel abroad, he visited with his British and American intelligence handlers and turned over documents relating to Soviet strategic planning and capabilities.[2] These documents revealed technical specifications and described the procedures required to set up, arm, and launch short-, medium-, and intermediate-range ballistic missiles.

Lundahl and I were summoned to Langley, briefed on the information that Penkovsky had provided, and given a complete set of the documents. The information was, of course, tightly controlled. After the Soviets arrested Penkovsky in 1962 and tried him for treason, which resulted in a death sentence, all photo interpreters were cleared to see the information, which would be widely used in the daily intelligence assessments during the Cuban Missile Crisis.

During the spring of 1961 Penkovsky provided information that Khrushchev was bluffing about Soviet missiles. The purpose, according to Penkovsky, was "to force Western military and government leaders to do their planning on the assumption that the Soviet Union already had a tremendous military potential."[3] He added that "the USSR does not have the capability of firing [even] one or two ICBMS . . . there are not hundreds even in a testing status. There may be only tens in that category. . . . Even now it may be possible that somewhere in the Far East or at Kapustin Yar there may be some missiles which could reach other continents and detonate with an atomic, even hydrogen explosion, but such launchings would be completely unplanned, uncontrolled, and certainly not of a mass variety. Of this I am sure."[4]

When Kennedy met Khrushchev in June 1961 in Vienna, the Soviets had deployed only six intercontinental missiles.[5]

SIXTEEN
epilogue

The general was absolutely flabbergasted.
Arthur C. Lundahl

I believe that the Corona program is President Eisenhower's greatest legacy; it laid the groundwork for all future U.S. satellite reconnaissance systems. Within a short time Corona intelligence eclipsed all other sources of intelligence. Among its most significant achievements, Corona allowed those responsible for the defense of the United States to:

1. Photograph any spot on earth, no matter how remote or distant
2. Locate previously unknown Soviet defense research and development installations and military installations
3. Remain up-to-date on missile, air, naval, and ground orders of battle
4. Image all Soviet medium, intermediate, and intercontinental guided missile bases
5. Learn, through repetitive coverage, which missiles were being tested, and later deployed, at Kapustin Yar, Tyura Tam, and Plesetsk
6. View the staging of new guided-missile submarine sections and to monitor their construction, launching, and deployment
7. Locate SA-1, SA-2, SA-3, and SA-5 surface-to-air missile batteries, providing SAC with vital information for planning entry and egress routes for their bombers in the event of war
8. Monitor the Sary Shagan Missile Test Center, antiballistic missile activity, and the construction of GALOSH missile sites around Moscow
9. Identify SA-5 sites near Leningrad and Tallinn

10. Locate phased-array radars undergoing testing that would be later deployed at a number of installations in the Soviet Union
11. Locate all command and control facilities in the Soviet Union
12. Determine how long it took the Soviets to produce and deploy strategic weapons and construct their bases
13. Maintain close observation of production, testing, and storage of nuclear arms worldwide
14. Track Soviet arms shipment to other nations
15. Assess new Soviet military equipment and devise countermeasures, saving billions of dollars
16. Examine Soviet goals and objectives, tactics, doctrine, and military capabilities, and determine force structure
17. Provide the Army Map Service and the Aeronautical Chart and Information Center with photographs and ephemeris data to produce accurate maps and charts
18. Observe and analyze the construction and deployment of new aircraft, ships, and ground forces equipment
19. Monitor chemical and bacteriological weapons production and testing
20. Observe the preparation and launch of Soviet space vehicles
21. Assess natural and technological disasters worldwide
22. Plan and monitor arms control agreements
23. Monitor wars and conflicts in the Middle East, the Far East, and Southeast Asia

Richard Helms wrote that "the Corona program . . . pioneered the way for satellite reconnaissance and deserves a special place in history. While serving as the DCI at the peak of Corona's operation, I witnessed first hand Corona's remarkable value to the intelligence community. I was particularly impressed with how its intelligence products built our confidence in monitoring Soviet compliance with their commitments—a confidence that would enable President Nixon to enter into the Strategic Arms Limitation Talks and finally sign what would become a historic Arms Limitations Treaty."[1]

Corona encompassed four satellite systems—KH-1, KH-2, KH-3, and KH-4A and KH-4B. Ground resolution improved from thirty feet initially to five to ten feet in the KH-4B. In all, 121 Corona satellites were launched from 1959 to 1972; 95 were successful.

In 1985, on the twenty-fifth anniversary of the first successful Corona flight, DCI William Casey awarded 125 Pioneer in Space medals to individuals responsible for the success of the program. Four members of the National Photographic Intelligence Center were among those honored: Arthur Lundahl, Chris Mares, Lou Franceschini, and Dino Brugioni. I consider it my greatest honor in more than a half century of activities related to reconnaissance and imagery interpretation.

At the awards ceremony, it was also a thrill for me to see nearly all of the prime participants of the Corona program: to recognize the extent to which they were involved; to hear about their challenges; to herald their accomplishments; and finally, to give them the recognition they so richly deserved. Corona was a rewarding time of singular scientific discovery. The program began with four engineers, two administrators, and a shop crew of ten, with James M. Plummer as the program manager. That small group set out to take on a number of historically unsolvable problems. A retrospective written for the program's thirtieth anniversary notes that "the team was told to take an untested space booster, an untested spacecraft, an untested reentry vehicle, an untested camera, untested photographic film, and an untested control network, and make them work together as a system."[2] The program involved precise planning, dedicated teamwork, quiet pioneering, and continuous demands to do the seemingly impossible. It also involved encouraging results, disappointing failures, and then unbridled enthusiasm when we received the first can of satellite film. Both the quality and quantity of the imagery we received improved over the course of the program, in turn increasing the amount of intelligence we could report and process.

The concrete knowledge that these pioneers facilitated allowed military planners and national security policy makers to understand the threat posed by our enemies and to plan more effective and efficient counterweapons. Areas of uncertainty diminished—not only those involving the location and scale of Soviet strategic activities but also those involving other problem areas of the world. At the Corona declassification ceremony in 1995, Acting Director of the CIA William Studeman pointed out that Corona "allowed the U.S. to base our national security—and spending—on facts rather than fear, on information rather than imagination."[3]

The processing and dissemination of U-2 and satellite information along with the necessary preparation of the data required by interpreters on subsequent missions took precise timing, enormous patience, and precision handling of sensitive data. When the division was created, with the exception of stenos and clerks it was essentially a male organization. We began receiving personnel folders of exceptionally talented women—graduates of nationally known colleges and universities—and with the support of Lundahl and his executive officer, Charles Camp, I began hiring them. The early career boards objected to hiring and training young women who undoubtedly would marry and leave the organization, but it soon became apparent that women performed collateral research and mission preparation and updating as well as, and often better than, men.

I also looked for women with managerial abilities. I hired two exceptional leaders: Anne Oberdorfer and Linda McMullin, who not only managed pre- and postmission data but were also invaluable trainers of new personnel. Aerial reconnaissance was covering a large portion of the earth, and newly hired imagery interpreters were calling for support in properly interpreting imagery of new areas. Women managed a well-stocked map library and also manned a special reference library. These talented women became adept at gleaning information from Washington's many libraries, including the Library of Congress. Their early successes prompted the hiring of more women. By the end of the Corona era the NPIC had hired more that one hundred women to perform not only collateral research but also in editorial, photogrammetric, and technical positions. A number were trained to be imagery interpreters.

We had skilled graphic illustrators who could produce line drawings on difficult-to-observe installations. Archie Archibald established a first-class model shop in 1964. The shop began by making models of installations and later, as the resolution of the imagery improved, even made models of military equipment. Hundreds of models were constructed for presentations for presidents, Congress, and high-level officials. Two presentations of imagery-based information incorporated three-dimensional models with spectacular results. The Russians were building ICBM silos with large prefabricated concrete sections that were brought to the site and later cemented together inside the silo. John Merritt, a young naval lieutenant and established photo interpreter at the NPIC, studied the unassembled pieces he saw on imagery. He carefully measured the sections and had models made of each, then put them together like a jigsaw puzzle and constructed three-dimensional models of the silos for the Soviet SS-9 and SS-11 ICBMs. It was fascinating to watch him construct a missile silo in front of the President's Foreign Intelligence Advisory Board. Gen. James Doolittle said that he had never seen such a brilliant presentation. Merritt gave more than a hundred briefings using the model, providing further proof to many that the United States did not need on-site inspection to monitor a strategic arms limitations agreement.

Another highly regarded imagery-based presentation pertained to the submarine hull assembly area of Severodvinsk Shipyard 402, the principal producer of nuclear-powered ballistic-missile submarines. In the 1960s the yard began producing the Yankee-class guided-missile submarine, which was similar to the U.S. Polaris. Sections of Yankee submarines fabricated elsewhere would arrive on flat railcars that were parked outside the assembly building and then taken into the assembly hall and welded together. Afterward the completed submarine would be launched into an adjacent basin. The process took about two years. The NPIC model shop made models of the sections based on the images, and NPIC personnel could put together a Soviet submarine and report on the finished craft long before the real ship was launched.

The model shop constructed hundreds of three-dimensional models, including Soviet and Chinese missile and nuclear production facilities, communications and radar facilities, missile launch sites, and biological and nuclear weapons testing areas. The NPIC made models of the Sinai Peninsula for Secretary of State Henry Kissinger during the Yom Kippur War and a model of Khe Sanh in South Vietnam for President Johnson. A model of the Son Tay prison was made for the Department of Defense, and models of large areas of Tehran and the prison where U.S. hostages were held were fabricated for President Carter and his staff.

The NPIC could measure just about any object captured on an image. Photogrammetrists refined their techniques with Control Range Network (CORN) targets (large, white plastic panels marked with precise black bars of different dimensions ranging from inches to more than twenty feet) that were laid out in various areas in the United States and photographed by the KH satellites. The targets, which were usually displayed at military bases or airfields, allowed photogrammetrists to determine the resolution of the camera using various types of film in various weather conditions. The targets created some confusion among people not cognizant of their purpose. I am originally from Jefferson City, Missouri, and it happened that on one occasion CORN targets were laid out on the lower portion of the Jefferson City airfield. There was a nice restaurant at the airfield that one of my hometown friends frequently patronized. On one of my visits he told me about a bunch of "wackos" that arrived one day in a truck, spread the black-and-white sheets all over the grass at the south end of the airport, and then came into the restaurant. They ordered and ate a meal but constantly consulted their watches. After a long lunch, one of them said, "It's time to go." The "wackos" went out, picked up and packed their equipment in the truck, and left. "Damnedest thing I have ever seen," my friend concluded. I pretended I knew nothing about what the "wackos" were doing.

Photogrammetrists spent thousands of hours obtaining precise locations, dimensions, heights, geodetic positions, and azimuths of Soviet strategic research, development, and production facilities for the Air Force Foreign Technology Division and the CIA Foreign Missile Strategic Analysis Center. They measured individual ICBM silo liner segments so that the hardness of the silos could be estimated. Soviet command and control facilities were measured for the same purpose. Measurements derived from imagery of Soviet nuclear subsidence craters (contour maps made both before and after nuclear detonations) were used to determine the size of the weapon detonated underground. Measurements were also made of a Soviet Golf submarine so that a cradle could be constructed for the *Glomar Explorer* to lift one from the ocean floor.

When even more precise measurements were needed, a high-precision stereocomparator capable of measuring a micrometer, or micron (a human hair is 15–20 μ in diameter), was designed to NPIC specifications and constructed in segments in the utmost secrecy. The comparator, manufactured by Houston Fearless Corporation, weighed fifteen tons and was set on bedrock at the NPIC facility to eliminate vibrations. It proved indispensable in precisely measuring not only missiles, aircraft, and other military equipment but also in providing data on distances, areas, azimuths, profiles, and geodetic positions.

Eisenhower's interest in aerial and satellite photography did not diminish with his departure from the White House. Periodic briefings kept him informed on current intelligence and new photographic systems. Every winter the Eisenhowers would travel by train to Palm Desert, California, where they stayed on the ranch of Floyd Odlum and his wife, the famous aviator Jacqueline Cochran. The Odlums provided the former president with an office and made their ranch available for entertaining his guests. Intelligence updates were usually relayed in DCI John McCone's home close to the nearby golf course. McCone would advise the president from Washington that he had "another chapter of the story," and Eisenhower would tell McCone to "come out, the golfing and weather are fine." McCone and Art Lundahl would fly out from the capital, and Eisenhower would normally arrive at McCone's home in golf togs, driving a golf cart. After a few words with the general, McCone would ask Lundahl to commence with his briefing. Always displaying keen interest, Eisenhower would comment on the quality and subject matter of the briefing. And ever gracious, he would thank McCone and Lundahl for taking the time to brief him.

The task of educating President Kennedy on photo interpretation devolved on Art Lundahl, who established a close working relationship with both President Kennedy and McGeorge Bundy, the president's assistant for national security affairs. Lundahl's articulate, erudite, and succinct explanations were always welcomed at the White House. The president wanted technical information presented in a straightforward manner, free of military jargon, comprehensible to an average person. In one of his early briefings, Lundahl explained to the president that the U-2 camera could photograph a swatch about 100 nautical miles wide and about 2,000 nautical miles long on more than 10,000 feet of film. He drew an analogy that each foot of film was scanned under magnification in much the same manner that Sherlock Holmes would scan evidence or look for clues with a large magnifying glass. "Imagine," Lundahl suggested, "a group of photo interpreters on their hands and knees scanning a roll of film that extended from the White House to the Capitol and back." Kennedy never forgot the analogy. When other high officials were briefed on the U-2 at the White House, the president would call on Lundahl to repeat the story.

Lundahl treasured the opportunity to get to know the president.

> President Kennedy loved photography. It was so factual, firm and unimpeachable that he loved to talk about it. And sometimes I was privileged to be able to sit talking to the President, one on one, about photography. He would ask all kinds of things. Like strategic arms limitations, could we do it all from photography? Where do you get photo interpreters? What kinds of training and background do they have? What do you pay them? And how much can they hope to earn? Of course it was wonderful for me to talk with the President of the United States about things that were so close to my heart. And President Kennedy said, "I really want to come over to your high tech place and see these things being generated and see the instruments and techniques you are using." And I said, "President Kennedy, if you can make it, just give us notice and we'll be there. Saturday, Sunday, weekends, holidays." Well, the fates never permitted that to happen.[4]

When Bissell and Dulles retired after the Bay of Pigs fiasco, Edwin Land and James Killian found that Kennedy had problems understanding technical intelligence methods and their use; he never used the PFIAB as Eisenhower did. William O. Baker noted that Kennedy did not "take the details of PFIAB as seriously, as intimately, as Eisenhower did. Jerome Wiesner, Kennedy's scientific adviser, was trying desperately to inform Kennedy on technical matters." Baker told an amusing tale about the two men trying to explain to the president that he had a telephone that was connected to the Ballistic Missile Early Warning System.

> Kennedy said, "I don't know how to do it." And we said, "Well, there is a phone here, another over there should tell you what crisis it is," and the news at that point was supposed to get at least several minutes of warning of a missile attack. . . . Kennedy got very interested. He said, "Where's the phone?" He couldn't find it. Kennedy and Wiesner and I got down on our hands and knees and we got under the desk and found someone had [put] it in a drawer and we finally found the damned thing. And then I explained the whole technology, which Kennedy was very interested in and apparently that, among other things, made a fairly strong impression on him.[5]

Kennedy did ask Baker how the president's science office should be organized. Although Wiesner tried hard, he never attained Killian's degree of knowledge or organizational abilities. Wiesner prepared a report on science and technology and the space program that had few good things to say about manned space flight in terms of what might be possible. Yet Kennedy announced—with more political acumen than technological—that we were going to the moon.

Eisenhower felt that America's prestige should not have been put on the line in that fashion, because "it immediately took one single project or experiment out of a thoughtfully planned and continuing program involving communication, meteorology, reconnaissance and future military and scientific benefits and gave the highest priority—unfortunate in my opinion—to a race, in other words a stunt."[6]

When the Chinese shot down a Nationalist Chinese U-2 on September 9, 1962, Kennedy staffers worried about the effect the downing would have on the president's image and his administration. On September 10 Gen. Marshall Carter, the deputy director of the CIA, called Lundahl and told him that the president would like a current briefing on aerial photographic systems for himself and General Eisenhower, who had recently returned from a six-week trip to Western

Europe. President Kennedy wanted to show Eisenhower the latest advances in photography and the recent U-2 photographs of Cuba. Carter said he would meet Lundahl at the White House at 10 AM, but the precise time of the presidential briefing was not set. President Kennedy had several items on the agenda for General Eisenhower, including a short tour of the White House to show him Mrs. Kennedy's remodeling project and the latest acquisitions of furniture and art.

According to Lundahl, Kennedy was in an expansive and relaxed mood. He enjoyed playing host to General Eisenhower. Lundahl called it a teacher-student relationship. Lundahl and his deputy, Colonel Parker, had set up Lundahl's briefing materials on an easel in the Cabinet room, and just before 2 PM President Kennedy and Eisenhower came in. The president said to Eisenhower, "You must certainly know these gentlemen?" Eisenhower said that he did, shook hands with Lundahl and Parker, and sat down on the president's right. Lundahl's presentation included recent improvements in the various photographic systems along with a detailed briefing on Cuba. Eisenhower listened intently and asked questions about the systems in the research and development stages. He especially wanted to hear about the "big one, the very, very high-speed and high flying aircraft [the A-12]," which had made its maiden flight on April 26, 1962. The briefing lasted approximately forty minutes, and all agreed it was a success for both the current president and the former one.

The discovery of Soviet missile sites in Cuba in October precipitated a crisis of the first magnitude. Before he addressed the nation on October 22, Kennedy wanted foreign leaders and General Eisenhower briefed. Lundahl briefed Eisenhower for about forty-five minutes on October 21 in McCone's residence on Whitehaven Street in northwest Washington, placing particular emphasis on the MRBM and IRBM sites. Eisenhower was concerned more with the IRBM sites in Cuba because most of the U.S. strategic striking force was within their range. Eisenhower was also shown a briefing board of SA-2 sites and asked a number of questions about the sites and if they had yet tracked and fired at a U-2. McCone told Eisenhower that the Executive Committee of the NSC had considered three courses of action: destroying the sites by conventional bombing, bombing in conjunction with an invasion of the island, and blockading the island along with further steps to assure the removal of the missiles. He added that President Kennedy had already concluded that the first plan would actually be detrimental to U.S. interests. Eisenhower told McCone that he was not in a position to make judgments on options 2 or 3 because he lacked background data, and that whatever the administration decided to do had his full support.

The next day Kennedy called Eisenhower and reviewed his options. Eisenhower expressed the same positions he had expressed to McCone. When Kennedy appeared uncertain what Khrushchev's reaction would be, Eisenhower offered a bit of advice. If the Russians resorted to any military action, the president should consult the Joint Chiefs of Staff and follow their recommendations. Eisenhower assured the president that whatever he decided to do would have his wholehearted support.

When President Kennedy was assassinated, President Johnson was thrust into the presidency with very little prior knowledge of reconnaissance or the value of intelligence derived from the interpretation of aerial photos. It has been said that the impressions we gain in the first twenty years of our life are the most lasting. It is thus not surprising that we tend to think of unfamiliar terrain in terms of what we knew during our youth. Johnson had grown up in the flat country of Texas and had a tendency to envision landforms in Vietnam as being flatter than they actually were. Hundreds of photos and intelligence cables delineating the Communists' activity in the Khe Sanh and DMZ areas where the North Vietnamese were pressing the U.S. Marines' stronghold arrived in Washington during the conflict. The president had difficulty grasping the situation around Khe Sanh, especially from high-altitude photographs acquired by SR-71 missions. Sensing the president's difficulty, Richard Helms asked Lundahl for help. Lundahl suggested that a three-dimensional terrain model centered on Khe Sanh might do the trick. In just three days the NPIC produced the model and sent it to the White House. Walt Rostow, special assistant for national security affairs and a World War II Army photo interpreter, was briefed on the model and the use of a special grid that could be superimposed on it to pinpoint new activity. President Johnson was pleased with the model and reveled in the ease with which he could use it to understand the Communists' activities in the Khe Sanh complex. Observing Johnson's obvious enthusiasm, Walt Rostow dubbed the model "the President's Sandbox." The model was also used to direct B-52 strikes on the Communists' positions.[7]

Johnson also had difficulty understanding the battle areas described in Robert McNamara's "light at the end of the tunnel briefings" and those given by McNamara's briefers. The NPIC prepared briefing boards using data from the various photographic systems. Two of McNamara's briefers would come and look at the briefing boards before McNamara's briefings. The briefing materials we prepared were accurate and unbiased, but McNamara's briefers were not; they showed only good news to the president. One problem, for example, involved the Ho Chi Minh trail, the supply route for communist troops. U.S. heavy and medium bombers bombed the trail repeatedly. High-altitude photos of the resultant cratering were shown to the president, giving him the impression that the bombing had been highly successful. On images taken during the subsequent evening hours, however, we could see North Vietnamese pushing bicycles with large baskets full of supplies as well as soldiers and ponies laden with packs going to resupply their troops. Within a week the craters would have been filled and trucks would be proceeding along the trail as if nothing had happened. I questioned one of the president's briefers about the wisdom of showing just one side of the picture. He replied that the president "gets madder than hell when he is shown bad news."

Johnson called or wrote Eisenhower frequently and visited him at Palm Desert for advice. General Goodpaster was brought back to the White House as a presidential aide, and Johnson would send him twice a week to brief the general and ask for his advice. Among the intelligence materials that Goodpaster carried with him were briefing boards that had been created at the NPIC.

A number of sources have reported that President Johnson just did not comprehend technological problems. William Baker, for example, said that when discussions turned to technology issues, "sometimes we would get a very poignant feeling that the President wasn't with us. We would be describing something the best we knew how and time after time what happened was—I finally leaned to look—that he was on the telephone. He would sit at the end of the table, you see, and he had a telephone there, and he would get on that telephone, and we would be talking to him about important matters and we thought he was paying attention, but he was on the telephone."[8]

The resolution of satellite photography continued to improve during the 1960s. By 1964 Corona was delivering film with a resolution of ten to fifteen feet. The quantity of film doubled, too, with the addition of a second bucket (capsule) to the Corona program. We had to be flexible at the NPIC because we had to deal with constant change. In rapid succession the resolution of the optics was increased and the capability of stereo viewing was added. The addition of the Defense Department's meteorological satellite allowed mission control to expose Corona film only over cloud-free areas.

Satellite imagery was to a certain extent responsible for the strategic arms limitation talks that began between the United States and the Soviet Union in the late 1960s. We were frequently asked what resolution on satellite images would be required in order to monitor a disarmament agreement. Albert "Bud" Wheelon, the director of the Office of Science and Technology, asked the Drell group, chaired by Stanford physicist Sidney Drell, to work with us and study the problem. We eventually determined that we wanted a resolution of at least five feet. In a 1966 briefing the NPIC staff learned that satellite images of the near future would have a resolution of less than one foot. Kermit Gimmel, Ed Cates, and I wrote a paper in which we stated that with the resolutions of the new systems, we could monitor ICBM sites, long-range bombers, ABM sites, and long-range-missile-firing submarines. Lundahl was pleased with the paper and sent it to DCI Richard Helms.

Helms met with us and asked if we had covered all the bases in our analysis. We replied that we had, and then he rather startled us by saying, "But you haven't taken into consideration the Potemkin factor." Helms was referring to the boat trip down the Volga that the wily politician Potemkin had arranged for Catherine the Great to show her how well her people were faring. Most of what she saw was a sham: the buildings that lined the riverbanks were fakes. Helms, who was an expert on Soviet disinformation techniques, pointed out that a missile base could be constructed to look like a large farm. We in turn pointed out the need for a rail-to-road transfer station; a well-constructed road with wide-radius turns; special buildings for the missiles; and, above all, heavy horizontal security. Helms liked our paper but suggested that we allow other members of the intelligence community to study it carefully.

Rae Huffstuttler, later a director of the National Photographic Interpretation Center, told a group of us that "imagery set the stage for the arms limitation talks. We began drafting the verification capabilities of the intelligence community in some interagency papers written in 1968 and 1969, several years before the dialogue began. With imagery, we could go to the numbers-based strategic arms limitations negotiation with a high degree of confidence that we didn't need any help from the other side to verify it." We created briefing boards and explained to President Richard Nixon how we could monitor such an agreement. He supported discussions with the Soviets.

The first Strategic Arms Limitation Treaty (SALT I), signed in May 1972, inaugurated a new era in overhead reconnaissance and marked a dramatic shift in the previous U.S. position, which had insisted on onsite inspections as part of any arms-control agreement. For the first time, international law recognized the Corona and subsequent reconnaissance satellites as "national technical means of verification." Both signatories agreed not to interfere with one another's means of verification. The agreement was also a benchmark in a farsighted quest begun by President Eisenhower to establish aerial reconnaissance as a principal tool of disarmament. SALT I was a tacit recognition of the contributions that aerial reconnaissance could make to international peacekeeping.

Congress had to be educated on the value of the reconnaissance satellites in disarmament agreements as well. Research and development had to be funded for the potential results to be obtained. Lundahl loved to quote the eminent scientist Dr. Eugene Fubini, a high-ranking Department of Defense official, on that subject: "As far as decisions that involve both technology and politics go, it is easier to have a good politician learn the technological aspects of an issue than to have a good technician learn the political aspects."[9] Fubini was a remarkable individual with a fantastic brain. If you gave him the dimensions of radars or communication devices in a briefing, he would interrupt and give you the capabilities of the system. One time, as Bob Boyd and I were briefing him in the Pentagon, he got out of his chair, turned his back to us, and started looking out the window. Boyd looked at me and I motioned him to stop the briefing. Fubini said, "Go ahead. Your last sentence was ——" and quoted it verbatim.

Lundahl and Dulles spent many hours on Capitol Hill briefing senators and representatives with the proper security clearance. Senator Richard Russell told Lundahl that "the scientists and your people analyzing the film have performed a heroic deed for this country." Lundahl was happy to have senators and representatives and their staffs with the proper security clearance visit the center as well. A number did visit us at the Steuart Building and were appalled at our working conditions. Funds to improve them were appropriated in 1960, and Building 213 in the Washington Navy Yard was converted into the National Photographic Interpretation Center.

Shortly after Jimmy Carter was elected president, the new director of the CIA, Adm. Stansfield Turner, ordered an intelligence briefing for Carter and his cabinet with a special emphasis on overhead reconnaissance. The admiral asked me to create a briefing on the various types of reconnaissance vehicles and their products. We brought light tables with microstereoscopes along with actual imagery and illustrative briefing panels to the White House for the president and some of his key officials. I asked Linn Poulsen, one of our first female interpreters, to be part of the group to show the president and Mrs. Carter how interpretation was performed. Carter, a Naval Academy graduate, was impressed with several images that showed submarines at a Soviet naval base. While the attorney general expressed interest, Treasury Secretary Bert Lance was falling asleep. Hamilton Jordan came in and lay on the floor while Zbigniew Brzezinski, the president's national security adviser, explained to Carter how he would be receiving information from reconnaissance. I greatly admired Admiral Turner's attempts to involve Carter in all phases of intelligence. I admired Carter as well, but the admiration did not extend to his cabinet officers and advisors. On their recommendation President Carter abolished the PFIAB in 1977, much to the consternation of scientists who felt that Carter and his advisers were "crackers" who simply were not "with it." Carter failed to realize that this distinguished group of private citizens and prominent scientists was a source of objective advice on the workings of the intelligence community. President Ronald Reagan reinstituted PFIAB.

The biggest disappointments with the Corona program occurred in August 1968. We hoped to keep the Corona satellite aloft as long as possible to glean as much cloud-free photography as possible. The focus was still the Soviet strategic threat. In early summer of that year President Johnson was preparing to go to Moscow to inaugurate a major arms-limitations discussion. The Soviet bloc countries' growing efforts to free themselves had generated months of tension between the United States and the Soviet Union. It was generally felt that the Soviets would do nothing to rein in their errant satellites while the president was in Moscow. That notion was proved wrong when the Soviets invaded Czechoslovakia on August 21, catching the U.S. intelligence community completely by surprise. When imagery from the latest Corona mission arrived at the NPIC days later, we could clearly see the Russians' preparations to invade Czechoslovakia. Fred Lowery, a senior NPIC photo interpreter, saw that tanks and equipment in the Soviet garrisons had been painted with markers similar to the Allied D-day stripes. Some of the tanks were lined up, some were leaving their garrison, and some had taken positions in the city. Airfields showed heavy activity and roadblocks surrounding Prague. Lundahl was called, and we made briefing boards of what had taken place.

Corona Improvements

The Czechoslovakia incident emphasized the need for instantaneous transmission from reconnaissance satellites—capturing an image from space and sending it to a ground station rather than relying on a film recovery system. Such a system entailed numerous difficulties, not only in design, but also in establishing a ground unit that could interpret photos around the clock. Lundahl and Bud Wheelon pushed for a near-real-time reconnaissance system to avoid missing critical information in future crisis situations, and the Technological Capabilities Panel gave its full support. On October 16, 1968, Dr. Land sent Dr. Donald Hornig, President Johnson's science adviser, a historic memorandum calling for just such a system:

> Since the beginning of the concept of satellite reconnaissance, the ultimate goal has been to give decision makers an "on call" capability to view interesting areas of the world in real time. Our dream has been in effect "to see it now." So far, however, technical limitations have forced us to compromise on this goal. To get high resolution and reasonable coverage we have had to use photographic film, physically recovered from orbit. In addition, short equipment operating lifetimes have been an economic barrier to keeping satellites in orbit continuously over the USSR and China. . . . We have just reviewed the technology programs being sponsored under the National Reconnaissance Program by the Air Force and the CIA and we would like to let you know that the necessary technology for a "see it now" system has become available. . . . The technology of satellite electro-optical imaging systems has advanced to a point where we can foresee in the very near future the capability to view the ground with high resolution and in a manner which makes this image available for rapid and, with some systems, immediate transmission to the United States.[10]

Funding problems had to be resolved first, and the Air Force was reluctant to divert funds destined for their high-resolution systems. The decision was up to President Nixon. On September 23, 1971, Henry Kissinger sent a memo to the secretary of defense, the director of the Office of Management and Budget, the director of central intelligence, the president's science adviser, and the chair of the PFIAB announcing that "the President has carefully considered the various options presented to him regarding the development of a near-real-time satellite reconnaissance system. He has decided that the development of the Electro-Optical Imaging (EOI) system should be undertaken under a realistic funding program with a view towards achieving an operational capability in 1976. In addition he has decided that there should be no further development of the MOL."[11]

The KH-11 would be the greatest of the many achievements of Dr. Land and the Technological Capabilities Panel.

Managers at the NPIC realized that feedback data on the quality of the satellite imagery obtained over each target left a lot to be desired. We needed a way to report the quality of the imagery we were interpreting so that the consumer would understand why our interpretations were sometimes qualified. But such ratings depended on the judgment of various analysts. What one analyst deemed good another might deem fair. Without a standardized rating scale that would be used by all interpretation units there would be chaos.

U-2 images had been classified as excellent, good, fair, or poor, but interpreters varied widely in their opinions about what each of those categories really meant. The satellite camera was panoramic and covered targets over large degrees of latitude. At first, interpretability of satellite imagery was expressed in terms of clear, scattered cloud cover, heavy cloud cover, haze, cloud shadow, snow, obliquity, semidarkness, darkness, ground cover, camouflage, and small scale. With the advent of the advanced-resolution satellites, NPIC officials decided that the interpretability could be better expressed by a numeric system indicating whether objects were actually visible on the images. William Forester was tasked to come up with such a system. The one he devised consisted of sets of interpretation tasks or criteria of successively increasing difficulty that required increasing resolution. The final system involved rating images from 1 to 9. A 1 indicated that the image was of such poor resolution that a building could barely be discerned; a 9 indicated that a person could be discerned. The system became the National Imagery Interpretation Rating Scale, or NIIRS. Eventually, all U.S. interpretation organizations adopted the system, as did British and NATO interpretation units.

It was also imperative that we find a faster and better method of viewing Corona photographs. Photo interpreters had to scan each frame with a microstereoscope even though we knew that large areas of the Soviet Union did not have any priority targets. To address this challenge the Richards Corporation developed a rear-projection viewer. Two photo interpreters would use it to scan a satellite frame; if they found anything of interest, the film would be removed and viewed under a microstereoscope.

Beginning with mission 9031, launched on February 27, 1962, Corona had a dual camera system. It was the first satellite camera system to provide stereoscopic imagery. In one of his visits to the NPIC Dr. Land posed a question: Since the Corona system was capable of acquiring images in stereo, why not systematically scan them in stereo as well? Lundahl replied that the NPIC did not have such a scanner, but he would see what could be done. The optical firm Bausch and Lomb was contracted to produce a viewer in which the forward film and aft film moved in unison, thereby permitting stereo scanning. An interpreter sat at a console and used a series of levers and controls to keep the forward and aft films flowing at the proper speeds. Lundahl placed me in charge of testing the machine, and I recruited Mark Baker, a missile interpreter, and Nick Manning, an aircraft interpreter, as participants. After a preliminary lesson on the use of the machine, they began stereo scanning the moving image. After several trials they both complained that the scanning was hard on their eyes—like scanning microfilm over a long period. They also expressed doubt that they could detect everything important on the film. Baker said that he doubted that an interpreter could identify an ICBM site in the early construction stage with the moving image. Manning claimed that he simply could not see everything on the frame. I conducted several tests with less experienced interpreters, who also complained that they could not vouch for their ability to see an important target. I reported to Lundahl that the machine caused severe eye problems and that important targets might be missed with a moving frame of photographs. About a month later Lundahl called me to his office and told me to be prepared to brief Land on the machine and to give him a complete demonstration, stating all the pros and cons. When Land arrived, I demonstrated the machine and had him sit at the console and listen to the complaints and concerns of the interpreters. I was worried that he would expound on what we could have or should have done to make the equipment work properly. He listened and reflected, and than, almost as an afterthought, said, "Well, it was only an idea." I breathed a big sigh of relief. Stereo viewing is now commonplace, permitting a viewer to almost literally fly over a target or walk through city streets in three dimensions. Land was just forty years ahead of his time.

As the resolution of satellite photos improved, the NPIC was deluged with requests for detailed reports on Soviet strategic forces. Information on Soviet ground forces, however, was almost completely unavailable. The information was out there, but no one had synthesized it into usable data. In one of our staff meetings Lundahl said that Defense Secretary Robert McNamara was complaining that he was continually flogged by Congress because he lacked precise information on Soviet ground forces. When Congress was briefed on the number of Soviet ground divisions, the number was a guess based primarily on outdated information. But Congress wanted a more definitive answer than "100 plus" or "up to 165." I was the chief of the Western Division (later the Warsaw Pact Division), which included all strategic and tactical forces of the Soviet Union, the bloc countries, and Soviet forces in Mongolia, and employed some of the most capable military imagery analysts in the intelligence community. Billy Fisher, a photo interpreter, came up with the concept of "unit reporting," which involved reporting the function and unit structure of Soviet tank, motorized rifle, border guard, and support divisions. We did make progress in analyzing the functions of Soviet divisions, but it was no easy task. Each division had more than fifteen subordinate units, and these were often scattered about a city and usually were under some type of cover.

Project MILOB (Military Order of Battle), a working group comprising several hundred imagery analysts from the NPIC, the CIA, the Defense Intelligence Agency, and the U.S. Army, was organized to meld COMINT, SIGINT, and collateral information with Soviet installations seen on photography. There was considerable World War II SIGINT information (German, British, and Japanese) on Soviet forces. The project evolved into the largest photo interpretation effort ever undertaken. It was decided that the analysis would be done on a military district basis, because Soviet ground forces were regionally deployed in military districts, each having its own military and economic significance. Although the Soviet military system was complicated, depending on peacetime or wartime mobilization, we decided to list the Soviet divisions in categories. We had a very good idea of what a category 1, full-strength division would look like since we had excellent aerial photography of the Group of Soviet Forces, Germany (GFSG), which was often referred to as the "cutting edge of the Soviet Army." These divisions were deployed in Eastern Europe and along the USSR-China border. A category 2 division was fully equipped but was at reduced strength (manned between 50 and 70 percent). A category 3 division was cadre manned at the 30-percent level with older or nearly obsolete equipment. The number of Soviet divisions was judged to be 102 at the time; the Soviets considerably expanded their ground forces in the 1970s and 1980s.

Analyzing satellite images of better resolution, images acquired from Berlin corridor flights over crack Soviet forces in East Germany, and ground photography provided by the Potsdam mission, Albert Conner, Cal Freland, Charles Perkins, Charles Tooten, and other division analysts were able not only to determine the function of the line divisions but also to identify the supply, communication, and civil defense units. Project MILOB's success generated a similar effort on

Chinese ground forces. Never in its history had the United States had such finite information on its potential adversaries.

The first attempt to get the United Nations involved in reconnaissance occurred during the Cuban Missile Crisis, when the UN agreed to monitor the removal of Soviet missiles from Cuba. RB-66 airplanes of the 363rd Tactical Reconnaissance Wing were selected to be transferred to UN authority and were flown from Shaw AFB in South Carolina to MacDill AFB in Florida, where their U.S insignias were replaced with the white-and-blue insignia of the UN. At the 1992 Havana Conference, Fidel Castro noted that Secretary General U Thant had proposed a UN reconnaissance plane during the Cuban Missile Crisis with a crew acceptable to the Cubans, Russians, and American governments. Castro, however, had rejected the proposal.

In 1964 Lundahl sent Dulles a proposal for a UN reconnaissance and interpretation program, which was forwarded to the U.S. representative at the United Nations. Nothing happened. In 1965 NASA prepared a report for the U.S. House of Representatives that was passed to President Lyndon Johnson. It read in part, "Down through the course of history, the mastery of a new environment, or of a major new technology, or of the combination of the two as we now see in space; has had profound effects on the future of nations; on their relative strength and security; on their relations with one another; and on the concepts of reality held by their people."[12] That report was also forwarded to the United Nations. Again, nothing happened. On September 18, 1974, President Nixon addressed the UN General Assembly on the subject of cooperation in space: "Of all man's greatest enterprises none lends itself more logically or compellingly to international cooperation than the venture into space. We are now just beginning to comprehend the benefits that space technology can yield here on earth."[13]

The successes of new reconnaissance systems prompted U.S. Vice President Walter Mondale to tell the United Nations on May 24, 1978, that the United States was prepared be the "eyes and ears of peace" for the world in order to support disengagement agreements or other regional stabilizing measures. He was followed on June 14, 1978, by the actor Paul Newman, U.S. representative to the UN Special Disarmament Mission, who announced that "the United States is prepared to consider requests for technical monitoring services—such as aircraft photo reconnaissance and ground-sensor detection—in situations where such 'eyes and ears of peace' might support disengagement agreements or other regional stabilizing measures."[14] Later that month the NPIC helped prepare a proposal for Andrew Young, the U.S. ambassador to the UN, for a special aerial reconnaissance unit to aid the UN in its efforts. The NPIC's 1978 report for Stansfield Turner for a UN Aerial Survey Company was the most comprehensive ever prepared on the subject.[15] Again nothing happened.

Aerial and satellite photography had a number of interesting and unusual applications. DCI William Colby remarked that "satellite photography is remarkably versatile. We've used them occasionally to check up on the credibility of Soviet defectors. A defector might tell you something, and then you could go photograph it and see if it made sense. Or you could photograph his hometown, then quiz him about the layout of various buildings, and so forth and see how good a memory he had, or how accurate his observations were."[16] Several times I was called in to provide photographic support involving clandestine efforts. We also supported the Warren Commission by analyzing photos taken of Lee Harvey Oswald and aerial photos of Minsk, where Oswald had once lived and worked.

The U.S. Secret Service had to react quickly when the president decided on short notice to travel abroad. Most of these trips were in response to the death of a prime minister or some other highly regarded political or religious figure. One case I remember well involved the death of Prime Minister Harold Holt of Australia, who had drowned. President Johnson at first said that he was not going to attend the funeral, which was to be held in Holt's hometown, and then decided that he would. We had aerial photographs of the town and helped the Secret Service plan a quick egress in case of problems. Another such instance occurred when former German chancellor Konrad Adenauer died. Initially, the services were to be held in his hometown. We did an elaborate analysis of the route, which would have taken the presidential entourage through several small towns on the way to Adenauer's hometown. Fortunately, the services were held in Cologne instead. We often worked with *Air Force 1* pilots on presidential trips. For example, when Nixon traveled to Beijing, we annotated all the communication and other towers as well as airfields along the route in case the president's plane had to make an emergency landing. The Beijing area was also photographed by satellites during the president's visit.

Aerial reconnaissance has also been involved in many serendipitous discoveries. In 1966, for instance, the U.S. Navy asked the NPIC to help determine how deep their Polaris submarines had to be submerged in order to be undetectable on aerial photographs. It was generally agreed that a submarine at rest at about one hundred feet would not be visible on color photographs in either the Atlantic or the Pacific. We asked Eastman Kodak to provide us with some color film that did not include the green layer, and our tests confirmed one hundred feet as a safe depth. The Canadians heard about our experiment and asked if they could borrow some of the film. We complied and they let us know that they had conducted one of the most successful censuses ever—of Beluga whales off the coast of Nova Scotia.

When NPIC personnel looked at U-2 or satellite images, we were always in search of targets of intelligence interest. Lundahl once remarked that the intelligence community used only about 15 percent of the information captured on the film. We overlooked an enormous amount of information pertaining to fields ranging from archaeology to zoology. Interpreters with geography or science degrees could immediately see the value of this material for urban planning, hydrology surveys, forest inventories, crop estimates, and mapping and charting.

Viewing satellite images taken high above the earth did not isolate us from nature; we became more aware of it. From space we could look down and see the changing of the seasons, the promise of rain, the grip of winter. Those of us who looked at satellite imagery throughout our careers eventually understood that the world we viewed from on high is exceptionally fragile. We saw the consequences of epochal events that happened hundreds, thousands, or even millions of years ago. We saw the impact of weather-related disasters such as floods, forest fires, earthquakes, and volcanoes. And we saw actions that will affect the future of humanity: the ravages of strip mining; the scouring of the earth for firewood that has left hillsides and valleys barren; the destruction of the equatorial forests; fissures stuffed with toxic and atomic wastes, sutured and forgotten and even now flowing into groundwater and filtering deep down into the aquifers. The resources of our planet are limited and are being expended at an alarming rate as the population is expanding geometrically.

The combination of an established database, synoptic observations, broad-area coverage, and large-scale photography has permitted many unique interpretations of our planet. I was impressed by the large areas that are uninhabited—millions of barren acres that could be made productive by diverting a stream or by leveling or replanting a forest. The interrelationship of land and water is especially visible on satellite photography. The snow on the Himalayas becomes the source of water for the thirsty villages of the Brahmaputra and its tributaries. Satellite imagery shows the annual waxing and waning of the polar ice caps, forests dying from acid rain, the growing blight caused by reckless misuse of resources. On images of Africa, particularly, we watched helplessly as the meager land was stripped of its bushes and grasses to provide cooking fuel and then became further blighted by the encroaching desert.

Lundahl was sufficiently impressed with what he saw to establish a "peaceful uses" branch in the early 1960s to look at modern technical advances to predict, prevent, and respond to both natural and technological disasters. He directed us to prepare briefing boards on what we had seen to illustrate how the satellite photography could be used. He began to show cleared non-USIB members the value of this material and technology. He discussed with the director of the CIA and the president's science adviser the value of sharing this data with civilian agencies. As a result, the White House called on us to analyze photography of the Santa Barbara oil spill, the Los Angeles earthquake, the Alaskan earthquake, Sierra Nevada snowfalls, Hurricane Camille damage, and the effects of Mississippi floods. We also analyzed the results of the earthquakes in Guatemala and Italy.

In 1967 the director of central intelligence entered into agreements with a number of federal agencies permitting them access to classified overhead photography. The first to respond was the U.S. Geological Survey, which had established a facility at Reston, Virginia, for the creation of topographic maps. Later the Argo Committee was formed under the auspices of the president's science adviser and with the concurrence of the DCI to investigate such possible peaceful uses. The committee consisted of numerous federal agencies, including the Departments of Agriculture and Commerce, AID, NASA, and the Office of Emergency Planning. Not every agency was willing to use intelligence gained by covert programs for civilian enterprises. The State Department, for example, continued to rely on reports from their personnel in the field when disasters occurred in foreign countries.

Even some within the CIA were hesitant, because the CIA is not supposed to get involved with domestic matters. In 1975, however, the Rockefeller Commission reviewed the concept of sharing reconnaissance data and found "no impropriety in permitting civilian use of aerial photographic systems. The economy of operating a single aerial photographic program dictates the use of these photographs for appropriate civilian purposes."[17]

Vice President Al Gore broke down many of the barriers by sharing images of technological and natural disasters in the United States with the various states. The value of such imagery in emergency management projects was substantial. Subsequently, the president directed the NPIC to exploit aerial and satellite photography for diverse projects, including assessing damage from natural disasters such as hurricanes and tornadoes, forest fires, and oil spills; conducting forest inventories and route surveys for the Alaskan pipeline; determining the extent of snow cover to forecast runoff; and detecting crop blight in the Great Plains states.

Lundahl saw that scientific and technological advances in U.S. intelligence operations had numerous applications in the international sector as well, and spoke to the DCI and the president's science adviser about sharing this data not only with foreign nations but also with international organizations trying to maintain peace and alleviate hunger and poverty. He felt strongly that a cleared photo interpretation center should be established at the United Nations to alleviate poverty and suffering in depressed areas in the world.

Eisenhower's Contributions to America

Scientific developments that occurred during the Eisenhower administration brought far-reaching and remarkable changes not only in intelligence acquisition but also in the time interval in which we received, processed, and used information. Successive generations of improved collection vehicles—Genetrix reconnaissance balloons, the U-2, the SR-71, and the photo reconnaissance satellites—gave us the ability to project photo reconnaissance technology farther and farther into space to photograph the moon and then other planets. We flew faster and higher, and acquired ever-increasing volumes of information on our enemies and our planet. In short, we reaped a wealth of information, developed innovative interpretation techniques, and constructed enormous data banks to store and retrieve this vital information. We gathered knowledge faster, at times, than we could process and absorb it. Each photo was an irreplaceable account of a moment in time. Each photo therefore established a baseline of critical importance in recognizing the inevitable changes that will occur in the future. We learned more about the earth in the period from 1955 to 2000 than we had in the previous five thousand years. And Dwight D. Eisenhower's interest in satellites was largely responsible.

One of the great accomplishments of Eisenhower's domestic agenda was the creation of the Federal-Aid Highway Act to address the poor condition of the roads throughout much of the United States. Most of the war material transported in the United States during World War II had gone by rail for that very reason. During and after the war Eisenhower was impressed with the German autobahn system, which allowed traffic to move quickly and safely. The growing number of automobiles in the United States required a similar system here. After the war, everyone wanted a new car. Between 1952 and 1955 the total number of cars in America increased by 10 million. Gas was plentiful and cheap, and Americans began taking longer vacations and traveling farther. The additional cars and travel combined with the poor road system was a recipe for disaster. Each year, more than 36,000 people were killed in highway accidents and more than 1 million were injured. The threat of a Soviet attack brought concerns about America's highway system to the forefront. "Our roads ought to be avenues of escape for persons living in big cities threatened by aerial attack or natural disaster," Eisenhower would later write, "but I knew that if such a crisis occurred, our obsolescent highways, too small for the flood of traffic of an entire city's people going one way, would turn into traps of death and destruction."[18] The nation was spending more than $5 billion each year maintaining those poor roads. Eisenhower clearly saw that what America needed was a road system like Germany's autobahn.

On February 22, 1955, Eisenhower sent a special message to Congress urging immediate action to improve the U.S. highway system. Such an ambitious and expensive endeavor was bound to be controversial. While the proposed system was hailed in the West, there was strong opposition in the East and South when people heard that the new highway system would bypass most cities and towns. Owners of stores, filling stations, and restaurants along existing roads complained they would lose their livelihood. Members of Congress protested that taxpayer money could be spent on more worthwhile endeavors. The first highway expansion bill passed in the Senate but failed in the House. In his 1956 State of the Union message Eisenhower repeated his recommendation for "a grand plan for a properly articulated system that solves the problems of speed, safe transcontinental travel; inter-city communications; access highways, farm to market movements; and metropolitan area congestion."[19] Eventually both houses of Congress passed the legislation, and the president signed it into law on June 29, 1956.

When Congress quibbled about how to finance the new highway system, Eisenhower became frustrated. Gen. Lucius Clay, chair of a presidential committee on financing the project, noted that finally, an exasperated Eisenhower decided that the construction of the highways would be financed from revenues gained from increased taxes, including taxes on gasoline, diesel oil, tires, trucks, buses, and trailers. Eisenhower told Commerce Secretary Sinclair Weeks, whose department was responsible for highway planning, that since the federal government was financing the system, he was not to take any crap from anyone.

The Federal-Aid Highway Act engendered the most gigantic federal road-building project of the twentieth century. It would necessitate the largest reconnaissance and mapping effort ever undertaken in the United States, requiring aerial photography, ground surveys, and the creation of the maps and charts. In addition to aerial missions flown by private survey organizations, the U.S. Geological Survey (USGS) was allowed to use classified U-2 training films and Corona satellite images to create up-to-date maps in a special secured facility in Reston, Virginia.

The Departments of Interior and Commerce coordinated closely with the Army Corps of Engineers and the highway departments of the states involved. Plans were tightly controlled to prevent land speculation along the routes. The final plan would to come down to a USGS map showing each new highway's routes. The plans called for the highways to be as straight as could be made, to be built by cut-and-fill methods, and to circumvent most cities and towns. Beltways would be constructed around major cities, with ramps for entering or leaving. Highways were to be built high enough that they could be used to move aid in catastrophic events such as floods and hurricanes. The highway construction continued into the 1970s and produced a 41,000-mile network of roads that linked nearly all U.S. cities with a population of 50,000 or more. Eisenhower was proud of what he termed "the biggest peacetime construction project of any description ever undertaken by the United States or any other country."[20] The Federal-Aid Highway Act facilitated nationwide commerce, diminished costs, saved lives, and provided avenues for the military in case of disasters or attacks. It galvanized popular response to Eisenhower's leadership. In addition to the highways, twenty-nine national parks and more than 150 national monuments and historical sites were created during Eisenhower's tenure as president.

President Eisenhower's intense personal and professional interest in the importance of reconnaissance to the national security continued throughout his life. After rallying from his fourth heart attack at Walter Reed Hospital, with time heavy on his hands, he asked President Nixon for an update on the status of various U.S. reconnaissance programs. The president forwarded the request to DCI Richard Helms, who in turn asked Art Lundahl to prepare a briefing for presentation to the general at an appropriate time.

Lundahl asked me to work with Fred Lowery to coordinate production of the briefing, making special note of the improvements and ongoing research and development in photographic collection and exploitation systems since the first U-2 missions in 1956. Almost every analyst in the center participated in the research and selection of materials, which came to be known as the "Eisenhower package."

Helms, Lundahl, and Tom Logan, Lundahl's special assistant for briefings, delivered the package to Walter Reed on February 13, 1969. Lundahl told me that

> Eisenhower looked better there than the last time I had seen him, at the White House. He was more loquacious; there was no stumbling of words. His ideas were crisp; his gaze was clear, and he was lying propped up in his bed. He shook hands with us and recalled all the times we had briefed him under many different conditions. Mr. Helms sat to the left of the bed; I stood on the right and with Tom Logan standing at the foot of the bed holding up the briefing boards, I went through the "how it was and how it is." The general was just absolutely flabbergasted about the improvements achieved in the systems. He was apparently writing a book. He had a manuscript— long yellow sheets of paper—and was writing things down. Every once in a while he asked me to stop, saying he wanted to make some notes about something I had just said. He asked about ABMs and about our ability to detect them. He also wanted to know about the ABMs around Moscow. He talked about the precision of our photographic effort and its possible usefulness if arms control or disarmament were initiated. We got into many things like that. Everything he wanted to know, we had in spades, before and after. He could not have been nicer. When we finished, he shook hands with us, saying that it had been very exhilarating and most enjoyable. I really felt as we left the hospital that here was a man who was going to recover. He had all the vitality signs showing, and I would have bet anyone ten to one that he was going to make it out of there.

The briefing confirmed that regular satellite photography had turned out to be by far the best source of current intelligence not only of the Soviet Union but of the whole world. The estimates it permitted now had such a high degree of confidence that détente with the Soviet Union and the initiation of disarmament agreements seemed possible in the near future. The general was pleased that he had played the major role not only in determining how we would gather current information but also in setting the stage for the next millennium in peaceful uses of once highly classified systems. Lundahl recognized the general's smile as satisfaction because what had begun in the early days of his administration had come to pass. Eisenhower, he later remarked, was a determined, resourceful, and courageous man, and he distinguished himself by pursuing the truth in the defense of his country. He brought reconnaissance to the White House.

General of the Army Dwight Eisenhower, thirty-fourth president of the United States and the supreme Allied commander in Europe in World War II, died after his fourth heart attack at Walter Reed Hospital at 12:25 PM on March 18, 1969. Eisenhower was the right man for that period in U.S. history. He pressed for new ideas, and the advances we made in aircraft and satellites were nothing short of stupendous. The film from those vehicles captures many of the defining moments in his administration. He had tried for a détente with the Soviets with mostly discouraging results, but he refused to be discouraged. He was a careful and deliberate man who practiced prudence, realism, and restraint in his dealings with the Soviets. After his passing, the accolades rolled in.

Gen. Andrew Goodpaster wrote of Eisenhower that

> he brought to the presidency a deeply rooted view that intelligence was of vital importance to the national security and to the conduct of military and diplomatic affairs. . . . He struck a fine balance between two imperatives of presidential leadership that shaped the direction of our relations, military and otherwise, with the Soviet Union. He carefully weighed the need for intelligence against the possible Soviet response to the provocation they considered it to be. Balance number one, as struck during his first few years in office, involved the attempt to gather vital intelligence by military overflights, while at the same time working to achieve the cooling of tensions that was also one of his long-term objectives. Balance number two continued and augmented the gathering of intelligence, but did so employing less provocative means—the civilian operated U-2 and the Corona when it became available.[21]

Goodpaster also said of his president:

> There was much in which Eisenhower could and did take pride and satisfaction. He had answered his country's call when he knew well that it needed him. He felt that he had met his responsibilities as our people's president—responsibility always uppermost in his mind. The nuclear threat that could destroy the world was held in containment. During the last morning of his presidency, when he and I talked alone, he spoke of the great pride he felt that in the eight years of his service, our security was maintained: no territory was lost by us or our allies; and above all, that this was done without the loss of American troops in combat.[22]

R. Cargill Hall, an eminent historian, noted that "on leaving office on January 20, 1961, Eisenhower could surely take satisfaction in the knowledge that he and his closest advisors had engineered a revolution in intelligence. Together, within a span of eight years, they had opened the Soviet Union and Communist China—indeed the entire world—to American scrutiny."[23]

Philip Taubman, a *New York Times* reporter and author, credited Eisenhower with great vision.

> The Eisenhower presidency (1953–1961) has often been depicted as a time of muddled leadership, but I found in the area of military and intelligence technology that Dwight Eisenhower was a visionary leader with a high tolerance for risk. In these fields, Eisenhower was confident in his judgments, open to new ideas, respectful of the contributions science could make, and wary of the Pentagon's conventional thinking and stifling bureaucracy. Throughout his presidency, Eisenhower repeatedly bet on daring new defense technologies, often rejecting the recommendations of his cabinet members and the established institutions of Washington, including the military services. When things went wrong, which they often did during the development and testing phase of new projects, he didn't flinch. The result was a formidable array of new spy systems and weapons, including exotic spy planes and satellites, nuclear powered submarines and aircraft carriers, intercontinental ballistic missiles and nuclear warheads compact enough to fit atop missiles. All in all, it was a time of landmark advances in defense, a record unequaled by nine subsequent presidents.[24]

Gen. Vernon Walters, who served as Eisenhower's interpreter at many international meetings and conferences, noted that when he saw the general "for the last time on February 17, 1969, shortly before his death in Walter Reed Army Hospital, he looked back with satisfaction over his life. He told me that he knew he did not have long to live, but he could not complain. Most of his dreams from childhood had been fulfilled."[25]

Eisenhower was a prolific letter writer. In a letter to Emmet John Hughes, his former aide and speechwriter, he wrote: "One man can do a lot. . . . If at that moment he happens to be ranking high in the public estimation. By this I mean if at that moment he is dwelling in the ivory tower and not in the dog house. But in our complicated political system . . . success is going to be measured, over the long term, by the skill which the leader builds a strong team around him."

At a symposium on Eisenhower held January 26–28, 2005, Clayton D. Laurie presented an extremely poignant paper. He concluded:

> Of all the presidents who have occupied the Oval Office since the creation of the CIA, Dwight D. Eisenhower was arguably the most astute, knowledgeable, and prudent consumer of intelligence and probably the president willing to utilize the Agency to the fullest use of its charter powers. Thus during the Eisenhower years, the CIA enjoyed what later historians termed a "golden age," when Agency influence was its height, when funding and personnel levels expanded many fold, where covert operations were sanctioned in large numbers, and where the DCI had direct access to the president, not only as a trusted and respected intelligence adviser and co-policymaker, but as a personal friend.[26]

Probably the greatest compliment to Eisenhower's intelligence collection efforts came from Sherman Kent, the director of the Office of National Estimates, who said after reviewing information gained from satellite reconnaissance in preparing a national estimate on the Soviet Union, "Hell, it's no longer an estimate, it's a fact book."

Two of the other great men of that era are now gone as well. Arthur C. Lundahl died on June 22, 1992, at the age of seventy-seven. Over his mantle hangs an autographed photo of Allen Dulles and Lundahl that is inscribed: "Art Lundahl has done as much to protect the security of this nation as any man I know." Richard Bissell's death at the age of eighty-four in 1994 ended the golden age of reconnaissance.

About the endeavors at the NPIC General Goodpaster wrote: "First I want to point out the skill shown by those dedicated individuals who interpreted the photographs made available by aerial overflights and satellite reconnaissance. Our ability to recognize and identify objects on the ground in these photographs was of tremendous importance to building the confidence on which actions of the president, the military, the State Department, and the NSC were so dependent. It made possible the easing of East-West tensions and Eisenhower's successful discharge of his duties relating to national security."[27]

NOTES

Chapter 1. The Beginning

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