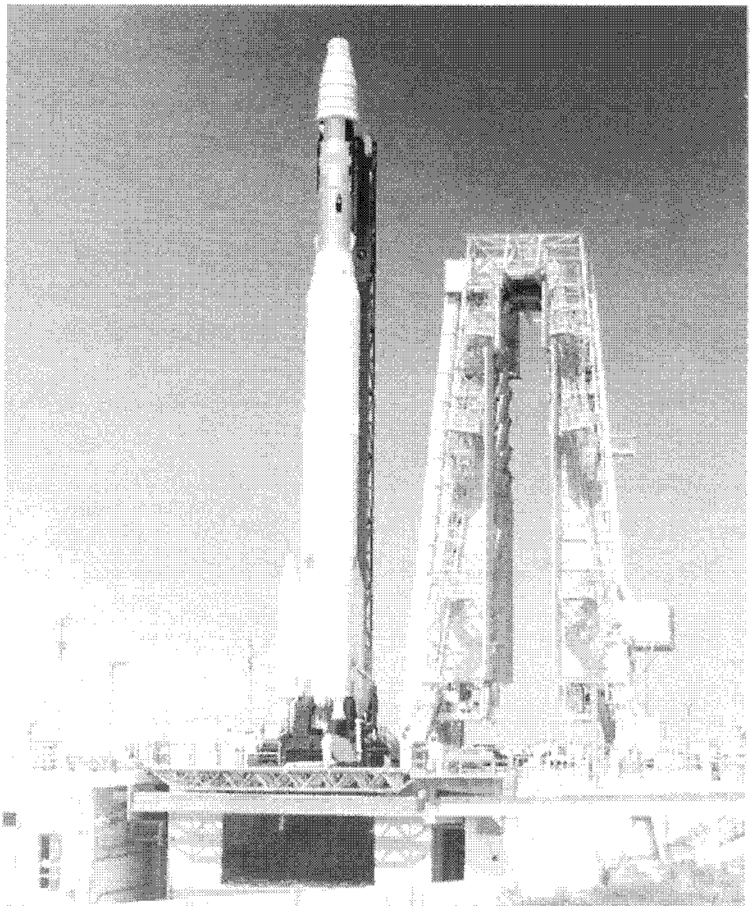
A Tribute to the People of the Air Force Satellite Control Facility; The National Security Impact of Its Corona Satellites



Corona

On the cover: AFSCF/Sunnyvale from the air.

A Tribute to the People of the Air Force Satellite Control Facility; the National Security Impact of Its Corona Satellites

Donald P. Steury

Second Printing

History Section
Center for the Study of National Reconnaissance
Business Plans and Operations
National Reconnaissance Office
Chantilly, Virginia

April 2007

Foreword

At various times during my career, I have had the opportunity to drive along Highway 101 near Sunnyvale, California, and see the large blue building near North Mathilda Avenue. That "Blue Cube" building had the words "Air Force Satellite Control Facility" displayed on its side. I did not come to appreciate the significance of those words, nor the national security contributions of that facility, until I became involved in planning a 1995 unclassified celebration to recognize publicly what had been a highly classified satellite reconnaissance program. President William Clinton made it possible to have a public celebration when he signed an order that authorized the Director of Central Intelligence to declassify the previously highly sensitive Corona photo reconnaissance satellite program.[1]

Corona was the world's first photo reconnaissance satellite. In the foreword to a 1997 book that I edited for the American Society for Photogrammetry & Remote Sensing (ASPRS) as a follow-on to the public Corona celebration, former Director of Central Intelligence Richard Helms wrote, " . . . the Corona program had pioneered the way for satellite reconnaissance and deserve[s] 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."[2]

It would be difficult to overstate Corona's value to the intelligence community. In the ASPRS 1997 Corona book, I concluded, "Corona

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[1] On 24 May 1995, the National Space Club, with the National Reconnaissance Office (NRO) and the Smithsonian's National Air and Space Museum, sponsored a celebration of the Corona program's 35th anniversary. The American Society for Photogrammetry & Remote Sensing (ASPRS) published *Corona Between the Sun & the Earth—The First NRO Reconnaissance Eye in Space* as a follow-on to that celebration.

[2] From Foreword to *Corona Between the Sun & the Earth—The First NRO Reconnaissance Eye in Space,* Bethesda: the American Society for Photogrammetry & Remote Sensing (ASPRS), 1997.

played a major role in determining how we would think about national security during the second half of the 20th century and then set the stage for how we are going to confront information in the domains of foreign intelligence and remote sensing in the next millennium."

On 7 March 2007, we are in that "next millennium," and that historic Air Force Satellite Control Facility just off Highway 101 is on a facility called Onizuka Air Force Station.[3] Even though the President and Congress endorsed the 2005 Defense Base Realignment and Closure (BRAC) recommendation to "close Onizuka Air Force Station," and the Director of the NRO is to preside over the closing ceremony for the Air Force Satellite Control Facility (AFSCF) at Onizuka AFS, the AFSCF and its predecessor Satellite Test Center (STC) already will have made their mark on the history of national reconnaissance and share with the Corona program a great 20th century legacy. It was in 1960 that individuals assigned to what was then the 6594th Test Wing and working at the STC played central roles in the operation of Corona.

It was Corona trailblazers like Forrest S. McCartney, William Bumm, and Joseph P. O'Toole who were among the handful of individuals involved with Corona's space operations at the Satellite Test Center. McCartney was responsible for on-orbit operations of the early Corona satellites and was at the console during the first successful Corona mission. O'Toole served as a control chief for Corona operations and supervised the duty controllers. Bumm provided the vital link between operations at other locations and the on-orbit controllers at the satellite test center.[4] These three trailblazers are representative of the many personnel

[3] The Air Force built the Blue Cube in 1968 to house the Air Force Satellite Control Facility (AFSCF), which in 1964 became the new name for the Satellite Test Center (STC). In 1971 the Air Force designated this Sunnyvale facility as the Sunnyvale Air Force Station. In 1986 the Air Force renamed Sunnyvale AFS Onizuka AFS in honor of astronaut Col Ellison S. Onizuka, who died on board the Space Shuttle *Challenger* when it exploded on 28 January 1986.

[4] McCartney, Bumm, and O'Toole were three of 48 Corona trailblazers whom the Intelligence Community honored at the Central Intelligence Agency on the

who played a role over the years in making the AFSCF and Onizuka AFS a vital part of the nation's national security infrastructure.

Because of the AFSCF's central role in the operation of Corona, and Corona's invaluable contributions to national security, I asked Dr. Donald Steury, a distinguished visiting historian at the Center for the Study of National Reconnaissance (CSNR), to write about Corona as a tribute to the contributions of all those who served at Onizuka AFS and in the AFSCF since its establishment in the 1960s. In writing about Corona in this way, Dr. Steury documents the legacy of Onizuka AFS and the Air Force Satellite Control Facility.

Dr. Steury is the ideal intelligence officer to write about this legacy. He not only is a distinguished historian of intelligence and the Cold War, but he also is a CIA analyst who understands from firsthand experience the value of satellite reconnaissance imagery. Dr. Steury served in CIA's Office of Imagery Analysis, as well as CIA's Office of Soviet Analysis, in the 1980s when satellite imagery was a major contributor to our understanding the nature of the Soviet threat to US national security. From that experience, Dr. Steury has personal insight into how Corona revolutionized intelligence analysis.

As you read this CSNR history pamphlet, I invite you to join us from the Center for the Study of National Reconnaissance in acknowledging the role that the AFSCF played in the history of space imaging and in paying tribute to those at the AFSCF who made those contributions possible.

Robert A. McDonald, Ph.D.
Director
Center for the Study of National Reconnaissance

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occasion of the Corona program's 35th anniversary. (You can read more about this celebration in "Corona's Pioneers," pp. 141-152, *Corona Between the Sun & the Earth—The First NRO Reconnaissance Eye in Space,* edited by R. A. McDonald, Bethesda, MD: American Society for Photogrammetry & Remote Sensing, 1997.)

Approved for Release: 2018/01/16 C05108189

Contents

Introduction: The Origins of National Reconnaissance

Much as it dominates the skyline at Onizuka, the "Blue Cube" figures prominently in the history of national reconnaissance. The Satellite Test Center was a key element in the Corona program, arguably the most important national reconnaissance effort in the Cold War. Corona was the first photo-reconnaissance satellite. It appeared at a pivotal time in American history, a period in which the Soviet Union seemed to be ahead of the United States in the exploitation of space and equally seemed on the verge of achieving a decisive superiority in intercontinental ballistic missiles. It was this that made Corona not only necessary, but urgently so. The story of Corona is, at least in part, the story of the men and women who worked at the Satellite Test Center. For more than a decade, they worked at the heart of the Corona program; its success was theirs.

The Corona program originated in the desperate need for intelligence on the Soviet Union that developed after World War II. The Soviet Union was a closed book to most Westerners—and the Soviet security services did everything in their power to keep it closed. Moscow kept secret the most basic facts about the Soviet Union and protected military secrets with a fanaticism bordering on paranoia. In this environment, it was only possible to collect reliable information on the Soviet Union through clandestine means. But the traditional forms of intelligence collection were of only limited utility when operating against the ruthless and efficient Soviet security establishment. This was particularly true of Soviet strategic weapons programs. "Reliable intelligence" of Soviet long-range plans and intentions regarding nuclear weapons was "practically non-existent," wrote one CIA commentator in 1953. "Little improvement...can be expected in the near future..."[5]

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[5] Gerald K. Haines and Robert E. Leggett (eds.). *CIA's Analysis of the Soviet Union, 1947-1991* (Washington, DC: Center for the Study of Intelligence, CIA: 2001), p. 40.

Although remote sensors offered the means of collecting some intelligence, overhead reconnaissance seemed the only reliable way to obtain information on Soviet strategic programs, most of which were located deep inside Soviet territory. In November 1954, a "Panel of Experts" advised DCI (Director of Central Intelligence) Allen Dulles to pursue aerial reconnaissance as the "most practical means" of reducing the gaps in intelligence on the Soviet bloc.[6] This idea was not new: the Air Force had been flying aerial reconnaissance missions over the Soviet Union since 1950. But success in these operations depended on avoiding Soviet air defenses, which meant that Air Force reconnaissance aircraft usually had to confine themselves to the periphery of the Soviet Union, an area unlikely to contain many of the targets of interest in Soviet strategic programs. The CIA achieved a dramatic success in 1956 with Project Aquatone, high-altitude aerial reconnaissance flights with the U-2 that penetrated deep into Soviet territory. But, Project Aquatone came crashing to a halt on 1 May 1960, when the Soviets shot down Francis Gary Powers' U-2 near Sverdlovsk. The 24 U-2 flights over the Soviet Union gave a dazzling look at Soviet strategic programs and the Soviet military infrastructure, but the program was too short-lived to be of lasting benefit.

Progress by Trial and Error

From the beginning, it was obvious that satellite reconnaissance would offer the best and most comprehensive technical means of collecting intelligence on the Soviet Union. Even as the first U-2s were taking off to reconnoiter Soviet territory, the Air Force was beginning a program—designated WS 117L—to develop an array of reconnaissance satellites. In May 1958, one of the photoreconnaissance systems was broken off from the other Air Force programs, designated Project Corona, and placed under the direction of the DCI's Special

[6] Dulles et al., Memorandum: "Intelligence," 23 November 1954; MORI: 7429:143430.

Assistant for Planning and Development, Richard M. Bissell. Meanwhile, the design of the satellite evolved. Corona eventually emerged as a film-return system: the satellite ejected exposed film in a capsule, or "bucket," that descended to Earth under a parachute, to be snared in mid-air by a specially equipped Air Force plane.

Because the satellite perforce needed a booster powerful enough to lift it into orbit, the progress of Corona depended on success of the Air Force's ICBM program. This itself was encountering teething problems and it was not until January 1959 that satellite and booster were ready for the first tests.

Since it scarcely was possible to conceal the launch of a space vehicle into orbit, Discoverer, a scientific program, provided cover for Corona launches. Progress was by trial and error. Discoverer-I successfully orbited its satellite, as did Discoverer-II. However, the attempt by the latter to test the film capsule recovery system failed when the bucket disappeared somewhere in the Arctic, near Spitzbergen—half a world away from where it was supposed to be. The next 10 launches all were failures. "It was a most heartbreaking business," recalled Bissell. "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 and ... you never get it back.... So you have to infer from 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."[7]

While attention in Washington focused on problems with the booster and the space vehicle itself, preparations for recovering the film capsules were underway. Corona inherited its film recovery system from Project Genetrix, a program for photographing Soviet territory with drifting

[7] National Reconnaissance Office, *The Corona Story,* pp. 47-48.

balloons.[8] Genetrix had ended in 1956, but the equipment was in storage and available for use by Corona.

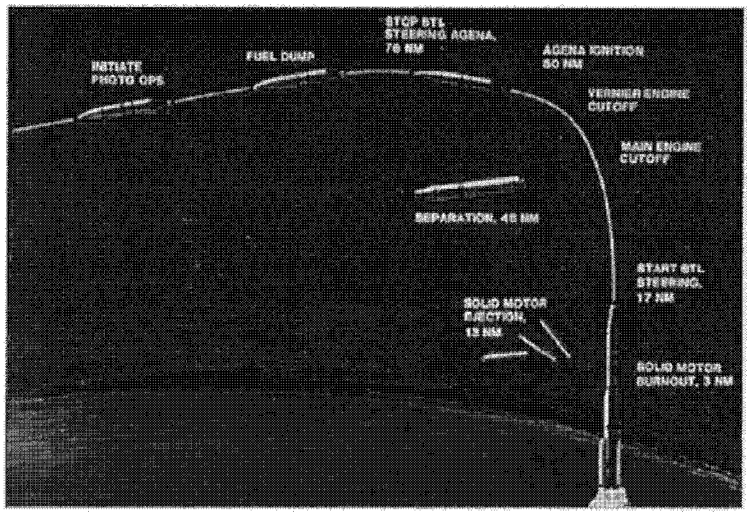

Figure 1. Corona satellite flight path

The film capsule recovery sequence involved a complex series of maneuvers. First, the orbiting vehicle had to rotate into a 60-degree down angle to position the capsule for ejection. When it separated from the satellite, the capsule stabilized itself with spin-rockets. Retro-rockets then slowed the capsule so that it entered into a descent trajectory. At this point, de-spin rockets fired to slow the stabilizing spin. The retro-rocket thrust cone and the heat shield would then separate and the drogue chute would deploy, slowing the descent. Finally, the main chute would deploy. If any one of these maneuvers did not occur more-or-less pre-

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[8] In Project Genetrix, camera-equipped balloons released from west of the USSR drifted across Soviet territory taking photographs. Aircraft then recovered the balloons over the Pacific. As might be expected, the film returned showed vast swaths of forests and farmland—and produced nothing of intelligence value.

cisely as planned, the recovery operation would fail. Finally, the recovery aircraft would snag the descending capsule with a trapeze-like hook suspended beneath the plane. Although the mid-air recovery system had been perfected in Genetrix, the need to recover a rapidly descending capsule complicated the operation, so that 25 out the first 74 practice drops failed.

The unit designated to carry out the recovery operations was the 6593rd Test Squadron (Special), activated on 1 August 1958 with specially equipped C-119J "Flying Boxcars." These twin-boomed cargo aircraft featured a rearward-opening cargo door that made them perfect for mid-air recovery operations. While the Corona system was being built and tested, the 6593rd trained and developed the equipment and film capsule recovery procedures.

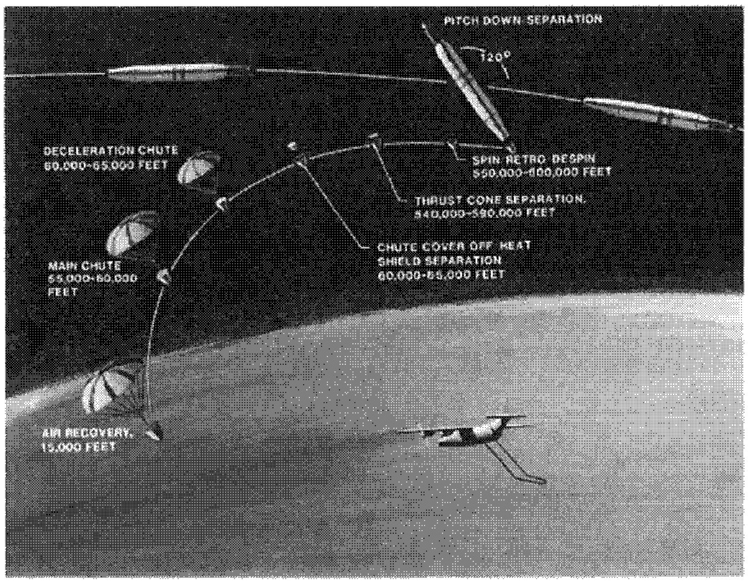

Figure 2. Corona film capsule recovery operation

On 10 August 1960, Discoverer-XIII launched from Vandenberg Air Force Base and successfully placed a Corona satellite into orbit. After 17 revolutions, the film capsule ejected and began its earthward descent. Although everything otherwise went as planned, the C-119s placed to recover the capsule failed to do so. However, the capsule splashed down safely in the Pacific, 330 nautical miles northwest of Hawaii. Within a few hours, a helicopter plucked it from the sea and deposited it on the deck of the recovery ship *Haiti Victory*. On the morning of 12 August, Major R.J. Ford of the Air Force Corona office sent a terse message to Washington: "Capsule recovered undamaged."

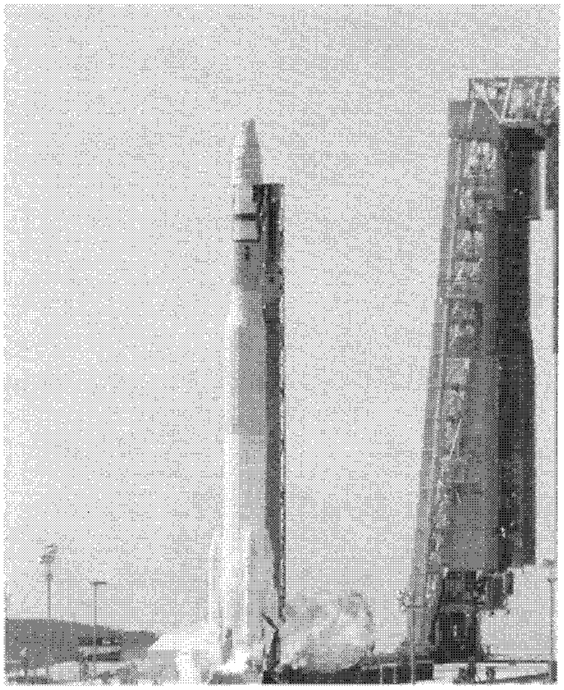

Figure 3. A Corona satellite blasts into space

The capsule and its contents, which included a brand-new 50-star American flag (Hawaii having joined the Union almost exactly one year previously), were conveyed to Washington and presented to President Eisenhower. Little realizing its importance for Cold War intelligence, *The New York Times* picked up the story, featuring it on the left side of the front page. Ironically, the right side of the front page covered the sentencing of U-2 pilot Francis Gary Powers, convicted of espionage by a Soviet court. It was as if an intelligence baton was being passed from one program to the next.[9]

The Cold War Edge

By any standard, this was a momentous event, one that pushed the limits of what was then possible in space flight. It is important to remember how new was the technology involved. Virtually everything used on the Corona satellites was developed expressly for the program and here was used for the very first time. The boosters used to lift the Corona satellites into orbit were themselves barely operational and hardly reliable—spectacular failures of both the Atlas and Titan boosters were features on the evening news, at a time when intelligence analysis credited the Soviets with hundreds of operational ICBMs.

Moreover, the Cold War competition with the Soviets gave an edge to Corona. The margin of western technical superiority was narrow in this period of the Cold War —if, indeed, it existed at all—even in reconnaissance satellites. The first successful Soviet recovery of an object from space occurred on 20 August 1960, a scant eight days after the success of Discoverer-XIII. On 28 July 1962, the Soviets orbited their first operational photo-reconnaissance satellite, the Xenit-2. For a launch vehicle, the Soviets also used a modified version of an operational ICBM, the R-7A, known in the West by the NATO designator, SS-6

[9] Fortunately, Powers did not serve much of his sentence. On 10 February 1962 he walked across the Glienicke Bridge into West Berlin, exchanged for Soviet agent Rudolf Abel.

(SL-3, when used as a space-launch vehicle). The Soviet satellite also was a film-return system, but the Soviets never attempted a mid-air recovery—their film capsules parachuted to earth on Soviet soil.


"All the News That's Fit to Print"

The New York Times.

LATE CITY EDITION

SPACE CAPSULE IS CAUGHT IN MID-AIR BY U. S. PLANE ON RE-ENTRY FROM ORBIT

SECURITY COUNCIL MEETS TOMORROW ON CRISIS IN CONGO

POWERS GETS A 10-YEAR SENTENCE; SOVIET ASSERTS PENALTY IS MILD, BUT EISENHOWER FINDS IT SEVERE

FLIERS ARE CITED

Vehicle Is Recovered 8,500 Feet Up in C-119's 'Trapeze'

Russians Orbit a Satellite Carrying 2 Dogs and TV

U.S. BARS LOAN USE FOR CUBA'S SUGAR

U-2 TRIAL ENDED

PRESIDENT VOICES REGRET AT RULING

Flier's Final Plea to Court

Figure 4. The baton passes

Corona came at the end of a decade in which the Soviets seemed to lead the way in the development of space technology: Sputniks-I and -II had caught the imagination of the world. The first successful test of an ICBM design was Soviet, and Soviet medium and intermediate range ballistic missiles blanketed Europe. But Soviet supremacy was illusory. Premier Nikita Khrushchev trumpeted these successes, but even he knew that the existing Soviet technology was reaching the end of its potential for development.

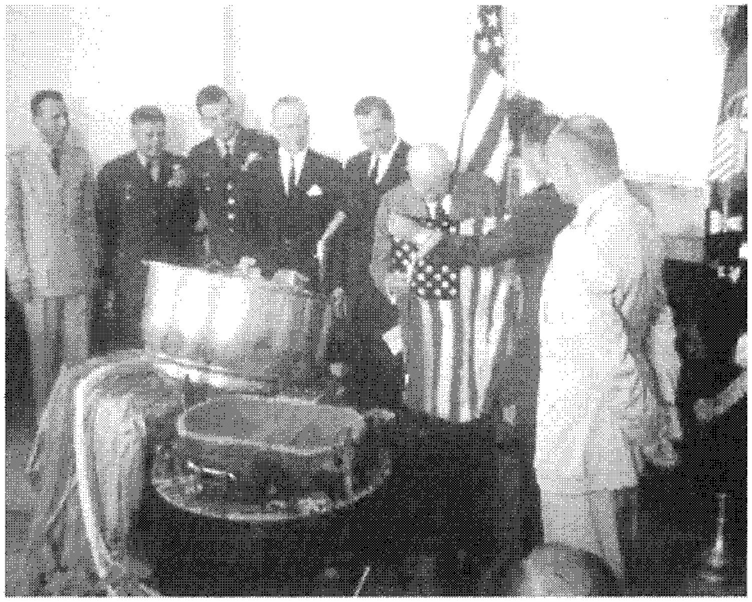

Figure 5. President Dwight D. Eisenhower receives the first Corona film capsule successfully recovered from space

Discoverer/Corona was a quieter success, but it signaled the waning of the triumphal period of Soviet space technology and the beginning of American space dominance. Implicit in this was a shift in the demographics and geography of the aerospace industry and its supporting infrastructure. From the very beginning, Corona was a program rooted in the burgeoning west-coast aerospace industry—the list of contractors involved in the program is a roster of west-coast industry leaders, including Lockheed's famous "Skunk Works." Corona's operational elements also resided on the west coast—only the intelligence functions were elsewhere. Vandenberg Air Force Base, on California's rock-bound coast north of Los Angeles, launched the satellites, supported by Sunnyvale Air Force Station. Remote tracking stations dotted the coast from Kodiak, Alaska to Point Mugu, California. The Air Force Satellite

Control Facility controlled the satellites when they were in orbit. The C-119Js of the 6593rd Test Squadron (Special) trained at Edwards Air Force Base—although they moved to Hawaii in time for the first recovery operation.

Figure 6. Sunnyvale Air Force Station

In all, Vandenberg launched a total of 121 Corona satellites from 1959 to 1972, of which 95 were successful. Given the designator "KH" (for "Keyhole"), the Corona program proper encompassed four satellite systems—KH-1 through KH-4A and KH-4b. Ground resolution of the photography gradually improved from 40 feet from the KH-1 to 6 feet from the KH-4b. Beginning in 1962, the first broad-area coverage KH-5 Argon systems appeared to supplement Corona, followed the next year by the high-resolution KH-6 Lanyard satellite. Both the KH-5 and the KH-6 were failures, however. The intelligence community's first successful high-resolution satellite, the KH-7 (eventually achieving a ground resolution of two feet) appeared later in the decade. The KH-9 mapping system appeared to assume the functions of the KH-5 in the mid-1970s.

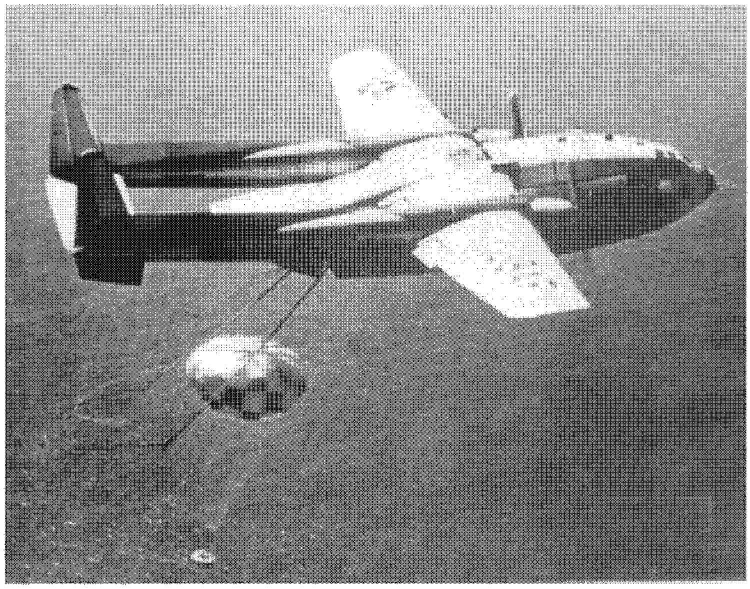

Figure 7. Successful mid-air recovery by a C-119J Flying Boxcar

On 18 August 1960, just over a week after the successful launch of Discoverer-XIII, Discoverer-XIV blasted into orbit, this time with a camera on board. The film capsule produced some 3,000 feet of film with photography of more than 1,650,000 square miles of Soviet territory. This time, the recovery operation worked perfectly: a C-119 piloted by Capt. Harold E. Mitchell USAF snagged the capsule on the third try. The film was flown to Moffet Naval Air Station and then to a Lockheed facility to be opened. Transferred to an unmarked container, it then went to Eastman-Kodak's Hawkeye Facility in Rochester, New York for developing. The processed film then was delivered to CIA's Photographic Intelligence Center and other intelligence community consumers.

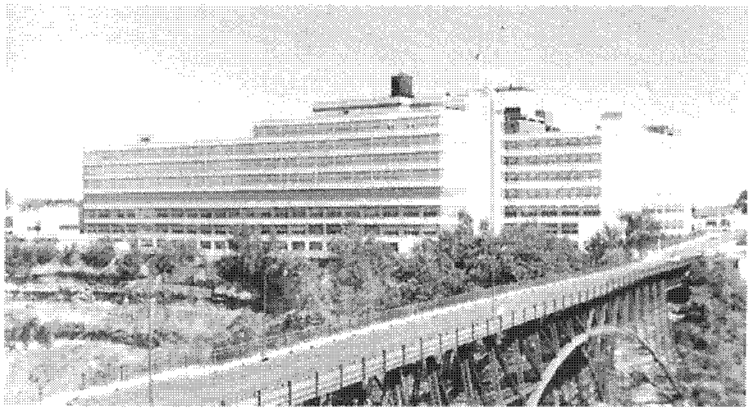

Figure 8. Eastman-Kodak's Hawkeye Film Processing Facility, Rochester, New York

Analysts viewing the film pronounced it, "terrific, stupendous."[10] Ground resolution was low: about 30 meters, but coverage was both comprehensive and synoptic, encompassing the whole of the Soviet Union. The satellite made a total of nine passes, covering targets ranging from Komsomolsk in the far east to Poland, Hungary, and Romania in the west. The very first satellite intelligence image of the Soviet Union was a misty, almost unearthly photograph of the bomber base at Mys Shmidta, in the far northeastern corner of the USSR. The satellite also photographed Kapustin Yar Missile Test Range, Sarova Nuclear Weapons Research and Development Center, 20 SA-2 surface-to-air missile sites, several new airfields, and numerous urban-industrial complexes. On the seventh pass, the shattered remains of Volgograd (the former Stalingrad) slid into view.

There then followed the sobering experience of three failed missions before Discoverer-XVIII repeated and expanded on the success of Discoverer-XIV. Already resolution was improving: Discoverer-XVIII ground resolution was 20 percent better than that of Discoverer-XIV.

[10] National Reconnaissance Office, *The Corona Story,* p. 59.

The 18th mission also carried twice as much film, returning coverage of 3,800,000 square miles of Soviet territory.

Figure 9. Photographic Intelligence Center (Steuart Building), 1960

Corona and National Intelligence

Unquestionably, Corona's finest hour came during the first year of its existence. Corona became operational at the height of the "missile gap"—a five-year period in which the intelligence community, concerned by Soviet successes in space and in medium and intermediate range ballistic missiles, believed that the Soviet Union was substantially ahead of the United States in development of an ICBM force.

Under the baleful eye of Corona, the missile gap withered away. Whereas in 1959 and 1960 National Intelligence Estimates credited the Soviet Union with as many as 300 operational ICBMs, Corona imagery in 1960-61 whittled that number down to 25. Before another year had passed, we knew that the Soviet ICBM force numbered exactly four operational missiles. Corona had burst the bubble of Soviet nuclear supremacy.

Figure 10. The first-ever satellite reconnaissance photograph: Mys Shmidta bomber base, 18 August 1962

Far more important than the initial success in debunking the missile gap, however, was the more intangible assurance that regular coverage of the Soviet Union provided policymakers in Washington. With satellite coverage of the Soviet Union becoming regular over 1962, many of the uncertainties that had characterized CIA's military analysis of the Soviet Union melted away. Whereas five years previously it had been difficult, if not impossible, to reach agreement on the number of deployed bombers and the pace of production, a year after the advent of the Corona system the missile gap was a closed issue, and detailed discussion was being presented on the extant Soviet ICBM order of battle and the pace and scope of Soviet ICBM programs.

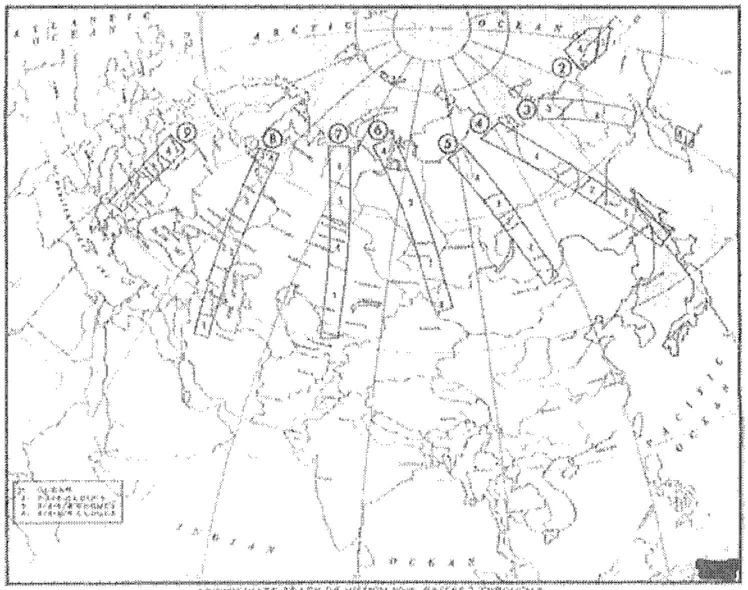

Figure 11. First Corona coverage of the Soviet Bloc

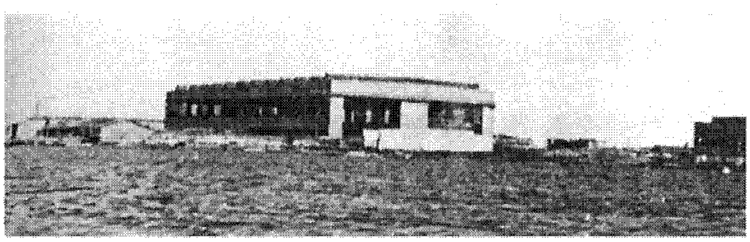

Figure 12. National Reconnaissance, 1940: Severodvinsk (Molotovsk) Naval Shipyard 402—photograph taken either from a boat in the water, or from Yagri Island, directly offshore.

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By the end of 1963, the Agency had identified satellite photography as "By far our best source" of intelligence on the Soviet Union, providing "...solid information which otherwise has not been available to US with the single exception of U-2 photography...."

> The usable satellite photography...has given US solid coverage of all of the large cities, all but one of the key submarine bases, all of the heavy bomber bases, and...of the rail network of the USSR...and the ICBM launching complexes.

Severodvinsk Shipyard, USSR, 10 February 1969

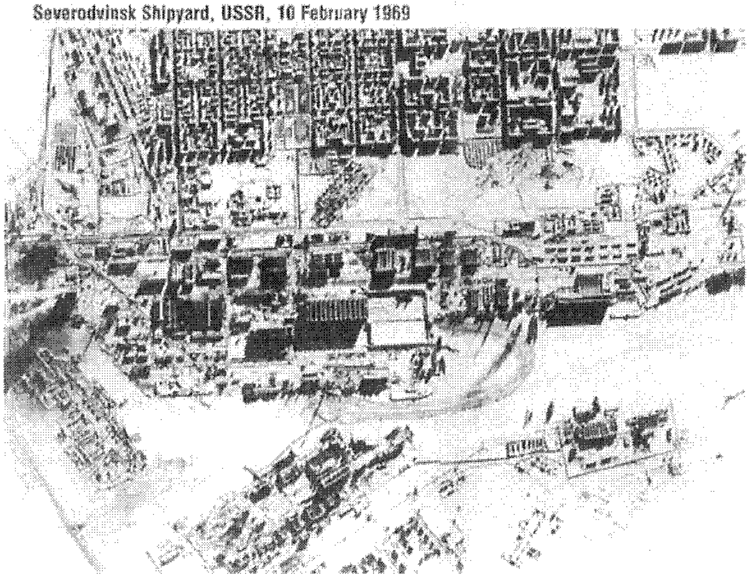

Figure 13. National Reconnaissance, 1969: Severodvinsk Naval Shipyard 402.
The building shown in Figure 12 is the large structure directly in the center of this photograph. Snow covers everything, while ice obscures the difference between land and sea. What appear to be road marks in the lower center of the photograph were actually made by the passage of several vessels through the ice.

The continuity derived from repeated photographic coverage gave a "high degree of confidence" to CIA estimates of "the scale and pace of most Soviet strategic weapons programs." This was particularly important in the mid-1960s, as the US intelligence community had to cope with tightened Soviet security measures following the arrest of Col. Oleg Penkovsky, the CIA's agent inside Soviet Military Intelligence.[11] In what perhaps was the most eloquent tribute to the value of satellite photography, CIA abandoned aerial reconnaissance of the Soviet Union, turning over its remaining U-2s to the Air Force. Likewise, in November 1965, CIA told the White House that the Oxcart program, successor to the U-2, was not necessary for missions against the Soviet Union. Oxcart, or the A-12, is perhaps best known, in its USAF configuration, as the SR-71.

It is difficult to overstate the importance of satellite photography to the US intelligence community. The rigorous security regime that blanketed the USSR meant vast swaths of Soviet territory were terra incognita to western observers. This included Severodvinsk Shipyard 402 (also called Molotovsk Shipyard), the largest submarine production facility in the world. Before Corona, the only glimpse of Severodvinsk was a hazy prewar photograph. Imagery from Corona exposed the whole of the shipyard in considerable detail. Photography of this quality became the staple of US intelligence for the remainder of the Cold War.

A Pivotal System

Film-return photo-reconnaissance satellites remained the mainstay of US overhead reconnaissance until the mid-1970s. The last Corona satellites were launched in 1972. On 20 January 1977, President Gerald R. Ford declared the first electro-optical imaging system operational. The days of the film-return satellite were numbered.

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[11] CIA Briefing to the National Security Council, 5 December 1963; MORI:-14454; pp. 5-6.

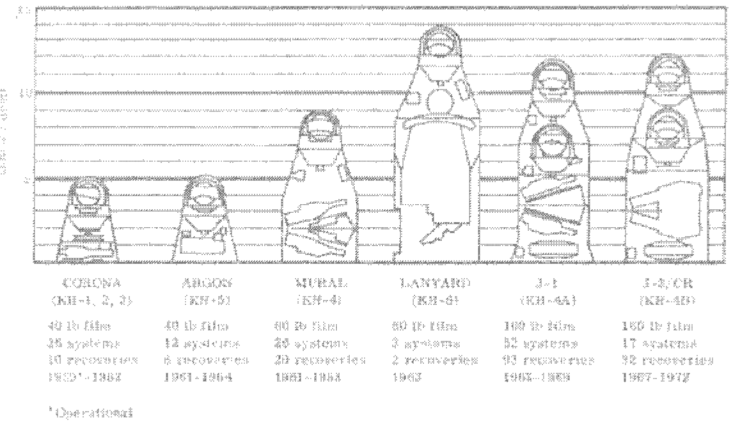

Figure 14. Corona satellite camera configurations

Corona had been the principal US photo-reconnaissance satellite through a crucial decade in the history of the Cold War. When the first Corona film capsule returned to earth, the confrontation between East and West was heating up and the Soviets appeared to be ahead in the space race. By the time Corona ceased operations, the Soviet Union and the United States had united in détente and a new generation of satellites was ready to monitor the Strategic Arms Limitations Agreement. The scale of what is now possible with recent technologies now makes the film return systems of the 1960s and 1970s seem almost quaint, but nothing can detract from their pioneering spirit or the vital contribution they made.

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