Center for the Study of National Reconnaissance Classics

THE CORONA STORY

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CENTER FOR THE STUDY OF
NATIONAL RECONNAISSANCE
CHANTILLY, VA

SEPTEMBER 2013

Other Publications from the Center for the Study of National Reconnaissance (CSNR) in the CSNR Classic Series*

The Gambit Story by Oder, C. E., Fitzpatrick, J. C., & Worthman, P. E. (original classified "Blue Book History" edition, 1991). CSNR Classic publication, 2012, U.S. Government Printing Office, ISBN: 978-1-937219-05-5, with an Introduction and an added section that has two additional Gambit documents and KH-8 imagery selected and compiled by James D. Outzen, NRO Historian.

Hexagon (KH-9) Mapping Camera Program and Evolution, by Burnett, M. (original classified version published 1982). CSNR Classic publication, 2012, U.S. Government Printing Office, ISBN: 978-1-937219-08-6, with an added section of KH-9 imagery selected and compiled by James D. Outzen, NRO Historian.

The Hexagon Story, by Oder, C. E., Worthman, P.E., et. al. (original classified "Blue Book History" edition, 1992). CSNR Classic publication, 2012, U.S. Government Printing Office, ISBN: 978-1-937219-06-2

A History of the Hexagon Program—The Perkin-Elmer Involvement, by Chester, R. J. (original classified version published 1985). CSNR Classic publication, 2012, U.S. Government Printing Office, ISBN: 978-1-937219-07-9; with an added section of KH-9 imagery selected and compiled by James D. Outzen, NRO Historian.

A History of Satellite Reconnaissance—The Robert L. Perry Histori*es*, by Perry, R. L. (original draft manuscript prepared 1973). CSNR Classic publication, 2012, U.S. Government Printing Office, ISBN: 978-1-937219-11-8, compiled and edited and with an Introduction by James D. Outzen, NRO Historian.

A History of Satellite Reconnaissance: The Perry Gambit & Hexagon Histories, by Perry, R. L., (original draft manuscript, 1973). CSNR Classic publication, 2012, U.S. Government Printing Office, ISBN: 978-1-937219-03-1.

* The CSNR Classic Series is a collection of occasional CSNR publications from the past that are about classic stories, and lessons from the Intelligence Community's experiences in national reconnaissance. The CSNR issues publications in the series both in connection with a significant event or on an *ad hoc* basis. The purpose is to inform readers of classic issues from the past.

Foreword

This volume re-publishes the 1988 NRO book, The Corona Story, as part of the Center for the Study of National Reconnaissance's (CSNR) Classics series. The Classics series is a collection of occasional CSNR publications of the past that are about lessons from the Intelligence Community's experiences in national reconnaissance, and often have a special significance in NRO's past. The purpose of the series is to inform our readers about classic issues from NRO's heritage. The Corona Story is particularly significant for two reasons: It has a unique status as a "Blue Book History", and it is a historical resource that played an important role during the declassification of the Corona program.

The Corona Story is the first volume in the notable NRO Blue Book History series that former Deputy Director of the NRO, Jimmie Hill sponsored during the time when the NRO had no formal program to study the discipline of national reconnaissance. Even though the NRO did not have a historian, and there was no Center for the Study of National Reconnaissance, former Deputy Director of the NRO, Jimmie Hill, had the foresight and commitment in 1984—twelve years after the closing of the program—to preserve NRO's Corona legacy and formed an ad hoc team of three individuals—Frederic E. E. Oder, James C. Fitzpatrick, and Paul E. Worthman—all of whom had first-hand knowledge, to document Corona's story. This volume represents the beginning of what would evolve into a formal NRO history program.

Eleven years later in 1995, The Corona Story took on a new meaning as an authoritative resource in telling the Corona narrative in a very public way through two unclassified publications. During the 35th anniversary commemoration of Corona, when President William Clinton declassified Corona imagery and DNRO Jeffrey Harris declassified Corona programmatic information, this book became a key resource for the drafting of two publications that were part of that commemoration. As part of announcing the declassification decisions and commemorating Corona's anniversary, the American Society for Photogrammetry (ASPRS), in cooperation with the NRO, published a highlight article about Corona in the June 1995 issue of its journal, Photogrammetric Engineering & Remote Sensing, and then followed with the ASPRS book, Corona Between the Sun and the Earth. The Corona Story, was one of the key, then classified, resource documents, that informed the drafting of those ASPRS publications. Now in this CSNR Classics edition of The Corona Story, you can read many parts of the story that were classified at the time.

The authors researched and wrote their history during what some observers might describe as the height of the Cold War, from 1964 to 1985. This influenced them to react to and focus heavily on the threat from the former Soviet Union and its allies. But more importantly, because the authors had first-hand knowledge about the program, the book gives you a window into what it was like to be a participant-observer in the development and operation of fi lm-return satellite photoreconnaissance systems during the Cold War.

Dr. James D. Outzen, the NRO Historian and Chief of the CSNR's Historical Documentation & Research Section, has included a brief preface in this volume to provide some context. His introductory comments review some of the history of the Corona program and explain the Air Force and CIA involvement with the Corona and follow-on film-return programs as they became operational and matured.

When you read The Corona Story you will note that some information still is missing. Even though the Director of the NRO authorized the declassification of almost all the programmatic information about the film-return satellite reconnaissance programs (i. e., Corona, Gambit, and Hexagon), some information, because of its potential impact on current intelligence sources and methods, remains classified.

Robert A. McDonald, Ph.D.

Director
Center for the Study of National Reconnaissance

The U.S. Government developed the Corona photo-satellite reconnaissance system initially as a program to fill the intelligence void left by the anticipated suspension of U-2 overflights of the Soviet Union, which actually occurred after the downing of Gary Powers aircraft in May 1960, and the inability to deploy an operational Samos television-based photographic satellite program. Samos subsequently experienced many developmental challenges, and with the loss of U-2 overflight operations, that eventually left Corona as the nation's sole means of photoreconnaissance after its successful launch in August 1960. The Intelligence Community expected Corona to serve the nation for approximately two years before being replaced by the more sophisticated systems under development in the Air Force's Samos program. It turned out that Corona served the nation for 12 years before being replaced by Hexagon.

Hexagon began as a Central Intelligence Agency (CIA) program with the first concepts proposed in 1964. The CIA's primary goal was to develop an imagery system with Corona-like ability to image wide swaths of the earth, but with higher resolution. Such a system would afford the United States even greater advantages monitoring the arms race that had developed with the nation's adversaries. The system that became Hexagon faced three major challenges. The first was development of the technology, which was eventually overcome by the Itek and Perkin-Elmer Corporations. The second was bureaucratic, deciding how the CIA and Air Force would cooperate in building such a system because they each had strengths and weaknesses in the development of national reconnaissance systems. The third challenge was to secure the resources that were required to build the most complicated and largest reconnaissance satellites at the time. By 1971, the NRO overcame the challenges to successfully launch the Hexagon satellite and fulfill, or even exceed, expectations for unparalleled insight into capabilities of US adversaries.

In 1963 the Gambit system already had joined Corona and was providing significantly improved resolution for understanding details of those targets. Corona, until Hexagon, provided search capability, and Gambit provided surveillance capability, or the ability to monitor the finer details of the targets

For many technologies that prove to be successful, success breeds a demand for more success. Once consumers of intelligence—analysts and policymakers alike—were exposed to Corona and Gambit imagery; they demanded more and better imagery. Consequently, the Air Force, who operated the Gambit system under the auspices of the NRO, entertained proposals for an improved Gambit system shortly after initial Gambit operations commenced. They received a proposal from Gambit's optical system developer, Eastman Kodak, for three additional generations of the Gambit system. Ultimately the Air Force settled on only developing the proposed third generation because the proposed second generation offered minimal incremental improvement and the fourth generation appeared technologically unachievable at the time. The third generation became known as Gambit-3 or Gambit cubed while it was under development. Once it replaced the first generation, it simply became Gambit. The new Gambit system, with its KH-8 camera system, provided the United States outstanding imagery resolution and capability for verifying strategic arms agreements with the Soviet Union.

The United States developed the Gambit and Hexagon programs to improve the nation's means for peering over the iron curtain that separated western democracies from east European and Asian communist countries. The inability to gain insight into vast "denied areas" required exceptional systems to understand threats posed by US adversaries. Corona, as the first imagery satellite system, had paved the way to see into those areas.

Coinciding with the commemoration of the 50th Anniversary of the National Reconnaissance Office (NRO), the Director of the NRO, Mr. Bruce A. Carlson, publicly announced the declassification of the Gambit and Hexagon imagery satellite systems on 17 September 2011. The Gambit and Hexagon program declassifications were possible because of the 1995 declassification of the Corona

program—the first of the United States' reconnaissance satellite programs to be declassified. The Gambit/Hexagon declassification constituted the NRO's single largest declassification effort in its history. The Gambit and Hexagon programs were active for nearly half of the organization's history by the time of the declassification announcement. Their history, along with Corona's history, very much represents the NRO's history—one that is defined by supremely talented individuals seeking state of the art space technology to address difficult intelligence challenges

At the time of DNRO's Carlson's announcement, the CSNR issued a collection of six Gambit-Hexagon histories as the initial publications in the CSNR Classics series. The Corona Story becomes the seventh volume that CSNR is publishing in the series as a consequence of the 2011 declassification efforts.

Like the earlier published The Hexagon Story and The Gambit Story, The Corona Story was written by Frederic Oder, James Fitzpatrick, and Paul Worthman. Since their publication these histories have served as a critical reference for the Corona, Gambit, and Hexagon programs, alongside the work of Robert Perry. Oder, Fitzpatrick, and Worthman each had varied and rich backgrounds in Air Force national reconnaissance programs that provided a strong foundation for researching and writing the histories of satellite imagery programs. These authors have preserved the essential history of the programs.

Like the other histories written by these authors, The Corona Story is very rich in detail. The authors carefully document the Air Force's involvement in the program with the CIA. Like their other histories, the authors also include a wide range of summary tables and information including details of each launch, companies and personnel involved in the launches, photographs and illustrations, and the capabilities of the systems. The history is well-documented and sourced.

Since the authors' backgrounds are in national reconnaissance programs—and primarily in the Air Force element of the NRO—they offer unique insight into the Air Force's perspectives on the development, controversies, and management of the Corona program. Like with their Hexagon history, if there is one shortcoming of this program history, it is the authors' minimization of the CIA's development and management of the Corona program.

The Corona system became the United States first reliable means for addressing difficult intelligence challenges once it became operational in 1960. It provided the nation with the first broad area imagery that was essential for understanding the strategic capabilities and arms control compliance of the Soviet Union and other Cold War adversaries. These national reconnaissance systems dutifully provided the nation reliable vigilance from above until the next generation of imagery satellites advanced the United States' intelligence collection capabilities.

James D. Outzen, Ph.D.

Chief, Historical Documentation and Research
The Center for the Study of National Reconnaissance

Center for the Study of National Reconnaissance

The Center for the Study of National Reconnaissance (CSNR) is an independent National Reconnaissance Office (NRO) research body reporting to the NRO Deputy Director, Business Plans and Operations. Its primary objective is to ensure that the NRO leadership has the analytic framework and historical context to make effective policy and programmatic decisions. The CSNR accomplishes its mission by promoting the study, dialogue, and understanding of the discipline, practice, and history of national reconnaissance. The CSNR studies the past, analyzes the present, and searches for lessons-learned.

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Internet: bookstore.gpo.gov Phone: toll free (866) 512-1800; DC area (202) 512-1800
Fax: (202) 512-2104 Mail: Stop IDCC, Washington, DC 20402-0001

ISBN: 978-1-937219-13-0

Published by

National Reconnaissance Office
Center for the Study of National Reconnaissance
14675 Lee Road
Chantilly, Virginia 20151-1715

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The CORONA Story

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Preface

In the decade following the conclusion of World War II, US defense planners were severely hampered by the USSR's Iron Curtain, which stood as an almost impenetrable barrier to routine information-gathering. Counteractions, such as high-flying reconnaissance aircraft and camera-carrying balloons, were attempted, but were, at best, last-resort expedients, providing a thin trickle of useful information.

The war in Korea, the appearance of the Soviet long-range BISON bomber, and the test of a Soviet hydrogen bomb in 1953 further accentuated and aggravated national concern. In 1955, President Dwight D. Eisenhower recommended a possible solution: the "Open Skies" proposal which would serve as an essential basis for mutual arms control. He was shocked and saddened by Soviet Party Chief Nikita Khrushchev's opposition to his offer; Eisenhower's memoirs cite this event as convincing evidence of a firm Soviet stance on preserving a closed society.

Although it had been a strong wartime ally, now that the emergency had passed, the USSR was drawing farther away from the rest of the world, setting up puppet governments in occupied Europe, and destabilizing neighboring territories in an effort to extend the communist power base. The United States, as the undisputed leader of the free world, would be dealing with the Soviet Union and its satellites on an entirely new basis. More than ever before, US policymakers would need timely, comprehensive, and accurate knowledge of events behind the Iron Curtain.

In 1958, Eisenhower set in motion a new, independent attempt to counter the effects of the Iron Curtain. It was a daring attempt, not only politically, but technically, for it was to be based on aborning space technology—a realm in which speculative hypothesis had not yet given way to trustworthy data or proven hardware.

The attempt was given two names. The public christening announced Discoverer—a satellite for gathering much-needed scientific information on the earth's atmosphere (out to perhaps 125 miles). At a more private ceremony, however, the name CORONA was pronounced, accompanied by expressions of fervent hope that the satellite would provide much-needed photographic reconnaissance of the earth's closed societies.

This volume is not the first account of the "daring venture." In 1963, Robert Perry, then with the Office of the Historian, Space Systems Division, USAF, in Los Angeles, began to collect and study documents available to the Air Force's CORONA Office and to draft an historical narrative. The final version of this work was published in 1974.

Additionally, in 1972, Carl E. Duckett, the CIA's Director for Science and Technology, directed CIA Historian Helen Kleyla to incorporate the CORONA history as an integral part of a history of the Office of Special Projects (1965-1970). This work was later expanded and published separately under the title "CORONA Program History" by the Air Force Special Projects Production Facility in May 1976.

Unfortunately, in the mid-1960s growing managerial differences between those DoD and CIA principals responsible for the program produced enough of a chill that neither of the historical offices had available to it all of the resources used by the other.

In 1984, Jimmie D. Hill, Deputy Director of the National Reconnaissance Office, observed that, with the passage of time, much of the interorganizational friction had muted. He proposed preparation of an independent history which would be based upon all existing documentary resources and would strive for a detached, analytical point-of-view. His basic maxim was that lessons learned should transcend grievances remembered.

This volume has been prepared under that sponsorship and guidance. The work was done in a warmly cooperative environment in which the complete files of the DoD and the CIA were made available and every possible form of support was enthusiastically given. Particular mention is made of the generous cooperation of [redacted] and his associates at the National Photographic Interpretation Center. [redacted] of the Graphics and Publications Division and the staff of the Photography and Printing Division gave most generously of their time and talent.

We owe thanks to the CIA's Office of the Historian and particularly to Donald E. Welzenbach for his sagacious assistance. Over and above essential basic information, he gave us access to his own monographs, some of them still in manuscript, and opened up important new perspectives on the principal participants in the program.

We are equally grateful to Robert Perry for his excellent pioneering account of the program, for the keen insight he gave us into contrasting approaches in military research and development, and for his steadfastness in completing what was, quite literally, a labor of love.

We have quoted freely and extensively from all previous histories and are honored to place this volume in their company. It seems especially appropriate, twenty-five years after the first success of that "daring attempt," to complete the story—before the colors fade.

Frederic C.E. Oder
James C. Fitzpatrick
Paul E. Worthman

November 1987
Sunnyvale, California

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Section 1

Problem: A Closed Society

The national security situation faced by the United States after World War II was unlike anything in its previous experience. While possessing nuclear-weapons capability it was soon joined in that arena by its former ally, the USSR. The United States was clearly the power base of the non-communist world and it had to be prepared to deal with the Soviet Union and its satellites and allies. Accordingly, the US policymakers needed timely, comprehensive, and accurate knowledge of significant events on a worldwide basis in order that the United States could effectively discharge its leadership role in the world. But the Soviet Union was a closed society, a monolithic police state with a fetish for controlling news both internally and externally.

In addition to the creation of significant intelligence capability in the CIA and augmentation of related activities in the Department of Defense, a constant need was seen for means of effective collection of useful information on events within the boundaries of the large landmass of the USSR. The means to accomplish this collection were many-faceted. Some critical data could be gathered by peripheral signals-intelligence sites. Agent operation could be accomplished but was very difficult because of the controlled and compartmented nature of most significant Soviet activities. Clearly an effective means of overflight or overhead collection was needed and an initial attempt to meet this need was made by the U-2 aircraft program.

In 1946 the Department of Defense (Air Force) started a comprehensive study of the feasibility and utility of earth-circling satellites under Project RAND.* Eight years later RAND presented "an analysis of the potential of an unconventional reconnaissance method" and concluded 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 intelligence posture with respect to the Soviets." At the same time the initiation of high-priority ballistic missile programs in the United States would make possible the most difficult job of providing orbital velocity propulsion. This historical report deals with how the need for reconnaissance combined with the new technology to bring photographic reconnaissance from space into reality not as an arcane supplement to more conventional means but as the main source of imagery critical to our national security.

*RAND had come into being shortly after World War II as a study effort contracted to Douglas Aircraft. RAND was the acronym for Research on America's National Defense. One of the first studies concerned the feasibility and utility of an earth-circling satellite.

Section 2

Faith: The Space Potential

Satellite reconnaissance is best understood in light of the history of earlier overhead reconnaissance programs.

The U-2, which began operating in the summer of 1956, was expected to have a relatively short operational lifetime, perhaps no more than several years. That expectation was based less on the likelihood of the Soviets perfecting a means of shooting the U-2 down than on a pessimistic estimate of their ability to develop a radar surveillance network that could track it reliably. As it turned out, the United States misjudged the performance characteristics and deployment pattern of the Soviet air-surveillance network: their radar promptly acquired and tracked the very first U-2 flight over Soviet territory.

For nearly four years, the U-2 ranged over much of the world, although only sporadically over the Soviet Union. The effectiveness of the Soviet radar network was such that each flight risked a protest and a standdown. Clearly, some means had to be found to accelerate the development of a less vulnerable reconnaissance system. By the time Francis Gary Powers was shot down near Sverdlovsk on 1 May 1960, an alternative means of carrying out photographic reconnaissance over the Soviet Union was approaching operational readiness. On 19 August 1960, just 110 days after the sudden termination of the last U-2 Soviet overflight, a critical goal was accomplished: the first successful air catch of a capsule of exposed film. This capsule was ejected from a photographic reconnaissance satellite that had completed seven passes over denied territory and 17 orbits of the earth. The feat was the culmination of three years of intensive effort to obtain intelligence from an imagery reconnaissance satellite.

Origins of Weapon System 117L (The Advanced Reconnaissance System)

At about the time the U-2 first began overflying the Soviet Union, the US Air Force was embarking on the development of strategic reconnaissance systems employing orbiting satellites in a variety of collection configurations. The program, Weapons System 117L (WS-117L), The Advanced Reconnaissance System, had its origins in 1946, when a requirement was placed on Project RAND for a study of the technical feasibility of orbiting artificial satellites.[1] RAND was soon formed into a separate corporation (a Federal Contract Research Corporation). The first real breakthrough had come in 1953 when the USAF Scientific Advisory Board reported that it was feasible to produce relatively small and lightweight thermonuclear warheads. As a result of that report, the Atlas ICBM Program was accorded the highest priority in the Air Force. Since the propulsion required to place a satellite in orbit is about the same as that required to launch an ICBM, the anticipated availability

[1]All footnotes can be found after Section 5.

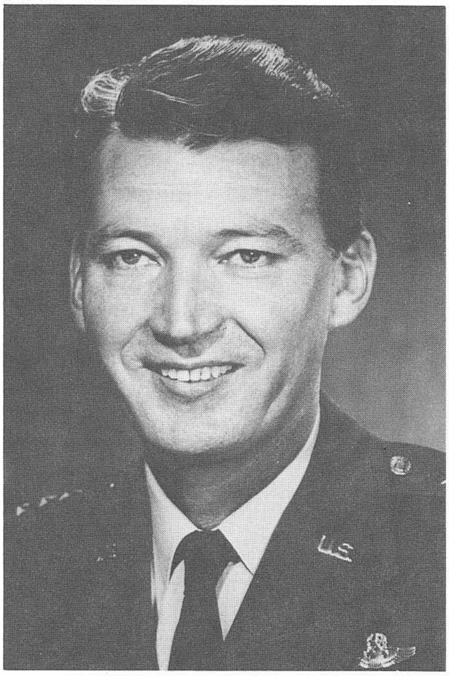
of Atlas made it possible to think seriously of launching orbital satellites. The requirement for WS-117L was established by General Operational Requirement No. 80[2] which was levied in 1954 with the stated objective of providing surveillance of preselected areas of the world to determine a potential enemy's warmaking capability.

System management responsibility for WS-117L was initially assigned to Wright Air Development Center (WADC) but, in October 1955, after preliminary study contracts had been let, the Air Research and Development Command (ARDC) transferred custody to its Western Development Division (WDD), created about a year earlier to manage the ballistic missile development. This hallmark management design was forcefully pushed by Major General Bernard A. Schriever, Commander of WDD, and was made by Lieutenant General Thomas S. Power, Commander, ARDC, over the strong objections of general officers from WADC and the ARDC staff. WDD had been established with handpicked military personnel and with special reporting channels for expediting program decisions. The close relationship between the satellite and its prospective booster, the Atlas, prompted the decision.

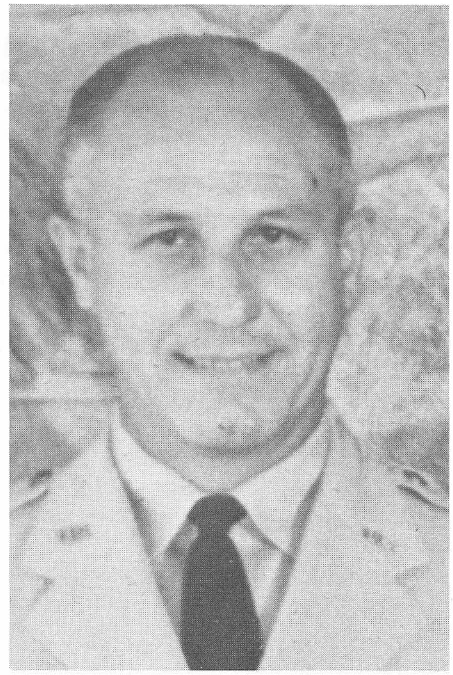
A cadre of WS-117L officers was transferred from WADC to WDD to staff the transferred System Program Office. On 2 April 1956, the WS-117L System Program Office (SPO) published the first complete development plan for a reconnaissance satellite, proposing full operational capability by the third quarter of 1963. (A plan for an "interim" satellite with "scientific" applications had been prepared in January.) Exclusive of facilities, development cost was estimated at $114.7 million. The first year of system work, fiscal 1957, would require $39.1 million. Over the preceding 10 years, $9.2 million had been expended on the program, including RAND studies and all component developments. Despite approval of the development plan (24 July 1956) and issuance of a confirming development directive (3 August 1956), the financial stringency continued; the initial fund allocation for fiscal 1957 was only $3 million.[3]

The planning for WS-117L contemplated a family of separate systems and subsystems employing satellites for the collection of photographic, electronic, and infrared intelligence. The program was scheduled to extend beyond 1965 and was divided into three phases. Phase I, a Thor-boosted test series, was to begin in November 1958 and had the primary objective of development/initial testing. Phase II, an Atlas-boosted test series, was to begin in June 1959 with the objective of completing transition from the testing phase to the operational phase and proving the capability of the Atlas booster to launch heavy loads into space. Phase III, the operational series, was to begin in March 1960 and was to consist of three progressively more sophisticated systems: the Pioneer version (photographic and electronic), the Advanced version (photographic and electronic), and the Surveillance version (photographic, electronic, and infrared). The photographic payloads (recorded on film, processed onboard and readout by a flying spot scanner) were designated E-1, E-2, and E-3; the ELINT payloads F-1, F-2, and F-3, etc. Operational control of WS-117L would be transferred to the Strategic Air Command with the initiation of Phase III.

Design studies had been solicited originally in December 1954; Lockheed Missiles and Space Division (LMSD) (teamed with Eastman Kodak), Bell Telephone Laboratories, Glenn L. Martin Company, and RCA received bid invitations.



USAF MGen Bernard A. SCHRIEVER



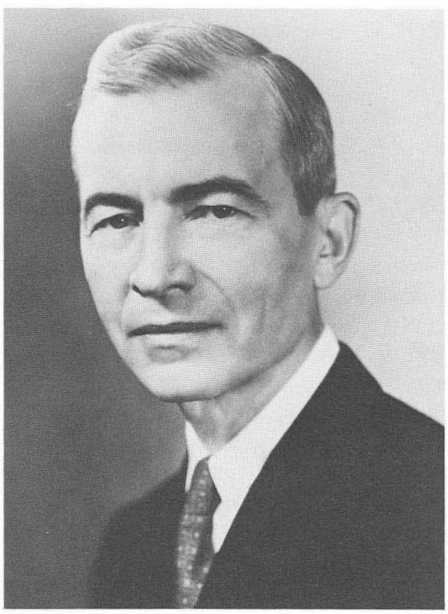
USAF LCol William G. KING

Bell declined. The Air Force funded design studies by the other three, and the trio of proposals were received by Western Development Division in March 1956. A selection board (which included as members Lieutenant Colonels William G. King and Victor M. Genez, both later to play very prominent roles in satellite reconnaissance) rated Lockheed's proposal highest and recommended its selection. The Western Development Division issued a letter contract to Lockheed Aircraft Corporation on 29 October 1956 which made Lockheed the prime contractor for WS-117L. The delay (from March to October) in letting a contract had been caused by fund shortages; even following the award to Lockheed, work could be conducted at only one-tenth the planned rate.[4]

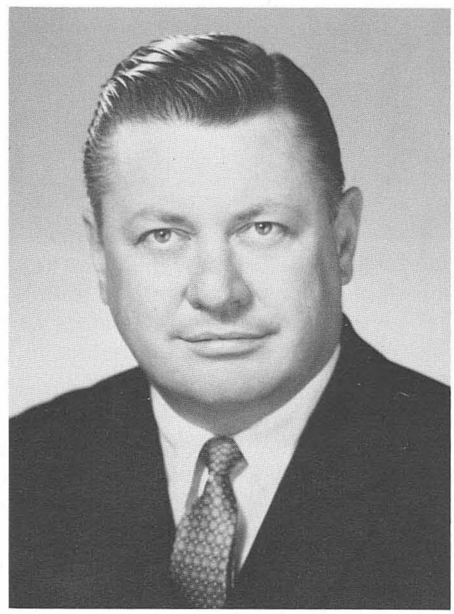
Policy Obstacles to WS-117L Development

For the next several months, efforts to secure additional funds for increasing the pace of the program were consistently unavailing. Air Force Secretary Donald L. Quarles responded to news of the contract award by ruling that neither mockups nor experimental vehicles should be built without his specific prior approval. The entire project seemed endangered by the "space for peace" theme that became a credo of US policy in 1955 and by a concurrent emphasis on cutting all "noncritical" funds from the defense budget.

General Schriever led the effort to secure further increments of fiscal 1957 funds, but the original $39.1 million request was scaled down to $24.9 million in August 1956; five months later, Air Force headquarters released enough money to bring the available fiscal 1957 funds total to $10 million. Schriever then suggested that WS-117L be employed as a "backup" to the Navy's faltering Vanguard scientific satellite. This brought no relief. Proposals for the use of the WS-117L satellite in the International Geophysical Year program had first been heard in 1955 but had been repeatedly rejected on the grounds that it was contrary to national policy to use military hardware in "peaceful" space programs. In April 1957, a final increment of $3.9 million was released to the Western Development Division, raising the total available for fiscal 1957 to $13.9 million. The prospect that no more than $35 million would be provided for fiscal 1958, against a "minimum requirement" for $47 million, cast further gloom on the program.



Air Force Secy Donald L. QUARLES



Richard S. LEGHORN

Two obstacles confronted Schriever: Quarles' attitude and the quixotic "space for peace" homily that so fascinated the Eisenhower administration. On the face of it, the "space for peace" theme did not conflict with a doctrine of "open skies" then being pushed within the Eisenhower administration. The "open skies" concept, which originated with Richard S. Leghorn, a reserve Air Force Colonel who later founded the Itek Corporation, held that the United States and the Soviet Union could best assure world peace by allowing free passage of each other's reconnaissance vehicles over any part of the globe. Quarles was not actively hostile to the satellite program as such, but had developed strong views about reliability and using low-risk technology, and he took very seriously the administration's commitment to eliminate "non-critical" defense expenditures. The technology to be embodied in the WS-117L satellite was largely unproven; no satellite had even been orbited, and

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little was known of problems that might arise in a weightless, airless environment. Nor was the need for satellite overflight generally acknowledged. To budget-conscious pragmatists, therefore, the entire thesis of satellite reconnaissance seemed shaky. In such reasoning Quarles found ample justification for his stubborn refusal to approve the start of a meaningful development program. He was more willing to allow relatively low-cost studies to proceed—but further he would not go. The fact that the administration was wrestling with a growing financial crisis, which later that year would cause it to postpone payments on defense contracts in order to relieve pressure on the established national debt limit, gave additional weight to the arguments of the economy bloc.

Perhaps equally critical to the future of the WS-117L program was the intransigence of administration advisors on the "space for peace" policy. The difficulty was not a simple one. In many respects it stemmed from the mid-1955 decision that the United States would participate in the International Geophysical Year satellite activity but that such participation would be limited to non-military "hardware." Whatever the public relations merit of this policy, it effectively eliminated ballistic missiles from consideration as space boosters and encouraged independent development of a system like Vanguard.

Open Skies

Although not clearly drawn, the "peaceful" issue stemmed from uncertainty about the legality, under international law, of satellite operations. As long as policymakers in the national military establishment doubted the technical feasibility of satellite operations, they were spared the need to consider how passage over national borders affected space operations. Even when technical feasibility was conceded, the absence of a realistic, funded development program made such discussions academic. It is not surprising, therefore, that concern for the jurisdictional complications that might arise from satellite operations was largely confined to a small circle of space flight devotees and to a few specialists in international law. With minor exceptions, most secretariat-level policymakers considered the entire subject a waste of time and money. The idea of introducing paramilitary vehicles into space, particularly if they were to have known reconnaissance capability, ran counter to instincts of the State Department and hence of the administration.

The Air Force and the RAND Corporation, along with professional societies, had addressed the issue of space flight and international law without conclusive results. There were no precedent cases and attempts to use maritime or aircraft analogies were unconvincing.

In July 1955, as part of a determined US effort to arrive at a technique of arms control acceptable to the Soviet Union, President Eisenhower proposed "mutual air reconnaissance" as a means of policing international disarmament. A somewhat similar concept had been embodied in the 1946 "Baruch Plan" for international control of nuclear weapons. Predictably, the Soviet Union endorsed the idea "in principle" but found excellent reasons for opposing its application. The traditional Soviet deference to "airspace sovereignty" was unquestionably a factor. Yet three months earlier, in April 1955, the Soviets had openly announced their intention of orbiting various scientific satellites and had identified "photographic equipment" as a portion of the proposed cargo. The United States followed suit, in July 1955, with an announcement of its own scientific satellite.

The USSR's obvious mistrust of the original Eisenhower inspection proposal convinced Leghorn that negotiating a mutually acceptable "open skies" inspection agreement with the Soviets would be "virtually impossible." Assuming that WS-117L eventually would be funded at a respectable level and thus would lead to an operationally eligible reconnaissance satellite by 1959-60, Leghorn suggested that the WS-117L or a similar vehicle be used for covert overflights of the Soviet landmass. In July 1956 he updated his earlier paper and sent a copy to Schriever.

By 1955, overflight, whether covert, overt in the face of Soviet protests, or openly conducted under the sponsorship of some international agency, was very nearly an essential of national security for the United States. Like espionage, overflight was a customary, if seldom acknowledged, instrument of peacetime military activity. The closed and police state nature of the Soviet Union made classical human agent collection very difficult. While peripheral sites were effective for some types of collection, the realities of the situation put even greater emphasis on overflight to provide information vital to the United States. Incidents involving both Soviet and American aircraft were common to the fringes of both the iron and bamboo curtains during the late 1940s. Neither side ever admitted a deliberate policy of aerial espionage, but its existence was indisputable. Aircraft range limitations and vulnerability to conventional air-defense measures made deep penetrations of Soviet airspace infrequent and dangerous. The enormous breadth of the Soviet Union diluted the worth of shallow penetrations. Some indication of the value of border-to-border passes was provided by a succession of unmanned balloon photographic reconnaissance overflights conducted under a covert program known as GENETRIX during a period in January and February 1956. Although the United States consistently denied a GENETRIX overflight intention, the effort was canceled because of the violence of Soviet protests (which were heightened by the fact that similar balloons were used to release propaganda materials deep behind the Iron Curtain).

A determined effort to use aircraft reconnaissance capability (with a potential for greater selectivity and accuracy than the random-path balloon operations) had begun in 1954. It included the "big wing" B-57D aircraft and the still-embryonic joint CIA-USAF U-2 as well as studies of more ambitious ultra-high-altitude winged vehicles, both manned and unmanned.

Leghorn's endorsement of satellite reconnaissance was based on the thesis that an orbiting camera would be more difficult to disable than cameras carried in balloons and aircraft. Also, his thesis provided that an unpublicized series of successful satellite reconnaissance flights might reasonably be followed by a discreet diplomatic approach to the Soviet Union, the presentation of copies of the reconnaissance imagery, and a private agreement that the Soviets were free to reap any propaganda credit they chose if they would but propose interference-free satellite inspections as an international *modus vivendi*.

Although Leghorn's ideas were well known to both Schriever and his WS-117L chief, Colonel Frederic C. E. Oder, they were of little more than academic interest until the spring of 1957. Then the funds crisis, the increasing frustrations with the "space for peace" theme, Quarles' natural conservatism, and general Defense Department coolness toward "space research" drove Schriever and Oder to consider all conceivable alternatives to the "normal" development cycle they had been pursuing.

While such deliberations were continuing, General Schriever made yet another effort to secure needed funds through established channels. The first annual revision of the WS-117L development plan went forward in April of 1957, but within a matter of weeks it had become apparent that in fiscal 1958, as in previous years, the program would probably be funded at a level well below that considered acceptable by program managers. The existing development plan called for initial launchings during 1960 and full operational status five years later, but that schedule was totally dependent on finding money to support accelerated development during fiscal 1958.

President Eisenhower had for some time been concerned about the United States' ability to know with certainty what was going on in the Soviet Union and had convened major study efforts on this problem. (One of them, the Beacon Hill Study, led to the U-2 aircraft.) Certain key advisors fell into a continuing relationship with Eisenhower, in particular, James R. Killian, Jr., president of MIT, and Lieutenant General James Doolittle, a retired Air Force officer, who had led the famous Tokyo raid, and had been close to Eisenhower since World War II.

USAF Col Frederic C.E. ODER

USAF BGen Osmund RITLAND

In mid-June 1957, General Schriever met with the President's Board of Consultants on Foreign Intelligence Activities (PBCFIA), headed by MIT's Dr. Killian, to rejustify the status of the satellite reconnaissance program, the critical need for satellite-obtained intelligence, the advantages of a military over a civilian-managed approach, and the rationale for continued Air Force conduct of the program. Shortly thereafter, the increasingly grave financial crisis obliged the WS-117L Project Office to submit a revised development plan that incorporated an "austere" as well as a "desirable" budget request. By late July, spending ceilings had been imposed which limited Lockheed to a maximum of $4.8 million for the first half of the fiscal year and to a possible total of $10 million for the entire year. Colonel Oder had earlier defined a $46.9 million requirement as the minimum needed to maintain hopes for a first launching by 1960.[5]

An Alternative: 'Second Story'

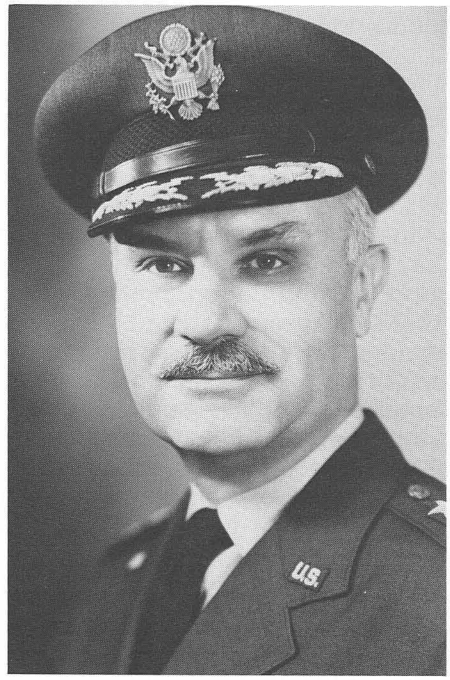
Well in advance of official notification that program funds would be virtually nonexistent during fiscal 1958, Colonel Oder had informally proposed to General Schriever an alternate approach called 'Second Story.' (Colonel Oder's secretary invented the name to identify the file of working papers which had to be kept apart from other WS-117L documents. 'Second Story' implied a cover legend rather than an upper floor.) 'Second Story' evolved because Schriever's deputy, Brigadier General Osmund Ritland, had previously worked closely with the CIA as U-2 project officer and Oder had been assigned to CIA before he came to work for Schriever. This concept was built around three preconditions: covert overflight; participation of the Central Intelligence Agency (CIA); and program acceleration. It involved an announced cancellation of the WS-117L program, an overt establishment of an Air Force scientific satellite project as a follow-on to the marginally-limited Vanguard, and covert reestablishment of the reconnaissance program under overall cognizance of the CIA, with the Western Development Division retaining technical management responsibilities.

Early in August 1957, it was generally believed that the Soviets would orbit a scientific satellite somewhat larger than Vanguard but probably smaller than the WS-117L vehicle. If that assumption were accepted, adoption of the 'Second Story' approach would leave undisturbed the official "space for peace" motif, would permit the eventual accumulation of significantly more scientific data than Vanguard could collect, would demonstrate the continuing technical superiority of the United States, and would still permit the collection of highly useful intelligence information.[6] It seemed to have some attraction for everybody concerned.

Sporadic attempts to obtain relief from the WS-117L expenditure ceiling during the late summer of 1957 were repetitiously unsuccessful. Early in September, Lieutenant General Donald L. Putt, Air Force Deputy Chief of Staff, Development, secured permission for the start of work on a mockup of the Lockheed upper-stage vehicle and for fabrication of hardware items that had to be purchased well in advance if an experimental satellite were to be flown during 1960. But restatements of the fiscal 1958 funding requirements, and their endorsement by the Air Council, had no effect. The purse remained closed.

The satellite program was not alone in that situation. Virtually every major development effort, including ballistic missiles, was affected. Expenditure limitations were imposed on all major military programs so that the administration would not be forced to ask Congress for a higher ceiling on the national debt, a possibility which the Treasury Department viewed with considerable distaste, particularly in an election year.

**Richard M.
BISSELL, Jr.**



**USAF LGen Donald L.
PUTT**

In such circumstances, 'Second Story' offered perhaps the only realistic hope. Its key was ostensible conversion of the existing WS-117L effort into a scientific satellite program to provide cover for the real program. General Schriever tentatively approved an action schedule which called for General Putt to "request" and BMD to submit a new scientific satellite proposal before 1 September. Assuming unimpeded flow of subsequent actions, the covert program would come into being several weeks later, side by side with the "scientific satellite" that had "replaced" the WS-117L.

The necessary ingredients, as Oder and Leghorn saw it, were: presidential confirmation of a high priority, followed by adequate funding; approval of the political approach; and, finally, cancellation of WS-117L and substitution of either a clandestine or a "very secure" Air Force reconnaissance satellite program.

The schedule Colonel Oder had proposed early in August proved impossible to maintain, but before the end of the month Schriever had briefed Dr. Killian and had related the total scheme to Brigadier General Andrew J. Goodpaster, the President's Staff Secretary, and others at the White House level. Later in August, Ritland and Oder approached Richard M. Bissell, Jr., assistant to DCI Allen W. Dulles, and his associates in the Central Intelligence Agency.[7]

The 'Second Story' proposal had been entirely concocted within Schriever's own organization and had not thus far been introduced into "normal" channels. General Putt and his immediate aides had been the principal contacts in Air Force headquarters. Through Putt, Schriever scheduled a formal meeting with State and CIA for late September, by which time he planned to have the 'Second Story' proposal in a form suitable for official submission.

While in the Pentagon on 10 September, General Schriever signed a letter[8] to Lieutenant General Samuel E. Anderson, Air Research and Development Commander, recommending conversion of WS-117L to a scientific satellite. Colonel Oder personally took it to General Anderson that afternoon, seizing the opportunity of its delivery to brief him on the background of the proposal and its real purpose. Unfortunately for the schedule earlier mapped out, General Anderson instructed his headquarters staff to prepare and coordinate an endorsement to Air Force headquarters. For several days the ARDC staff group debated the merits of various responses and then produced an unenthusiastic letter which, in the later view of at least one 'Second Story' supporter, was worse than no response at all. (The possibility that the Anderson "endorsement" was composed by officers unaware of its actual motivation cannot be dismissed, but neither can it be satisfactorily explained. It is far more likely that Anderson's staff acted out of native dislike for a scheme that would have removed yet another major program from ARDC staff control, as had happened with the whole of the ballistic missile effort.) Consquently, the "formal" proposal Schriever had wanted Anderson to send to the Air Force Chief of Staff proved both late and ineffective.

By late September, the complications inherent in coordinating the proposals with all the authorities involved in scientific and military satellite programs had effectively impeded progress toward Schriever's goal. Early that month, he had learned of a Department of Defense decision to re-activate the "Stewart Committee" (an *ad hoc* committee under Professor Homer J. Stewart, of the California Institute of Technology established to provide oversight to Vanguard) that had recommended the original Vanguard program and had later rejected Army and Air Force backup proposals. It appeared that the Stewart Committee was to be the chief executive agency in selection of an advanced scientific satellite. In its turn, the revived Stewart Committee planned to call on the services to submit proposals for such advanced satellites; the invitation was to be issued between November 1957 and January 1958.[9]

General Schriever also learned that an "influential DoD consultant" was preparing a memorandum for William M. Holaday, the Defense Department's Director of Guided Missiles, calling for establishment of a national policy on space exploration and unfavorably analyzing the feasibility of a WS-117L scientific satellite. Arguments against the "scientific WS-117L" included the lack of agreement within the Air Force on the value of such a satellite, the security complications inherent in a scientific satellite using military hardware, and possible interference of a scientific satellite program with the military satellite effort.

Of course, the 'Second Story,' as refined, summarily disposed of such objections by transforming the WS-117L reconnaissance activity into a covert project, but advice of such a course obviously had not reached the "influential consultant." Moreover, the tenor of the pending memorandum was in agreement with existing administration policy.

In order to secure acceptance of the 'Second Story' approach, it would be necessary for the Ballistic Missile Division (WDD was renamed BMD in August 1957) to prepare a detailed scientific satellite proposal which the Air Force could present to the Secretary of Defense (thus demonstrating Air Force unity on its desirability), to plan an acceptable information release policy, and to convince all concerned (including the Stewart Committee) that a scientific variant of the WS-117L satellite would benefit the military program. It seemed unlikely that all those steps could be taken before 1 November.

Sputnik-I Breaks the Impasse

After the successful Soviet launching of Sputnik-I on 4 October 1957, and the initiation by the Senate Preparedness Subcommittee of an investigation into the US "missile lag," there was pressure from all quarters to accelerate the US missile and space program and also much public discussion of civilian versus military control of the program. Almost immediately thereafter, General Thomas D. White, Air Force Chief of Staff, told the Air Staff to drop consideration of a scientific satellite and to concentrate on accelerating the basic WS-117L program. Defense Secretary Charles E. Wilson, notoriously antipathetic to space projects, was retiring from office and his replacement, Neil McElroy, was expected to approve a substantial program expansion.

Defense Secy Charles E. WILSON

Defense Secy Neil H. McELROY

Essential funds, long delayed by dissension over the feasibility of, and the real requirement for, a reconnaissance satellite, could be expected shortly. However, a subsequent attempt to convince the then Deputy Secretary of Defense, Donald A. Quarles, that WS-117L should be accelerated was generally unsuccessful, and, under pressure from Quarles, Air Force Secretary James A. Douglas hedged his earlier approval of program acceleration. Putt, working desperately to overcome secretarial inertia, secured permission from Douglas to present the issue directly to McElroy for resolution and simultaneously urged General Anderson to submit a plan for an early Air Force "space spectacular" which would enhance the possibility of securing appropriate WS-117L funding.[10] At the same time, General White, disregarding command channels in the interest of speed, instructed BMD to propose a new ballistic missile and space program at a funding level of $300 to $500 million above the current fiscal 1959 ceiling, thus increasing the level of effort to ". . . the maximum possible in terms of technical and operational capabilities."

The optimism of the Air Staff and of General White proved justified. On 29 October, after Putt briefed him on the WS-117L program, Defense Secretary McElroy reversed the Quarles decision of 16 October and asked to be advised on how the satellite program could be accelerated. Three days later he authorized the Air Force to proceed "at the maximum rate consistent with good management."[11]

For the moment, 'Second Story' was submerged in a welter of proposals, acceleration plans, and suggestions for "interim" satellites, both scientific and military. In part because of the consternation caused by Sputnik and by immediately subsequent failures in several hasty and overpublicized attempts to orbit "something" made in the United States, WS-117L acquired the support so long withheld. But beneath the surface there flowed an undercurrent of reluctance to sponsor an open reconnaissance satellite program which, by antagonizing the Soviets, would weaken the prospect of relaxing world tensions or reaching agreement on other points at issue. Additionally, there were psychological obstacles to securing uninhibited approval of a major space program. President Eisenhower resented the inference that his administration had been lax in supporting earlier space and missile proposals, so there was continued reluctance to approve program accelerations which indicated that crash efforts were necessary to overcome earlier lapses. Finally, notwithstanding the evidence at hand, a conviction persisted at high levels that the entire space program was more a matter of public relations than of engineering, and that nothing useful could come of an investment in satellite development.[12]

Even though WS-117L had finally been approved and funded, much remained to be done before the United States acquired a satellite reconnaissance capability. It was an ambitious and complex program that was pioneering in technical fields about which little was known. The program suffered from insufficient funding, and, not surprisingly, it had become apparent, by the end of 1957, that the program was running behind schedule. It also was in trouble from the standpoint of security. The U-2 program had been carried out in secret from 1956 until May 1960. The Soviet Government knew about it, of course, but chose to allow it to remain secret from the general Soviet public (and from most of the official community) in preference to publicizing its existence and thereby admitting that they lacked a means of defending their airspace against a high-flying aircraft. WS-117L was undertaken as a classified project, although its existence was not concealed. Program details were reported to, and approved by, Congress. The press soon began publishing stories on the nature of the program, correctly identifying it as involving military reconnaissance satellites, and referring to it as "Big Brother" and "Spy in the Sky."

There was a related consideration that affected the views of Schriever and his people at that time. Air Force plans were that WS-117L as a "weapon system" would be operated by the Strategic Air Command (SAC); a Weapon System Phasing Group had been formed to plan the transition from BMD to SAC. It had become clear to Schriever, Ritland, Colonel W. A. ("Red") Sheppard, BMD Plans Chief, Oder and Major Raymond Zelenka, WS-117L Plans Chief, that satellite launching and operation would have a high engineering content. Such skills were not forseeably available within the Air Force and even contractors would be stretched by the demands and would be required to participate in the operational phase of the program to a degree that would be inconsistent with SAC policy. This was another reason for WS-117L to be managed in a nonstandard fashion.

Against this background, the President's Board of Consultants on Foreign Intelligence Activities submitted its semiannual report to the president on 24 October 1957. The Board noted that it had considered two advanced reconnaissance approaches. One was contained in a study then in progress in the CIA concerning a manned reconnaissance aircraft designed for greatly increased performance and reduced radar cross-section; the other was WS-117L. Killian had been persuaded to change his mind about satellites, or at least to listen to presentations about them. There appeared to be little likelihood that either of these efforts could produce operational systems earlier than mid-1959, without increased funding and decisive management actions. The Board emphasized the need for an interim photo reconnaissance system and recommended that an early review be made of new developments to ensure that they were given adequate consideration and received proper funding in the light of pressing intelligence requirements. On 28 October 1957, Mr. James Lay, the Executive Secretary of the National Security Council, notified Secretary of Defense McElroy and DCI Dulles that the president had asked for a joint report from them on the status of the advanced systems. Quarles responded on behalf of himself and Allen Dulles on 5 December that, owing to the extreme sensitivity of the subject, details on the new systems be furnished only through oral briefings.

CORONA is Born

As a consequence of that approach, there are few official records in the project files bearing dates between 5 December 1957 and 28 February 1958. Another reason, certainly, is that President Eisenhower suffered a stroke on 25 November. It is clear, however, that major decisions were made and that important actions were undertaken during the period. In brief, it was decided that the portion of WS-117L offering the best prospect of early success should be separated from WS-117L. This effort would be designated as project CORONA and placed under a joint CIA-Air Force management team, an approach that had been so successful in the covert development and operation of the U-2.

The nucleus of a team was constituted in the CIA Development Projects Staff under the direction of Richard Bissell, Special Assistant to the DCI for Plans and Development. Bissell was designated as the senior CIA representative on the new venture; his Air Force counterpart was Osmund Ritland, who had previously served as Bissell's first deputy in the U-2 activities of the CIA Development Projects Staff and who was now Vice Commander of the Air Force Ballistic Missile Division.

Bissell recalls that he first learned of the role intended for him "in an odd and informal way" from Dr. Edwin Land who headed a CIA panel of technical consultants informally known as the Land Panel. Bissell also recalls that his early instructions were extremely vague: that the subsystem was to be developed out of work accomplished under WS-117L, that it was to be placed under separate covert management, and that the management pattern established for the development of the U-2 was to be followed.

Trailing after the USSR's successful Sputnik-I and Sputnik-II came a succession of proposals for accelerating the WS-117L program and for "regaining the pre-eminence" of the United States in space. This furor of activity occurred in parallel with, and in ignorance of, the high-level decision to proceed with the CORONA program. Any attempt to curb this unnecessary effort would have jeopardized CORONA security and to some extent the variety of proposals for space programs during this period provided cover for CORONA. Perhaps because the problems of the Vanguard program absorbed public attention almost to the exclusion of concern for military programs, Congressional inquiries into the American space effort did not focus on WS-117L. Attempts to fix responsibility for the "space gap" became entangled with partisan politics and interservice rivalries.

The Air Force was the recipient of suggestions from several quarters that the Thor intermediate-range ballistic missile, scheduled for availability sooner than the Atlas, be used to boost a satellite into orbit. The earliest formal proposal of this sort emerged in the report of a special ARDC committee in October 1957. Well-intentioned recommendations, such as this one, contributed to a "space-booster problem," faced by General Schriever: he was being hounded for missiles to be used as boosters, but his missiles were not, as yet, working as missiles! Any favored choice of a missile-booster was made on a very speculative basis.

On the day following issuance of the Quarles' "go slow" directive, General Putt directed General Anderson to assemble an *ad hoc* group to consider possible USAF space contributions that would counter the effects of Sputnik-I on world opinion. Headed by noted nuclear physicist Edward Teller, the group submitted a report, which included recommendations for a series of space probes and moon shots, together with a suggestion that Thor boosters and makeshift second stages be used to orbit 200-300 pound satellites at an early date.[13]

This proposal to use Thor as an interim booster evoked considerable enthusiasm. Air Force Assistant Secretary Richard E. Horner submitted a formal memorandum to the Secretary of Defense on 12 November elaborating on the subject, stating that a Thor-boosted interim reconnaissance vehicle could be operational by April 1959, whereas the Atlas-boosted WS-117L program had been so affected by earlier funds shortages that late 1959 or early 1960 seemed to be its earliest possible launching date. Horner stated that a combination of Thor with a modified WS-117L upper stage could place a 300-pound reconnaissance device in a 150-mile orbit.[14]

Concurrently with the Horner recommendation, RAND circulated the first written discussion of its proposal for an interim reconnaissance system based on a combination of the Thor booster with the Aerobee-derived upper stage used in the Vanguard program. Advance copies were distributed on 12 November 1957, the day of the Horner memorandum. In addition to using Thor as a booster, RAND urged a technique of spin stabilization for a third-stage, camera-carrying element of the system. (The concept had been invented by Amrom Katz and Merton Davies, two of several RAND scientists who contributed to the study.) RAND also suggested abandoning the WS-117L readout concept for the interim system, urging a mode of payload deboost and water landing to permit recovery of the entire third stage.

Though the RAND proposal was new to many who first heard it in late 1957, it embodied elements of several earlier suggestions, in particular a former RAND recommendation dated 12 March 1956 to the Air Staff, written by Richard L. Raymond. The basic notion of combining a ballistic missile with an Aerobee upper stage had originated at Wright Field in 1955, when it was proposed as the Air Force alternative to Vanguard. In that instance a combination of Atlas with an Aerobee upper stage had been suggested as the best means of boosting a relatively large scientific satellite into orbit. The use of recovery rather than readout techniques had been suggested, and studied, at least as early as December 1956, when the Ballistic Missile Division had asked Space Technology Laboratories to analyze the technical aspects of such an option. RAND researchers had examined the prospects in some detail through the summer of 1957; the revised version of RAND's 12 November study eventually suggested a complete family of recoverable satellites.[15]

Apparently quite independent of the RAND and Teller recommendations, the General Electric Company, on 29 October, suggested to ARDC headquarters that a "pioneer" system could be put together using the Thor booster, a General Electric Hermes rocket as a second stage, and a third stage built around a horizon-stabilized recoverable satellite. One month later, on 27 November, General Electric, under the leadership of Mr. Hilliard Page, followed up the initial suggestion with a more detailed proposal which outlined a camera subsystem, a recoverable capsule subsystem, propulsion, command and control, program planning, and a management approach. The original camera concept, embodying an eight-inch lens capable of resolving 350-foot objects, had by November become an f3.5, 18-inch lens used with Microfile film to provide resolution of 75-foot objects. The capsule design, bearing an obvious likeness to General Electric ballistic missile reentry bodies then in development, was intended to free-fall into the ocean, at which point the ablative shell would crack and the recovered elements would remain afloat encased in a foam rubber ball.

Although the General Electric scheme was further elaborated in a 4 January 1958 brochure, it apparently had little influence on the program then being considered on the West Coast. Colonel Sheppard, intimately aware of the satellite proposals, later said he had absolutely no recollection of having encountered the General Electric proposal or brochure. A high General Electric official insisted that the idea had been submitted to BMD in October 1957. In the frenzy of the first 100 days following Sputnik, many such proposals could have been received, filed or misrouted, and forgotten. Additionally, the BMD group was by mid-November rather firmly committed to its own approach.[16]

That approach, undoubtedly influenced by the Teller Report, the Horner memorandum, and the RAND study, appeared as a BMD-Lockheed plan for the acceleration of the entire WS-117L program. Discussions between Lockheed and BMD officials preceded the dispatch of an informal Lockheed proposal on 26 November. It was considered in some detail immediately thereafter, particularly in the course of a 5 December meeting at BMD. Lockheed urged the adaptation of the WS-117L upper stage to the Thor missile as the first step in a program acceleration. Taking issue with Teller Report and RAND conclusions that the Aerobee upper stage promised earlier availability than the WS-117L upper stage, Lockheed proposed a "more realistic" system embodying elements of the RAND-proposed camera technique, the Horner vehicle concept, and Teller committee suggestions for schedule acceleration. On 23 December 1957, General Schriever asked Lockheed to prepare a formal proposal along such lines, and on 6 January 1958, Lockheed completed and forwarded a development plan.[17]

Central to the system concept proposed by Lockheed was a booster configuration consisting of the Thor missile as a first stage and an upper stage powered by the Bell XRM-81 rocket engine (orginally designed for the "powered pod" missile of the B-58 Hustler bomber, hence the name Thor-Hustler). Much later, the upper stage acquired the more lasting name, "Agena."

One aspect of the Lockheed proposal was particularly applicable to a clandestine satellite reconnaissance program, an approach revived at BMD early in December. General Schriever's November correspondence with Lockheed had included some mention of the highly sensitive U-2 program and Lockheed's success in pushing that reconnaissance aircraft system to early completion. Lockheed had also called attention to its relatively recent experience in the development of a covert reconnaissance vehicle. Using these inputs, General Ritland was a principal in early December discussions between Schriever and a group of important policy figures in Washington: Richard Bissell of the Central Intelligence Agency, Drs. Land and Killian, and General Goodpaster from the White House. That group quietly considered the political and technical aspects of the satellite reconnaissance problem, discussed aircraft reconnaissance capabilities, as well as advanced satellite options, and finally concluded that the best course for the nation was to sponsor a covert program employing the Thor-WS-117L vehicle.

On Thursday, 6 February 1958, the President's Science Adviser James Killian and Polaroid's Edwin H. Land met with DCI Allen Dulles, Defense Secretary Neil McElroy, and McElroy's deputy, Donald Quarles, to discuss the plan to give the film-return satellite effort to the Bissell-Ritland team in order to speed up its development. The next day, 7 February, Killian and Land met with President Eisenhower and General Goodpaster at the White House to discuss the matter.

BGen Andrew J.
GOODPASTER

President Dwight D.
EISENHOWER

Edwin H.
LAND

James R.
KILLIAN, Jr.

They explained to the president that the satellite would orbit the earth three times, taking pictures as it passed over the Sino-Soviet bloc, and then would deorbit the film capsule. Killian told Eisenhower that the satellite would emit no electronic signals and, therefore, could be completely covert. At Killian's request, Land explained that this specific, small project was for *bona fide* intelligence purposes. It would be of utmost importance to conduct it quietly, under the cloak of other activities. Comparing the satellite's optics to those in the U-2, Land told the president that whereas the U-2 could photograph objects as small as 4 feet, the satellite cameras would only be able to discern objects 50 to 100 feet on a side. This being the case, it would be very easy for the Soviets, if they learned about the project, to build dummies that could "fool" the satellite cameras, therefore, it was of paramount importance to keep them from learning of it. The satellite pictures, said Land, could be used as a "scouting" program to guide more precise intelligence means to selected targets. He indicated that General Schriever could work on this as a joint project with the CIA, and mentioned that a Thor missile plus a Navaho booster might be used to launch the satellite.

President Eisenhower said he supposed this would be done as part of the space program Killian was then working on. This was a reference to the Advanced Projects Research Agency (ARPA) which the President's Science Advisory Committee had recommended be established to oversee the nation's major space projects and which the president had only that day approved as Department of Defense Directive 5101.15. The president also indicated that CIA should have complete and exclusive control of all of the intelligence phases of the operation. He said that only a handful of people should know anything at all about it.

Following this meeting, Goodpaster spoke separately with Killian and Land about their understanding as to how the president intended the project to be handled. They told him it was their understanding that General Schriever and the Air Force would be in charge of the program. Goodpaster said that was not his understanding of the president's intention, and he returned to the Oval Office to speak with the president. Eisenhower told Goodpaster "emphatically that he believed the project should be centered in the new Defense 'space' agency [ARPA], doing what CIA wanted them to do." Goodpaster then told Killian the President's wishes.*

Concurrently, on the strength of detailed instructions from General Schriever, Colonel Oder began drawing up a revised 'Second Story' cover plan based on staging an "open" Thor-Hustler scientific satellite program to cloak reconnaissance overflights. In the sense that Killian and Goodpaster were spokesmen for the White House and would undoubtedly be able to commit the administration to support such an effort, their acceptance of this scheme shortly before Christmas of 1957 constituted an unofficial but highly significant endorsement. Bissell's agreement, and acceptance by the Central Intelligence Agency of the covert program approach, closed the loop.[18]

*A.J. Goodpaster, Memorandum of Conference on 8 Feb 1958, dated 10 Feb 1958, White House Office of Staff Secretary, Alpha Series, Box 14, Intelligence Matters, D.D. Eisenhower Library (S).

While there was no National Security Council Intelligence Directive (NSCID) which specifically authorized the Director of the Central Intelligence Agency to conduct overflight reconnaissance operations, NSCID No. 5 gave the CIA primary responsibility for the conduct of clandestine intelligence activities abroad. The collection of intelligence by means of aerial reconnaissance was therefore considered to be within the responsibilities assigned to the CIA under the National Security Act of 1947, as amended.[19] The amendment to the Act made the Director of Central Intelligence the only US Government employee authorized to spend money without substantiating vouchers.

Additional factors leading to CIA involvement in the satellite reconnaissance program were: (1) the ability and authority of the CIA to use unorthodox methods in contracting with industry for expeditious procurement of components; (2) the ability to maintain effective security; and (3) the desire of CIA to have a part in the program to orient it toward the collection of intelligence to fulfill priority requirements. A CIA role was assured by the timely furnishing of $7 million from the Director's Reserve, by DCI Dulles, to buy the photographic payloads and install them in the satellites.[20]

Plans for the interim satellite photo reconnaissance system entailed the overt cancellation of the interim Thor-boosted satellite portion of WS-117L, and the reinitiation of the project under the Bissell/Ritland management structure. The Air Force would continue to pursue other portions of WS-117L.

The plan was favorably received by Deputy Secretary of Defense Quarles, Assistant Secretary of the Air Force for Research and Development Horner, Generals Schriever and Ritland, and Messrs. Dulles and Bissell, among others.

The ARPA Factor

Meanwhile, on 7 February 1958, Department of Defense Directive 5101.15 established the Advanced Research Projects Agency (ARPA) with the mission of directing and performing advanced research and development projects in the fields of space science and technology, ballistic missile defense, and other advanced research and development. Not stated in DoD 5101.15, but clearly understood, was that ARPA was to provide cover for DoD funding and program approvals of the covert portion of WS-117L. Accordingly, ARPA's first director, Dr. Roy W. Johnson, and Chief Scientist, Dr. Herbert York, as the new managers of DoD space activities, became involved in discussions of the covert Thor-boosted satellite portion of WS-117L, which was renamed Project CORONA by the CIA. (George Kucera, of Bissell's staff, an inveterate cigar smoker, was inspired to select this name as he glanced at a cigar wrapper.)

On 28 February 1958, a memorandum (actually written by Bissell, Ritland, and Sheppard) from the Director of ARPA to the Secretary of the Air Force directed that BMD's interim Thor-boosted reconnaissance system be cancelled. It authorized the use of available Thor boosters (built for the Air Force by Douglas Aircraft Company) for test flights of satellite vehicles developed by Lockheed under the WS-117L program. This included provision for recovery of biological specimens in the furtherance of manned satellite flights projected for the future. The provisions of this ARPA directive formed the basis for the original classified cover story for Project CORONA.[21]

On the basis of advance information, Schriever instructed Jack Carter, manager of WS-117L activities at Lockheed, to assemble "black" (referring to the covert nature of the project) estimates on system specifications and costs, made Oder responsible for coordination with the Central Intelligence Agency, and ordered transfer of payload contract costs from BMD to the Central Intelligence Agency. (General Electric and Fairchild Camera had earlier begun working, under Lockheed, on the spin-stabilized payload.) The cover story for all of this work was a Lockheed contract for developing a "biomedical" capsule.

One complication was the injection of the Advanced Research Projects Agency (ARPA) into the scheme. ARPA had been proposed the previous December as a "super agency" which, by controlling the various military space system developments, would eliminate interservice rivalries. On 24 February, McElroy formally approved the WS-117L program acceleration recommended in November but also specified that it would be conducted under ARPA direction. ARPA, although theoretically functional, possessed neither personnel nor facilities for such a responsibility.

Some confusion characterized technical activities during the latter part of February and the first two weeks of March. Oder and Sheppard had gradually developed reservations about the wisdom of a spin-stabilized reconnaissance vehicle. As early as 18 February, Oder had urged General Schriever to fund a preliminary stable-body approach, suggesting that both the stable body design and a camera configuration proposed by Itek Corporation* were improvements over spin stabilization and the Fairchild camera then being supported. At the same time, Air Force headquarters, in early March, advised BMD that the Thor-boosted "reconnaissance test vehicle" approach had been endorsed by the Department of Defense and that formal development plans for an operation called "Nightshift"—the proposed nickname for early Thor-boosted WS-117L launchings—should be drawn up for early submission to the Air Force Ballistic Missile Committee. The "Nightshift" proposal had been devised within the Air Staff as a means of obtaining early Air Force entry into a "satellite club" that still was limited to the Navy Vanguard and the Army Explorer Programs. Unaware of the scheduled covert program, Air Staff officials were intent on securing permission for launching something developed by the Air Force.[22]

The ARPA directive ostensibly cancelling the Thor-boosted interim reconnaissance satellite was followed by all of the notifications that normally accompany the death of a military program. The word was passed officially within the Air Force, and formal contract cancellations were sent out to the prospective suppliers. Contractors were shocked by the suddenness of the action, and Air Force personnel were startled at the abandonment of that part of WS-117L which seemed to have the best chance of early success. Subsequent to the cancellation, only a few individuals in the Air Force and in participating companies were cleared for Project CORONA. These people were informed of the procedures to be followed in the covert reactivation of the cancelled program.

*Itek had come into being in 1957, principally through the efforts of Richard Leghorn, Professor Duncan Macdonald from Boston University's Physics Research Laboratory, and A. W. Tyler from Eastman Kodak.

Discoverer and CORONA

When CORONA was removed from WS-117L and placed under separate management as a covert activity, the intent was to disguise its real purpose by concealing it as an experimental program carrying the name Discoverer. Discoverer was represented as an Air Force scientific program whose findings would be of value to many related programs. This permitted overt procurement of the necessary boosters, second stages, and hardware associated with the biomedical cover launchings. It also provided an explanation for the construction of launching and ground control facilities. Only the program components associated with the true photographic reconnaissance mission had to be procured covertly.

After Bissell and Ritland had worked out the arrangements for the overt cancellation and covert reactivation of the program, they began to address the technical problems associated with the design configuration they had inherited from WS-117L. The system concept proposed Thor as the first stage booster and, as a second stage, a Lockheed-designed Agena satellite vehicle.

Schriever and Oder were meeting with CIA and Lockheed representatives on the afternoon of 28 February 1958, when a copy of the formal signed ARPA directive first reached BMD. They completed arrangements to inform General Electric and Fairchild of what was afoot and reviewed the preliminary BMD analysis of proposals for camera and vehicle subsystems. Both the technical approach and the management pattern were gradually taking shape.[23]

CORONA Design Evolution and Contractor Selections

Four distinct proposals for vehicle-reconnaissance system development had emerged. Lockheed and RAND both favored spin stabilization employing a Fairchild transverse panoramic camera with film drive synchronized to vehicle rotation rate. Lockheed, however, urged that only a ballistic-missile type nose cone be recovered, while RAND favored recovery of the entire orbital vehicle. Both proposals assumed use of Fairchild cameras capable of resolving 60-foot objects.

General Electric and Itek proposed stable-body vehicles carrying panoramic cameras. General Electric thought ground resolution of 25 feet could be obtained; Itek, that seven-foot resolution was possible. General Electric paralleled Lockheed in favoring data-capsule recovery, while Itek supported the total-vehicle recovery concept originated by RAND. On 1 January 1958, Itek acquired the personnel and facilities of the Boston University Physics Research Laboratory with funding support provided by Rockefeller interests. Boston University had long been uneasy at the transition occurring in the Physics Research Lab, which had become more of an industrial research facility than a campus establishment, contracting largely with the government. The resignation of Professor Duncan Macdonald, who had been the chief figure in laboratory activities for some years, caused the University to decide to withdraw from the field. The resulting arrangement, by which Itek acquired the laboratory, equipment, contracts, and personnel, made Itek a very strong contender for new research and development contract awards, the company having assimilated (in Colonel Oder's judgment) "some of the nation's best camera people." Itek personnel had directly participated in the development of the balloon reconnaissance cameras.

Before a final decision could be taken in technical matters, certain critical management items required attention. Most were satisfactorily arranged in a series of meetings between 26 February and 15 March. The Central Intelligence Agency was charged with security control and, therefore, was responsible for the overall conduct of the covert activity. Bissell, as the responsible CIA official, was obviously in need of a "very knowledgeable WS-117L man" to assist him in Washington; Schriever and Oder suggested Oder's deputy, Captain R. C. Truax, US Navy, who initially served as technical assistant to Bissell, using an ARPA assignment as cover.

The intelligence agency agreed to brief both General Electric and Fairchild on the covert program in advance of formal notice to Fairchild that the overt program had been "cancelled." In order to establish the proper "black" environment, it would be necessary to cancel overtly the Fairchild contract and to reorient the General Electric effort toward development of a "biomedical" capsule.

Several important design decisions were implemented in this organizational period of CORONA. Recognizing the need for resolution to satisfy the intelligence requirements, it was concluded that the previously developed concept of physical film recovery did indeed offer the most promising approach for a usable photographic return in the interim time period and should be pursued. This resulted in the need for a recovery pod or capsule; General Electric was selected as the recovery vehicle contractor. The decision to pursue film recovery proved in retrospect to be one of the most important made in US reconnaissance activities. History shows that, during the crucial decade of the 1960s, intelligence needs could not have been served by the state-of-the-art in readout technology, the alternative concept developed under WS-117L. It is also noteworthy that both the manned and unmanned US space recovery programs which followed drew heavily from the reentry technology developed for CORONA.

In the opinion of the BMD analysts, the choice between spin stabilization and stable body configurations should be based on earliest availability, and on this criterion spin stabilization appeared to have the advantage.

Bissell arranged with the proper Washington authorities to delay circulation of the ARPA directive until Fairchild and General Electric could be advised of the background factors. BMD agreed to pay Lockheed the basic costs of the "cancelled" program as they involved these contractors. Officially, BMD would pay "under protest," since all three firms had proceeded on the strength of informal agreement only.[24]

A 15 March meeting between Bissell and Ritland, in Washington, confirmed the earlier BMD decision to use the Agena upper stage for CORONA, rather than the Aerobee stage from Vanguard. It was also agreed that Bissell's interests in WS-117L would be authenticated by a formal assignment to keep CIA Chief Dulles briefed on the progress of that "major collection system." In both the Department of Defense and the Central Intelligence Agency, CORONA was to be a closely-held secret.

The choice during March 1958 of both a technical approach and specific contractors was not without confusion. As a result of preliminary actions during that January, Lockheed's oral commitments to Fairchild for the camera subsystem and General Electric for the reentry body were along the lines of the RAND proposals. Continued expressions of BMD's unease plus advice from CIA technical specialists apparently caused Bissell to have second thoughts. On 15 March, Bissell told Ritland that special meetings were scheduled for 17 and 18 March to discuss the advisability of funding a backup alternate to the primary Fairchild-General Electric approach.

The group that met at Cambridge, Massachusetts, on 18 March included three members of the President's Science Advisory Committee, two Central Intelligence Agency officials (including Bissell), three BMD officers (Ritland, Oder, and Truax), and Dr. Herbert F. York of ARPA. Its task, decided only one day earlier, was to select a backup contractor. After hearing detailed presentations from Itek, General Electric, Fairchild, and Eastman Kodak, the panel concluded that Itek was best qualified to develop an alternate camera system for CORONA. Going further, the group recommended that Itek and Lockheed, with assistance from General Electric if needed, should develop a gas-jet-stabilized vehicle using capsule film recovery with Lockheed having system engineering and technical direction responsibilities.[25]

The differences between the Itek proposal and the "primary" Fairchild camera subsystem compelled attention. Essentially, Itek was proposing a 24-inch camera with theoretical resolution on the order of 15 feet, while Fairchild was urging a camera with 60- to 100-foot resolution. Principally because of that difference, the Central Intelligence Agency, in late March, began to look more favorably on the Itek than the Fairchild proposal but continued to advocate concurrent development of both spin-stabilized and three-axis, stable-body techniques.

A series of technical meetings between Bissell, Ritland, and the contractors' representatives took place on 24, 25, and 26 March 1958 at the Flamingo Motel in San Mateo, California. James W. Plummer, Lockheed Program Manager, was the principal representative of the prime contractor. Tentative decisions made at these meetings included:

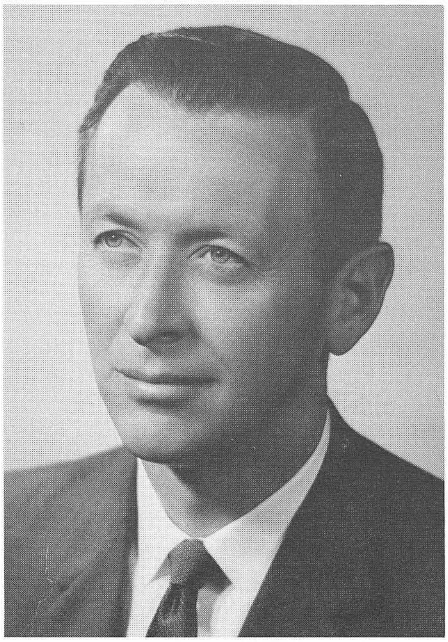
a. Scheduling aimed at production of elements of the system by 1 July 1958 and a program of 19 weeks of assembly and testing to readiness for first launching.
b. The photographic record would be acquired by physical recovery of the film. General Electric would be issued a subcontract for development of the recovery capsule.
c. Agreement that Cooke Air Force Base (later renamed Vandenberg Air Force Base) was the most advantageous launching site.
d. Initial procurement would be 10 vehicles, with a potential for three additional.

Bissell remarked that he was "faced with the problem at present of being broke" and would need estimates from all of the suppliers as soon as possible in order to obtain the necessary financing to get the program under way. The suppliers agreed to furnish estimates by the following week.

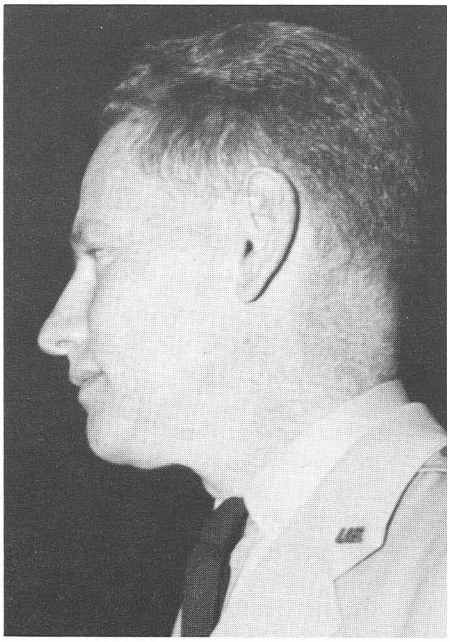
The Choice of a CORONA Camera

Following this meeting, the project quickly began taking formal shape. Within a span of about three weeks, approval of the program and of its financing was obtained, and the design of the payload configuration evolved. In late March and early April, there was lengthy and serious review of the different camera and spacecraft configurations proposed by Fairchild Camera and Instrument Company (FCIC) and Itek Corporation.

The original proposal called for a Fairchild unit similar to the one used by the GENETRIX balloons. Fairchild assumed the camera would be housed in a spin-stabilized spacecraft—that is, in order to prevent tumbling, the spacecraft would be induced to spin or spiral, like a football in flight. Spin stabilization also equalized the heating and cooling problems encountered in space. The camera would have a 153-mm (six-inch) focal-length lens, without image-motion compensation; it would use fast film and a very short exposure time. This combination would produce grainy photography with an expected resolution of 40 to 60 feet on the ground, a rather poor image for intelligence purposes.



**James W.
PLUMMER**



**USAF Col William A.
SHEPPARD**

Shortly after the San Mateo meeting and as a result of the 18 March Cambridge meeting, Bissell received a competitive proposal for a more sophisticated high-acuity (HYAC) camera from the Itek Corporation. Itek proposed a vertical-looking, reciprocating, 70-degree panoramic camera that exposed film by scanning at right angles to the line of flight. It would use a 24-inch focal-length, f/5.0 Tessar lens with image-motion compensation, and would fly in a three-axis (earth-oriented) stabilized spacecraft. Although more complex than the Fairchild scheme, this proposal had greater promise. In the Fairchild proposal, the camera could operate only during that brief period when the camera window on the spiraling spacecraft was pointed toward the earth. The Itek proposal, on the other hand, would have a camera pointed at the earth at all times. It did, however, require horizon sensors and gas jets in order to control the pitch, roll, and yaw axes so as to keep the camera orthogonal in relation to the horizons and vertical in relation to the earth's center. The Itek camera promised a ground resolution approaching 20 feet.

Bissell recalls that he personally decided in favor of the Itek design, but only after much agonizing evaluation. The decision was difficult because it involved moving from the previously intended method of space vehicle stabilization to one that was technically more difficult to accomplish. It did, however, standardize on the three-axis stabilization which was being pursued in the WS-117L Agena development and which has been a part of all subsequent photo reconnaissance systems.

Bissell's first project proposal, completed on 9 April 1958, requested approval for concurrent development of both the Fairchild and the Itek systems, with the Fairchild configuration becoming operational first and the Itek configuration being developed as a follow-on system. Within two days, however, Bissell made a final decision to abandon the Fairchild spin-stabilized configuration entirely. He rewrote the project proposal taking note of the earlier configuration and giving his reasons for favoring the Itek approach: the better resolution attainable, the lower overall cost, and the greater potential for growth. The proposal was rewritten a second time, retaining the Itek configuration but raising the cost estimate from $20 to $31 million. Of the total estimated cost, $24 million represented "a rather arbitrary allowance" for 12 Thor boosters and Lockheed second-stage vehicles and was to be financed by ARPA through the Air Force. The remaining $7 million was for covert procurement (by CIA) of the pods containing reconnaissance equipment and recoverable film cassettes.

Formal CORONA Proposal to the President

In response to official approval to proceed with the program, a formal plan was outlined calling for the development and subsequent operational use of a short-lived reconnaissance satellite from which, at the completion of its mission, a recoverable capsule containing exposed film would be separated for return and pickup in a preselected ocean area. The payload would consist of a pod containing a 24-inch focal length camera and a recoverable capsule into which exposed film would feed as the camera operated. The anticipated ground resolution of 20 feet would allow the distinguishing of one structure from another and the identification of major Soviet targets, such as missile sites under construction.

The program, to consist of 12 launchings, was expected to become operational around June 1959 and to be completed in the spring of 1960. The division of administrative responsibilities for CORONA was to be as follows:

a. ARPA would exercise general technical supervision over the development of the vehicle.

b. The Air Force Ballistic Missile Division, acting as agent for ARPA, would perform detailed supervision of vehicle development and provide ground facilities for launching, tracking, and recovery in collaboration with the US Navy.

c. CIA would supervise the technical development and covert procurement of the reconnaissance equipment and have overall responsibility for cover and security.

The final project proposal[26] was forwarded to General Goodpaster, the President's Staff Secretary, on 16 April 1958, after having been reviewed by Johnson and Admiral Clark of ARPA; Assistant Secretary Horner, General Ritland, and Dr. Killian. The proposal was approved, although not in writing. (Only 10 launchings were funded, as against the 12 proposed in the 16 April CORONA development plan.) Some program personnel were told that the only original record of the president's approval was a handwritten note on the back of an envelope by Lieutenant General Charles P. Cabell (then Deputy Director of Central Intelligence); however, a memorandum for the record prepared by Goodpaster confirmed the decision.

CORONA Management Arrangements

When CORONA began, Bissell bore the title of Special Assistant to the DCI for Planning and Development, as well as Project Director of the U-2 activity. Within CIA, he also added the title of Project Director for CORONA. He, together with General Ritland, who headed the Air Force efforts in support of CORONA, gave strong leadership and management to the project under the liberal overall direction of ARPA. A strong and cooperative bond developed in the day-to-day working relations between Bissell's Development Projects Staff (DPS) and Ritland's Ballistic Missile Division (BMD) personnel assigned to support the CORONA Program.

Although it may have been the original intent that CORONA would be administered along the same lines as the U-2 program, it actually began and evolved quite differently. CORONA was a joint CIA-ARPA-Air Force effort, much as the U-2 was a joint CIA-Air Force effort, but it lacked the central direction that characterized the U-2 program. The project proposal described the anticipated administrative arrangements, but fell short of clarifying the delineation of authorities. It noted that CORONA was being carried out under the authority of ARPA and CIA with the support and participation of the Air Force. CIA's role was further explained in terms of participating in supervision of the technical development, especially with regards to the actual reconnaissance equipment, handling all covert procurement, and maintaining cover and security. The work statement prepared for Lockheed, the prime contractor, on 25 April 1958, noted merely that technical direction of the program was the joint responsibility of several agencies of the Government.

Imprecise statements of who was to do what permitted a range of interpretations; however, vague assignments of responsibilities caused no appreciable difficulties in the early years of CORONA. The organization was small and had a single concern: producing a reconnaissance satellite. Much later (1963-65) those loose statements were analyzed more parochially and became a source of friction between the CIA and DoD.

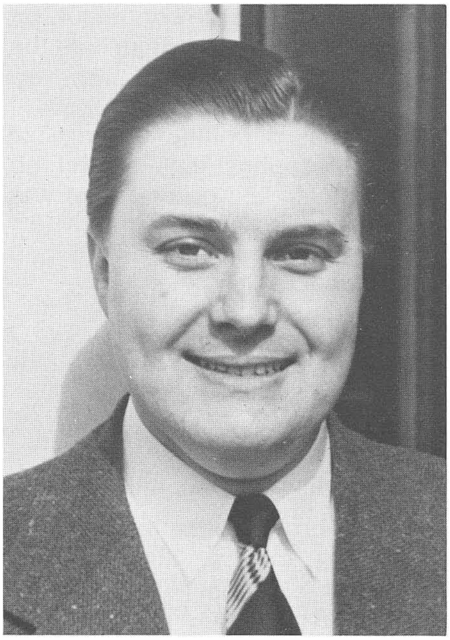
The official statement on the management and technical direction of CORONA read:

> Technical direction of the program is the joint responsibility of several agencies of the Government. In the interest of effective management, however, such direction would be provided primarily by and through the Air Force Ballistic Missile Division acting as the agent for all interested components of the Government. A Project Officer will be established in BMD as the single day-by-day point of contact for the contractor. This officer will have authority to make on the spot decisions within the scope of the work statement on all matters pertaining to the program other than those of major importance. From time to time the Government agencies concerned will jointly review the progress of the program. The Government will make arrangements to permit the prompt rendering of major decisions concerning the program which cannot be made by the Project Officer.[27]

Despite these flexible management criteria and the broad authorities which the BMD Project Officer might be led to assume under the wording of this paragraph, Bissell exerted strong and direct program control over CORONA through the monthly suppliers' meetings. This was the same means he had used for liaison and control during the U-2 development period. While the BMD project office (initially run by Lt. Colonel Lee Battle, USAF) was the day-to-day contact point for the contractor, CIA maintained direct and frequent contact with the working level people at the Lockheed Advanced Projects (AP) Facility at Palo Alto. This contact was made through visits and, after 1 June 1959, by assignment of a liaison officer to the AP Facility, the first being Lt. Colonel Charles L. Murphy, a USAF detailee to CIA.

Mr. Bissell's Operations Staff, which had principal responsibility for the direction of CIA's U-2 activities, also played an important role in the early stages of CORONA. Key persons were John Parangosky, Chief, Development Staff, and Eugene P. Kiefer, Special Assistant for Technical Analysis. Colonel [redacted] Chief of Development Projects Staff Operations (initially run by William Battle), and his staff participated in July 1958 with BMD/ARDC personnel and representatives of the Tactical Air Command in planning for a C-119 squadron to be assigned the support function of retrieving re-entry vehicles.

The DPS Operations Center in the Matomic Building in downtown Washington was designated as the CORONA Project Control Center and



John
PARANGOSKY

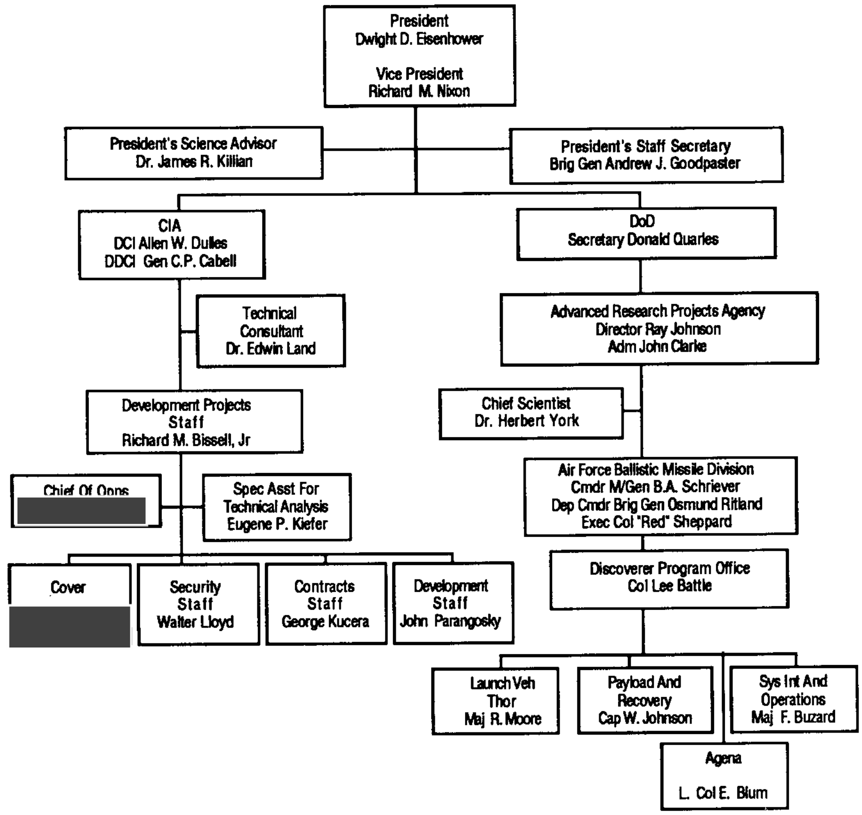
Eugene P.
KIEFER

communications were activated through the special signal center in DPS to the Lockheed AP Facility and BMD's Los Angeles headquarters.

The DPS Operations Staff took the initiative in drawing up operational control procedures for CORONA in the summer of 1958 and sent requirements to the Air Weather Service for climatological studies and weather support. In September 1958, agreement was reached between DPS Operations and BMD that DPS would draft an order formalizing the operational relationships and control procedures among the various participants with regard to CORONA. This order remained in effect for the duration of the program.

Bissell gave this description of how the program was initially managed:

> The program was started in a marvelously informal manner. Ritland and I worked out the division of labor between the two organizations as we went along. Decisions were made jointly. There were so few people involved and their relations were so close that decisions could be and were made quickly and cleanly. We did not have the problem of having to make compromises or of endless delays awaiting agreement. After we got fully organized and the contracts had been let, we began a system of management through monthly suppliers' meetings — as we had done with the U-2. Ritland and I sat at the end of the table, and I acted as chairman. The group included two or three people from each of the suppliers. We heard reports of progress and ventilated problems — especially those involving interfaces



1958 CORONA Organization Chart

> among contractors. The program was handled in an extraordinarily cooperative manner between the Air Force and CIA. Almost all of the people involved on the Government side were more interested in getting the job done than in claiming credit or gaining control.[28]

Management of CORONA involved many agencies and contractors. ARPA reviewed and funded the overt effort, ensured adequate support, arranged for sea recovery, a Navy operation, and kept the Office of the Secretary of Defense advised. BMD developed and provided all hardware that could be related to a cover or supporting program and provided facilities and personnel for launching and tracking operations. The Central Intelligence Agency defined covert program objectives, established and policed security policy, maintained liaison with the Department of State, funded and developed the covert hardware items, and insured that covert and overt developments were compatible. Lockheed Missiles and Space Division (under contract to both CIA and BMD) served as technical director and integrator of all equipment other than the Thor booster; developed the orbiting upper stage; and integrated and led the test, launching, and on-orbit control operations. Itek developed the camera under subcontract to Lockheed and General Electric subcontracted for the recovery capsule. Douglas, as an associate contractor, furnished the Thor boosters.

CORONA Scheduling

The schedule of the program, as it had been presented to the CORONA group at its meeting in San Mateo in late March 1958, called for a countdown beginning about the first of July 1958 and extending for a period of 19 weeks. It was anticipated that the equipment would be assembled, tested, and the first vehicle launched during that 19-week period, which meant that the fabrication of the individual components would have been completed by 1 July. By the time Bissell submitted his project proposal some three weeks later, it was apparent that the earlier scheduling was unrealistic. Bissell noted in his project proposal that it was not yet possible to establish a firm schedule of delivery dates, but that it was likely that the first launching could be attempted by June 1959.

It is pertinent to note that there was no expectation in 1958 that CORONA would still be operating more than a decade later. The CORONA Program got under way initially as an interim, short-term development to meet the Intelligence Community's high-priority requirements for area-search photographic reconnaissance, pending successful development of more sophisticated WS-117L systems. The original CORONA proposal anticipated the acquisition of only 12 vehicles, noting that at a later date it might be desirable to consider whether the program should be extended, with or without further technological improvement.

Special CORONA Security Arrangements

To provide for working space where Lockheed personnel could actually assemble the "black" hardware into operationally-ready satellite vehicles, the Lockheed Program Office, under the direction of Jim Plummer, entered into arrangements with Hiller Helicopters in Menlo Park, California (later known as Hiller Aircraft Division of Fairchild-Hiller Corporation) on 1 April 1958, for leasing space, equipment, plus technicians and support personnel for a period of 12 months. (The covert facility thus established was referred to fondly as "The Ranch" by cleared personnel.) The cover, as Advanced Projects (AP) of Hiller, was maintained from 1 April 1958 until 1969 when, because of concern for the ability to maintain a cadre of skilled technicians in the phaseout period, the program was moved to the Lockheed complex in Sunnyvale, California. In addition to the hourly personnel furnished by Hiller, LMSD assigned skilled salaried personnel to set up an integrated organization in the leased Hiller premises. The LMSD AP operation was highly autonomous and needed only financial and subcontracting support from the parent organization. Lockheed explained to Hiller that the work to be carried on in the Hiller buildings was company proprietary and thus was not to be disclosed to anyone, including other sections of Lockheed.

Conscientious Air Force plant representatives and Lockheed supply personnel presented an early problem, derived from the need for moving expensive equipment and materials to a place that had no legal existence, but the CORONA people devised "secondary" cover stories which satisfied inquiries. There was no real need for elaborate deceit, chiefly because no one would expect Lockheed to be doing work in the Hiller plant, and no connection linked Hiller with any space projects. The "company proprietary"

Lockheed's Covert "Advanced Projects" Facility at Hiller Aircraft

explanation satisfied most of those who were curious. Within the company itself, prolonged absences of personnel were explained by reference to a "company program." Itek, General Electric, and Air Force people who were known by Lockheed personnel to be associated with reconnaissance programs only made the most circumspect visits to this new "Skunk Works." The wives of the Lockheed employees did not know where their husbands actually worked. Assembly work at Lockheed was compartmented; most workers engaged in a single, segmented phase of the vehicle-assembly process.

In July, Lockheed officials issued an "in-house" statement that the recoverable payload for Thor-WS-117L flights would include "in addition to normal instrumentation, recording devices for the advanced engineering tests." Responsibility for these devices was assigned to a special department with the explanation that ". . . the existing shortages of space at the Palo Alto plant and . . . the sensitive nature of the experiments" made it necessary to expand into new facilities.

"Instrumentation development" and the assembly and checkout of nose cones and payloads would be concentrated in the "additional facilities." Lockheed officials cautioned that extreme project secrecy was essential to prevent an anti-vivisectionist outcry over the scheduled biomedical experiments. Fully cognizant project personnel also understood that the phrase "recording devices" could be used to explain the presence of camera equipment in the "biomedical capsule" if an explanation were necessary.[29]

[redacted] CIA security specialists constructed a special briefing form to be signed by all military and contractor personnel exposed to program details. Permission to brief additional personnel on CORONA was reserved to CIA headquarters. It shortly became apparent, however, that both ARPA and ARDC headquarters staffs contained more knowledgable people than were authorized there, principally because high-ranking officials had yielded to the compulsion to inform their immediate superiors and their immediate staff assistants. (Brigadier General Robert E. Greer, who encountered the same compulsion problem two years later, when he took the Samos* program underground, concluded that it was a prime syndrome of any covert effort.)

Problems of Growth and Change

By mid-1958, contractors were moving toward meeting the goal of a first launching no later than mid-1959. The government side, however, was running into difficulties. The first had to do with money, the second with cover, and the two were inextricably intertwined. The $31 million cost estimate for the 12-vehicle program had assumed that the cost of the Thor boosters would be absorbed by the Air Force by diverting them from the cancelled WS-117L subsystem. That assumption proved to be incorrect; an additional $18 million had to be found to pay for the 12 Thors. Further, an additional four launching vehicles would be required for test launching, orbit, and recovery procedures and an additional three would be required for biomedical launchings in support of the CORONA cover story. ARPA could not see its way clear to making DoD funds available merely for testing or for cover support when there were other DoD space programs with pressing needs for money. Consequently, CORONA management had to go back to the president for approval of a revised estimate.[30]

Before the photoreconnaissance system became operationally ready for launching, a reorganization took place within the CIA which directly affected management of the program. On 1 January 1959, Bissell was promoted to the position of Deputy Director for Plans (DDP), CIA. In addition to taking on all of the problems which that position entailed, he amalgamated all Agency air activities into a new division in DDP. The Development Projects Staff, with its sensitive manned and satellite reconnaissance projects, was used to form the nucleus of a new Development Project Division (DPD). This reorganization was formally mandated as of 16 February 1959, but it took the balance of the year to sort out and solve major problems in the new division. Bissell became more and more involved in all the time-consuming matters of the Plans directorate and consequently had less time to give to daily CORONA affairs.

*Name of a Greek Island used as Program Identifier.

Fortunately, he did maintain his overall control as Project Director and was successful in his efforts to obtain continued high-level approvals and the necessary funds to carry CORONA forward.

The former DPS officers responsible for the support of CORONA found themselves with a problem similar to Bissell's: their time and efforts were being spread more thinly over an increasing number of projects.

Another basic difficulty was that well-meaning people, convinced they were advancing the interests of the Air Force, insisted on tinkering with one or another aspect of the "open" Discoverer program. Generally, the Air Force CORONA managers at BMD were able to limit ill effects by calling on the Central Intelligence Agency to apply quiet pressure to danger spots. Sometimes it proved necessary to brief one or more persons who had no role to play in CORONA itself but whose influence was necessary to keep events from unfolding in undesired directions. A case in point was the July 1958 Department of Defense suggestion to deploy all Thor missiles and use Army-developed Jupiters as satellite boosters. Since Jupiter was essentially incompatible with the WS-117L upper stage, the threat to CORONA was obvious: at least a nine-month delay in schedules, reengineering of payloads, reduction in orbital weights, and reliance on non-standard boosters. In this instance, Colonel Sheppard immediately contacted Bissell with a request that the CIA official take action to ensure that the suggestion was withdrawn before it could become a matter of debate. The maneuver was effective. (On 8 April 1958, General Schriever made Sheppard the Air Force Director of CORONA. Oder, associated with the WS-117L reconnaissance program, was removed from direct participation because of the danger that his association with reconnaissance would weaken the CORONA cover plan.)

Sometimes it was difficult to decide whether to stifle such "assistance" or to draw secondary benefits from it. One person, known to Colonel Sheppard, was complicating matters by "going around convincing people we should be doing the things we in fact are doing in the CORONA program." This affair had its useful aspect, however, since it was inconceivable that one so highly placed could be unaware of actual reconnaissance programs, and his ill-timed propaganda must also have served to convince many that the Air Force was concentrating on WS-117L rather than on the Thor-boosted satellite.

Another interesting problem Colonel Sheppard encountered was that the program director for the Thor-WS-117L "experimental and biomedical" satellite vehicle kept "insisting that the overt part of the system be designed rationally to support the overt missions." In this instance there was no alternative to making him aware of the covert plan. How else could one explain designing the satellite vehicle for horizontal rather than the vertical flight attitude (which was logical for biomedical experiments but impossible for film-recovery purposes), or why it was undesirable to air-condition a specimen chamber when the truthful reason was that the chamber in question must covertly be made light tight?

Separating CORONA From WS-117L

It had soon become apparent to the project managers that the original, but as yet unannounced, cover story conceived for the future CORONA launchings (an experimental program within the first phase of WS-117L) was becoming increasingly untenable. WS-117L had become the subject of fairly widespread public speculation identifying it as a military reconnaissance program. It was feared that linking Discoverer to WS-117L in any way would inevitably place the reconnaissance label on Discoverer; and, given the hostility of the international political climate to overflight reconnaissance, there was risk that the US Government might cancel the program if it should be so identified. Some other story would have to be contrived that would dissociate CORONA from WS-117L and at the same time account for multiple launchings of stabilized vehicles in low polar orbits and with payloads being recovered from orbit.

It was decided, therefore, to separate the WS-117L photo reconnaissance program into two distinct and ostensibly unrelated series: one identified as Discoverer (CORONA-Thor boost) and the other as Sentry (later known as Samos-Atlas boost). A press release announcing the initiation of the Discoverer series was issued in mid-January 1959 identifying the initial launchings as tests of the vehicle itself and later launchings as explorations of environmental conditions in space. Biomedical specimens, including live animals, were to be carried into and recovered from space. There were to be five biomedical vehicles; three of these five were committed to the schedule under launchings III, IV, and VII. The first two were to carry mice and the third a primate. The two uncommitted vehicles were to be held in reserve in event of failure of the heavier primate vehicle. In further support of the cover plan, ARPA was to develop two radiometric payload packages designed specifically to study navigation of space vehicles and to obtain data useful in the development of an early warning system (the planned Midas infrared series). It might be noted here that only one (Discoverer-III) of the three planned animal-carrying missions was actually attempted, and it was a failure. ARPA did develop the radiometric payload packages, and they were launched as Discoverers-XIX and XXI in late 1960 and 1961.

The CORONA Launching Site

The photo reconnaissance mission of CORONA necessitated a near-polar orbit, either by launching to the north or to the south. There are few suitable areas in the continental United States where this can be done without danger of debris from an early in-flight failure falling into populated areas. Vandenberg Air Force Base (originally Camp Cooke and Cooke AFB) near California's Point Arguello met the requirement for down-range safety because the trajectory of a southward launching would be over the Santa Barbara channel and the Pacific Ocean beyond. Vandenberg was a natural choice because it was the site of the first Air Force operational missile training base and also housed the 672d Strategic Missile Squadron with a number of Thor launching pads which could be easily modified to accommodate the Thor-Agena configuration. Two additional factors favored this as the launching area: (1) it was not too far removed from manufacturing facilities and skilled personnel, and (2) a southward launching would permit recovery in the Hawaii area by initiating the ejection/recovery sequence as the satellite passed over the Alaskan tracking facility.

Unlike U-2 flights, launchings of satellites from US soil simply could not be concealed from the public. Even a booster as small as the Thor (small relative to present space boosters) launched with a thunderous roar heard for miles. Space vehicles transmit telemetry that can be intercepted; and the vehicle can be detected in orbit by radar skin-track. Although launching could not be concealed, maintenance of the cover story for the Discoverer series required that launchings of the uniquely configured photographic payloads be protected from observation by uncleared personnel. Vandenberg was excellent as a launching site from many standpoints, but it had one drawback: the main Southern Pacific railroad cut directly through the base and both regularly scheduled and unscheduled trains passed near the launching site. Relocation of these tracks would have been prohibitively expensive. Operational parameters, including the requirement for daylight recovery and for seven denied area passes during daylight with acceptable sun angles, dictated early afternoon launching from Vandenberg. Trains passing through the area broke up this launching window into a series of smaller windows, some of no more than a few minutes' duration.

The CORONA Recovery Capability

The recovery method had been selected (air catch, with water recovery following if the air catch failed), and a test and training program covering recovery aspects was taking shape. In actuality, the process of selecting a recovery technique, assembling capable personnel, and locating equipment was much less difficult than it might seem. The basic methodology had been perfected four years earlier in the GENETRIX program, the balloon reconnaissance operation that ended in February 1956. Colonel Paul E. Worthman, who later became the Air Force director for CORONA, had headed an Air Force laboratory which developed aerial recovery equipment; he and others with

USAF LCol Clarence L. BATTLE, Jr.

USAF Col Paul E. WORTHMAN

operational experience were able to assist in reactivation of a flight organization. After the cessation of GENETRIX activity in 1956, the equipment had gone into storage and required no more than refurbishing to qualify for reuse. The difference between hooking and reeling in a package parachuted from a high-altitude balloon and performing a similar operation for a package descending by parachute after reentry from orbit was not large.

In the case of CORONA it would be most difficult to conceal a capsule recovery, particularly if, as seemed probable, several hundred people were involved in interlocked shore, sea, and air operations. Briefing such vast members on CORONA was out of the question, so the air-sea recovery portion of CORONA became an overt element. The fact that some publicity on the more newsworthy aspects of such a recovery activity would provide additional cover for CORONA, assuming that the "package" itself could be adequately protected, was another attraction.

Through "normal" channels, though with a fair amount of discreet pre-planning, BMD was authorized to operate its own recovery squadron. A contingent of C-119J aircraft equipped for aerial recovery was drawn from the Tactical Air Command, essentially complete with air and ground crews at least in part familar with the requirements of the original GENETRIX operation. General Orders activating the contingent as the 6593d Test Squadron (Special) took effect on 1 August 1958.[31]

Initially, the squadron moved to Edwards Air Force Base to begin intensive training and practice. Both balloons and high-altitude aircraft were used to release "training capsules" for C-119 retrieval. Within a few months, in time to meet the schedules for first capsule recovery, the squadron was to move to Hawaii, the center of the planned recovery area. Other essentials, such as tracking stations in Alaska, Hawaii, and at Vandenberg Air Force Base; the seaborne task force to provide an optional recovery mode if air catch failed; and a plan for returning a recovered capsule to "black" channels after its "white" recovery, were arranged relatively early. The matter of who should operate the tracking stations, particularly the one at Kaena Point, Hawaii, and the question of how to stage a "shell game" that would let the real capsule vanish enroute to the mainland caused some later difficulty, but during the summer of 1958 nothing of this sort was foreseen.

CORONA Contractor Arrangements and Progress

Of more immediate concern was a serious controversy between Lockheed and General Electric that threatened the stability of program management. Although the apparent difficulty was the inability of the two to agree on a General Electric work statement, the real problem was more deep-seated. During the early weeks of April, General Electric proposed to Lockheed and the Air Force a separate third stage, which it would design and build. Although an Air Force-Central Intelligence Agency ruling on the final design presumably resolved the issue in May, in June the contractors were at odds again. To the CORONA managers at BMD it appeared that they were jockeying for position, each attempting to ensure a favorable position for future programs. General Electric held that Lockheed wanted General Electric to deliver basic hardware which Lockheed would thereafter engineer, modify, and install; while Lockheed maintained that General Electric wanted to deliver a sealed package for Lockheed to load and launch without question. Each contractor pressed his viewpoint on the CIA and the Air Force. The issue was resolved in June with the respective roles of the prime and the subcontractor defined in work statements acceptable to both.[32]

Lockheed, General Electric, and Itek designed their systems and subsystems basically in conformance with a philosophy jointly agreed upon by the CIA and the Air Force. Of the available technical approaches, that one offering the best potential for success during the period of prospective operation was almost always adopted. Reliance on existing techniques or relatively simple extensions of the current state-of-the-art was universal. Reliability through simple design rather than an attempt to derive "the last few percentage points in perfection of product" was a consistent policy. Proceeding on this basis, Lockheed was able to report the total system design ready for initial review on 14 May, design freeze on 26 July, and release of engineering drawings on 23 October. By all indications, the technical program was proceeding at a reasonable pace.

CORONA Management Arrangements: The ARPA Factor Revisited

As much could not be said for all the program management aspects of CORONA. Starting about September 1958, a succession of difficulties and uncertainties began to plague CORONA managers. In part they were the natural but nonetheless unwelcome offshoots of a tightly scheduled program with unusually important objectives. Another portion, however, derived from the peculiar alignment of technical and managerial responsibilities which saw BMD, ARPA, CIA, and several high officials in the Administration sharing authority. In particular, the ill-defined role of ARPA in the CORONA program proved troublesome.

As ARPA assumed control of the entire military space effort during the summer of 1958, the tendency of that agency was to redirect space programs toward ARPA's own objectives. Moreover, the National Aeronautics and Space Administration (NASA) was gradually acquiring control of the obviously "scientific" and "research" aspects of the national space effort during the summer of 1958; ARPA both resisted that trend and attempted to create an alternate program which would give it a significant and lasting role in space operations. WS-117L funds provided the largest portion of fiscal 1958 ARPA resources and constituted the most valid justification for a large fiscal 1959 ARPA budget (the Thor-Agena [CORONA] program nominally fell under the budgetary aegis of WS-117L). ARPA's tendency to redirect WS-117L toward new objectives indirectly affected the immediate conduct of CORONA itself, but ARPA's attempt to exercise direct control over portions of the CORONA program, largely by manipulating the purse strings, threatened much greater consequences. Finally, as the fiscal 1960 budget cycle entered its closing phases, the matter of continuing some form of CORONA into calendar 1960 became of increasing concern. If CORONA proved successful, a matter which could not be judged until the first satellite reconnaissance photographs were actually examined, its continuation was logical. The question of its continuance as a covert operation—the matter of whether cover could be successfully maintained past the period of "engineering" and "biomedical" flights—versus its reincarnation as a highly secure but overt activity, had to be faced eventually.

The original CORONA approval of April 1958 had been based on 10 vehicles. The CIA-Air Force plan, however, called for a minimum of 12 shots (on the assumption of one-third successes) and the need for a minimum of four successful reconnaissance flights to provide adequate coverage of the Soviet Union. In June, Colonel Sheppard had convinced Air Force Secretary James A. Douglas of the need to provide enough additional money (through ARPA) to keep ahead of the "lead time problem" and to ensure a continuing flow of Thor boosters and Lockheed second stages. On 2 July, Secretary Douglas responded with an open directive to BMD which expanded procurement authority as Sheppard had urged.[33]

The 14-vehicle program thus constructed accommodated the 12 scheduled CORONA flights and two engineering or biomedical tests. It lasted only until 6 August, when BMD learned of ARPA instructions that the "Thor-WS-117L" program was to be expanded by nine vehicles in addition to the 10 currently authorized. (Biomedical payloads were specified in the ARPA directive, though with the proviso that "special payloads . . . to investigate and measure certain suspected space phenomena" might later be substituted.) The new addition essentially provided for seven real biomedical payloads in addition to the 12 CORONA packages. Its timing and the fact that ARPA was then attempting to retain control of the "Man in Space" program (which subsequently went to NASA), indicated that ARPA intended to use the "Thor-WS-117L" program as a counterweight to the announced NASA biomedical program.

By virtue of these and related changes, the total WS-117L program had risen by September 1958 from a FY-59 budget level of $107 million to a total of $296 million. Of this total, $215 million was shown in the current proposed development plan for WS-117L and the remainder was required for purchase of additional Thor and Atlas boosters. ARPA apparently intended at least $8 million to go for biomedical research and $18 million to long-lead items. Another $11 million, not shown in the "open" totals, was CIA money supporting "black" CORONA procurements. (The April 18 plan approved by the president had contemplated expenditures of $7 million for "black" hardware and R&D, plus $24 million for Thor and Agena development and procurement. That $31 million total reflected an increase of $11 million over the first [9 April] cost estimates.)

In this maze of chaotic figures, ARPA Director Johnson, in August, identified $65.5 million as "open" CORONA money, concluding that an additional $13 million in fiscal 1960 would see to the purchase of the 19 scheduled vehicles as well as programmed engineering changes. He also suggested that CIA bear a larger portion of the cost, arguing that the CORONA effort was principally for CIA benefit.

On 1 October, revised CORONA program costs reached Bissell. The total shown was $129 million, the bulk of the increase arising from the reestimates by Lockheed and its subcontractors.

ARPA had questioned the validity of the cost increase, protested its size, and passed the matter to the CIA. Bissell, in turn, protested strongly. He cited the fact that the funding estimates of April, used in obtaining approval for

CORONA, had totaled $31 million, and he told General Ritland that if McElroy, Dulles, and Killian had been aware of the prospective costs in April they would never have recommended the program to Eisenhower. Displaying the effects of having just been scored by Killian, Bissell told Ritland that "CORONA [is] simply not worth $129,000,000 [in] ARPA funds plus $11,000,000 [in] CIA funds." Dulles, Killian, and McElroy were slated to discuss the entire affair with the president in the immediate future, he added, and it seem probable that ". . . complete cancellation of CORONA will be considered."

Bissell had concluded that CORONA was being charged for undefinable development costs that actually belonged to the remainder of WS-117L. He urged that the two programs be disengaged for funding purposes, and made some references to "rubbery accounting systems" and "juggling costs." In a separate message to Colonel Sheppard, Bissell said sadly that "all of us concerned with CORONA have some embarrassing explaining to do."

Apart from being more accustomed to differences between early estimates and actual program costs, Ritland and Sheppard were less alarmed than Bissell because they were closer to and more aware of the remarkable convolutions of the program during the preceding six months. To explain the situation to their CIA counterparts, they detailed program fluctuations and broke down the cost totals to show that changes in the level of engineering effort and in the scope of the program had caused price increases. Sensitive to the implications of reprogramming, they added the caution that a covert program could not be conducted under requirements for constant rejustification and that it would be advisable to keep program matters in the hands of program participants. In their reply they also included a resume of CORONA potential and a further explanation of the worth of the basic Thor-WS-117L program as a major contribution to the national space effort.[34]

Before the end of October the problem was largely resolved by the personal intervention of Schriever, Ritland, and Sheppard with key CIA and White House officials. The role of ARPA in the funds crisis and the cancellation threat received implicit confirmation through a subsequent agreement between Schriever, Killian, and Bissell that the funding totals provided by the Air Force were reasonable and that henceforth the role of ARPA should be as a "utility intermediate" without authority "to steer or affect CORONA." But the basic suggestion earlier endorsed by Bissell, that it would be advisable to separate CORONA from the balance of WS-117L, continued to receive attention.

ARPA had taken a preliminary step in this direction early in September. All reaction was not favorable. Colonel Oder, for instance, contended that program segmentation would draw too much attention to CORONA, since the rationale for the Thor-WS-117L program was partly based on "engineering tests" of WS-117L upper stages. Oder also emphasized that once the Thor-boosted vehicle was recognized as a separate "scientific" program, scientists would expect to see recovered data. A counter argument, of course, was that continued association of a Thor-boosted satellite with the Atlas-WS-117L effort would lead inevitably to the conclusion that CORONA flights were reconnaissance oriented. The fact that efforts to improve the image of the US space "program" had caused WS-117L to be openly identified with reconnaissance—and even glorified in that role—tended to color all aspects of the

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original program. The name "Sentry," given the WS-117L program in September 1958, was itself compromising.[35]

Early in November, Bissell went to General Goodpaster (who was responsible for liaison between CIA and the White House) with a strong suggestion that the CORONA flights be completely separated from the balance of the Sentry program and covered by a scientific satellite mission assignment. Almost concurrently, a special scientific committee examining the status of the entire reconnaissance program became aware of the problems generated by the latest instance of ARPA interference. Dr. Edwin Land, of that committee, made it clear to ARPA's Johnson and Richard Cesaro that CORONA was "an operating program to achieve a limited objective" and was not to be "subjected to or perturbed by R&D tinkering; and that the actions of all must be primarily governed by security since exposure of the program must be avoided at all costs." Bissell also pressed the point of limiting the ARPA role in a letter to Major General Jacob E. Smart, Assistant Vice Chief of Staff, USAF on 25 November 1959. During the U-2 days, Smart had worked effectively with Bissell to remove unnecessary blocks to the program within the Department of Defense.

There was no indication that the ARPA officials were very much impressed: they promptly proposed the deletion of three of the scheduled biomedical shots and the addition of a "Super-CORONA" satellite, essentially an Atlas-boosted CORONA with an "improved" recoverable payload. In other channels ARPA people also suggested that CORONA be reoriented toward an electronic-readout system rather than a recovery payload system. (Electrostatic tape systems were great favorites with ARPA that fall.) On the whole, however, such notions had a cool reception. Dr. Land, influential in both CIA and high administration circles, was particularly insistent that the nation take advantage of what was available rather than plan any expansive substitute programs.[36]

Notwithstanding Dr. Land's words, on 25 November ARPA officially notified ARDC that two of the scheduled biomedical tests in the Thor-Agena series were to be cancelled; however, no change was made in the total number of vehicles.

A 1 December 1958 memorandum report from the ARPA staff to Johnson, motivated by new funding strictures directed from the Office of the Secretary of Defense, allotted $160 million for WS-117L in fiscal year 1960, instead of the $297 million earlier programmed. In order to stay within the funding limit, the ARPA staff proposed cancelling all newly proposed Thor-boosted shots and reducing the approved total from 19 to 15 shots. Two of the 15—the cancelled biomedical tests—were to be further abstracted for transfer to "other" ARPA programs. Of the remainder, the first two were to be vehicle development tests, the next two were to carry mice, eight were to be in the CORONA configuration, and the 13th was to carry a small monkey. All were to be fired from the Pacific Missile Range launching facility.

The 1 December report also stated a significant new ARPA philosophy: ". . . ARPA's program responsibility ends when a system has been brought through its Research and Development. At this point it is available for users." And most significantly, thereafter, the "user" would have to fund the program.[37]

When word of ARPA deliberations first reached BMD, late in November 1958, the WS-117L office concluded that ARPA meant to support 15 of the scheduled 19 flights and that the Air Force would have to find money for the remainder. The fact that no ARPA money would be available for CORONA after fiscal 1960, and that the Air Force presumably would have to carry on the program from its own resources, prompted thought for a program approach based on the transition of CORONA to a highly classified Air Force program managed under the WS-117L aegis. Toward this end, there was renewed discussion of separating the Thor-boosted satellite program from Sentry.

A succession of meetings in Washington took up the several critical issues arising from the latest ARPA actions. Late on the afternoon of 4 December, Air Force Under Secretary Marvin A. MacIntyre wrote a memorandum to himself, had R. W. Johnson's signature block typed at its foot, took it to Johnson, and obtained his signature. The directive formally created a separate Thor-WS-117L program, under the nickname "Discoverer," to include "a number of systems and techniques which will be employed in the operation of space vehicles."[38]

Uncertainties concerning FY-60 funding were eliminated in the course of a 15 December meeting during which the participants decided that eight CORONA firings would complete the ARPA development effort and that the remaining four CORONA flights would require Air Force funding. By a memorandum to MacIntyre, two days later, Johnson confirmed the agreement and formally specified the research agency's intention of sponsoring only 13 Discoverer flights: two vehicle tests, three biomedical flights, and eight CORONA launchings.[39] The settlement was not reached easily, however, since first Air Force and CIA officials had to convince ARPA that a readout program was not available to substitute for CORONA recovery techniques. There were interesting sidelights: on the afternoon of Johnson's directive, Colonel Sheppard discovered a Pentagon staff officer busily attempting to rejoin Sentry and Discoverer as a Top Secret program. The officer was convinced that ARPA had succeeded in stealing an Air Force satellite program.

Improving CORONA Cover and Security

With the establishment of the Discoverer project as a formal, autonomous activity and with the open identification of Sentry as a reconnaissance satellite, the conditions for conducting CORONA were somewhat altered. The first scheduled Discoverer launching was but a month away in December 1958, and this impelled thought for improving the cover story.

In a sense, the disclosure that Sentry was a reconnaissance program tainted all aspects of the earlier development effort, including what was now Discoverer. Additionally, the international political climate was even more hostile to overflight than formerly. Indeed, in the opinion of CORONA personnel "this hostility has manifested itself to the point where high government officials might cancel the CORONA program should it continue to be identified with such efforts."

Cover requirements were straightforward.[40] ARPA participation had to be logically explained: if Discoverer was not a military program, why was ARPA involved? Any intelligence interest in or associated with Discoverer had to be concealed, as did any military reconnaissance implications. Finally, it would be essential to obscure any direct connection between CORONA (as Discoverer) and a later Sentry vehicle with similar equipment. By the same token, a logical explanation was needed for using a polar orbit. Finally, cover efforts should satisfy professional curiosity by ensuring a "logical sequence of technical effort and the production of a product having military application."

The proper approach appeared to be to release enough information to discourage untidy speculation and to dispel any air of mystery. It also seemed useful to offer "consistent but much more complete technical explanations (. . . at least in part classified) to the considerable number of persons who do not need to know the true purpose of CORONA but are in a position to guess what it involves unless they are provided with a convincing alternate explanation." Military and contractor personnel at the launching site, in the recovery force, and in related military and corporate organizations fell into the latter category.

Inasmuch as the CORONA configuration and the Discoverer biomedical configuration would be outwardly indistinguishable, there was no great concern for unauthorized observation and no real need for "closed" launchings. Press releases, by emphasizing hardware tests rather than scientific probes, would help to prevent interference from "the vast number of scientists who claim a right to such data."[41]

The CORONA office also expected to take advantage of the planned "leaks." Lockheed personnel connected with the special Advanced Project facility were to divert attention from the true purpose of CORONA by filing personal requests for data on electronic countermeasures, ablation, vehicle maneuverability, reentry control and guidance studies, magnetic effects data, and infrared sensors, thus prompting conclusions that the "special facility" was concerned with classified work in such areas.

The use of a recoverable capsule could be explained as the only means of ensuring that recorded data were reserved for the United States, that recovery was the only means of providing visual inspection of equipment returned from orbit, that it provided the most accurate data records, and that it permitted the reuse of costly equipment. Polar orbits (which were somewhat illogical in the light of the facilities available for equatorial orbit tests) were to be explained in terms of range safety requirements and the possible exercise of the missile warning-net. Thus, there emerged explanations that Vandenberg Air Force Base was so located that only a polar launching was possible, that Air Force research vehicles had to be launched from Vandenberg because of limited facilities at Cape Canaveral, and the fact that the vehicle passed over the Soviet Union was incidental.

Military and contractor personnel who inadvertently became aware of the presence of CORONA cameras could be told either that they were intended for astronomical observation and were not being publicized because of the possibility of misinterpretation or that they were used as part of the stability tests, to provide a continuous record of the attitude of the vehicle by photographing the horizon.

One major unresolved issue remained of those created by the ARPA-directed program alterations of November-December 1958. With the marked reduction in ARPA support, only eight CORONA firings were covered by approved funds. The remaining four in the original series plus any follow-on firings had to be dealt with in some fashion.

Assuming the need for the photographic product would still exist, either CORONA would have to be continued as a completely covert element of Discoverer or all Discoverer flights following the eighth CORONA would be part of a highly secure but "normal" noncovert approach.

As a hedge against the possibility that continuation of a covert CORONA program might not be approved, the Discoverer program office prepared a development plan providing for 20 highly secure but noncovert Discoverer reconnaissance flights extending through 1960. This plan was submitted along with Sentry and Midas development plans by BMD to the Pentagon in January 1959. On 2 February 1959, Air Force Under Secretary MacIntyre directed that the 20-flight proposal be integrated with a revised and integrated CORONA effort and funded within the total available FY-59 Discoverer-Sentry funding.[42]

These deliberations caused security concerns for the CIA-Air Force CORONA management teams. Some of the Discoverer supporters and Air Staff planners were not CORONA-briefed. Continuation of the covert CORONA program meant that cover and security actions were necessary to provide for a larger and longer program.

A simple extension of the Discoverer program with provision for sufficient flights to cover 20 CORONA operations was the most direct means of documenting the program and obtaining the necessary funds. That course was complicated, however, by the ARPA's February action in cutting the program back to 13 vehicles and cancelling procurement authorizations for all additional Discoverers. Under existing arrangements, funding had to come through ARPA.

Through CIA, General Ritland arranged an unofficial but effective authorization to continue work on all of the 19 vehicles earlier scheduled. Bissell assured Sheppard that funds were available. On 1 April, $20 million in "emergency funds" came to hand, drawn from the President's Reserve. Of the total, $2.4 million was diverted to the CIA to fund additional camera subsystems and $17.6 million to ARPA to finance reexpansion of Discoverer. The Air Force scraped up an additional $10.4 million by reprogramming, to cover the residual requirement.

A means of effectively throttling support for a noncovert reconnaissance Discoverer had to be devised, and it had to be convincing because, as with the situation a year earlier, the entirely logical notion of using Discoverers to loft reconnaissance payloads had attracted a swarm of eager devotees. Sheppard concocted the antidote. He sent to Bissell a message which could be transformed into a directive from Air Force Assistant Secretary Richard E. Horner to General Roscoe Wilson, on the Air Staff. Wilson would then shape it into a formal directive to BMD. It would (and ultimately did) say that Horner had been briefed on using Discoverer for reconnaissance early in February, that the cost and risk of that approach were incompatible with the gain over established projects (Sentry), and that the proposal was, therefore, disapproved. But because of other attractive alternatives Discoverer was to be extended to include 25 flights lasting through 1960 and sufficient funds were available.

On 27 April, Air Force headquarters officially instructed BMD to undertake the 25-flight Discoverer program. The ARPA directive legally required to authenticate such an expansion was issued on 20 May, thus closing the circle.[43]

A final installment in the restoration of complete cover for CORONA was an interchange of letters between L. Eugene Root, Lockheed vice president, and General Schriever. The maneuver was planned in March as a means of satisfying curiosity that might have been aroused both in BMD and in Lockheed by the recent turmoil. The letters, classified Secret, handled through "normal" security channels, and seen by any number of people at both sites, would in the normal course of events provide a "Secret" explanation for some of the peculiar aspects of the current situation. Root's letter, dated 7 April, opened with a reference to "recent conversations" and the fact that the Sentry program was relatively well known in industry as a readout effort. Root remarked that he had been approached by several concerns proposing recoverable photographic payloads for Discoverer capsules for the 1959-60 period, before Sentry became available. What, he asked, should be Lockheed's position?

During the interim, Ritland had replaced General Schriever as commander of BMD. Ritland, in a letter that had been widely "coordinated" within BMD, said BMD had also been approached, had arranged a quick reassessment of the Discoverer reconnaissance potential, and had learned that it would take too long to get results through Discoverer reconnaissance. He explained that available cameras were too heavy, that test schedules would not permit early introduction of photographic payloads, and that ". . . the Discoverer . . . already has too many complications of a sensitive nature without adding the probably unsolvable complications of a reconnaissance mission." (Colonel Sheppard was uniquely adroit at answering his own letters.)[44] The letters served their intended purpose.

In the spring of 1959, an effort was made by the US Army, on behalf of the Army Map Service, to obtain ARPA approval for a reconnaissance satellite program to obtain precise geodetic data on the Soviet Union for the ultimate purpose of pinpointing strategic targets. Because such a program would impinge upon CORONA from a security standpoint and would compete for launching facilities, it was decided, through coordination with the Secretary of Defense, that the program would be administered within the organizational framework of CORONA. This was done to protect the security of the latter and to establish priorities for launching scheduling. An agreement between CIA and ARPA on the control of the mapping project, named ARGON, was signed on 7 July 1959. This gave CIA authorization to contract for the exploitation of ARGON's product for the Army Map Service and to maintain security control over the project. Approval was received from the White House on 21 July, 1959.

The Early Flight Program

The attempt to launch the first Discoverer satellite, on 21 January 1959, was aborted by the premature ignition of ullage orientation rockets on the upper stage. The second stage vehicle was severely damaged and the Thor was withdrawn for major overhaul.

Discoverer-I — actually the second scheduled flight vehicle — left the Vandenberg launching pad on 28 February 1959, and established an orbit with an apogee of 605 miles and a perigee of 99 miles. Although somewhat more eccentric than planned, its flight constituted a success. Since no capsule was carried, recovery was not attempted.

Discoverer-II was also reasonably successful in establishing orbit, following its 13 April launching. Unhappily, human error in setting the satellite's timer caused the capsule to eject halfway around the earth from the planned recovery zone, descending near Spitzbergen, Norway. There were reports that the descending parachute was actually observed.

At that time Air Force Lt. Colonel Charles "Moose" Mathison (who was not cleared on the CORONA Program), a protege and confidant of General Schriever, was assigned as Vice Commander, 6594th Test Wing (which operated the ground station and control facilities for the Air Force satellite programs). When Mathison heard of the Spitzbergen sighting report he, together with a junior officer from BMD, flew in civilian clothes by commercial airlines to Norway. There Mathison enlisted the aid of a high-placed Norwegian Air Force Officer to make a ground and air search near Spitzbergen. No sign of the capsule was found. Because of ski marks in the probable impact area some of the more impressionable program personnel concluded that the capsule had been captured by a resident Soviet mining party. If such had indeed been the fate of the Discoverer-II capsule, it did not gravely disturb CORONA managers: the missing capsule had carried "mechanical mice," electronic devices rigged to record biomedical effects data.

Discoverers-III and -IV, launched on 3 June and 25 June, failed to reach orbital velocities because Agena thrust did not meet expectations. The 3 June flight carried another biomedical payload, but the 25 June vehicle contained the first of the CORONA cameras. Because of the failure to orbit, no data on camera-operating characteristics were obtained.

All these malfunctions created problems for Bissell and his staff. After the January 1959 failure, President Eisenhower upbraided Bissell personally. After the second failure on 25 February, Eisenhower began asking DCI Dulles for explanations. As Bissell subsequently recalled:

> It was 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 recce satellite, you fire the damn thing off and you've got some telemetry and you never get it back. There is no pilot, of course, and you've got no hardware, you never see it again. 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.[45]

After the disappointing failure of the first CORONA satellite with a camera payload—Discoverer-IV—to achieve orbit on 25 June 1959, General Ritland asked Space Technology Laboratories to perform an independent analysis of the CORONA system with particular reference to design and performance margins.

As a result of system failures, CORONA was running short of cameras and more units, as well as more reentry vehicles, had to be purchased. The new cameras, ordered on 26 July 1959, were essentially the same as the first HYAC cameras except for an improved velocity-over-height compensation system. They were known as C′ units. General Electric built an improved reentry capsule that could hold twice as much film as the first model—an increase from 20 to 40 pounds. This new CORONA configuration was designed to stay aloft for two days instead of one.

After Discoverers-V and -VI failed in orbit in August 1959, BMD halted the launching program once again to permit a new analysis of the recovery capsule failures. A succession of exhaustive ground tests, involving both the capsule recovery subsystem and the camera subsystem, lasted well into October 1959, when it seemed feasible to resume launchings. The analyses revealed several areas where technical weaknesses existed: (1) the reentry subsystem was being exposed to temperatures lower than those for which it had been designed; (2) insufficient electrical power was being provided to the reinjection squibs; (3) telemetered information was insufficient to establish the point of reentry system failure; (4) it had been impossible to track the reentry vehicle until parachute deployment occurred; (5) data on the capsule-separation sequence were imprecise; (6) the reentry capsule had marginal stability characteristics; and (7) telemetry did not adequately indicate the precise pitch angle of the Agena vehicle before capsule separation. The first flight items modified to correct such deficiencies left Lockheed for the launching area in late September. Subsequently, ground tests revealed that the spinup rockets had been deficient in quality, and those originally installed had to be replaced at Vandenberg.

An additional significant change resulted from the August 1959 failures: conceding that CORONA operations were being conducted in a high-risk environment and under a high-risk philosophy, BMD began a long-term instrumentation and analysis program as insurance against further failures.[46]

Lockheed also acted to increase the electrical power output of the satellite batteries and to instrument the recovery capsule much more elaborately than had initially been thought necessary. In part, this was the consequence of the report by a special STL study group which on 8 September seriously urged that the program be halted to permit additional engineering refinement of the Agena and the recovery capsule. It appeared both to the STL specialists and to the BMD program managers that Lockheed had been overconfident and that the Agena and capsule section were not instrumented adequately. Lockheed, in the words of one scientist, had not "instrumented for failures."[47]

The next two Discoverer flight trials, on 7 and 20 November, were as disappointing as their predecessors. Discoverers-VII and -VIII both had subsystem failures which prevented recovery of the capsule, and in neither instance did the camera system function properly. The Ballistic Missile Division again suspended flight tests.[48]

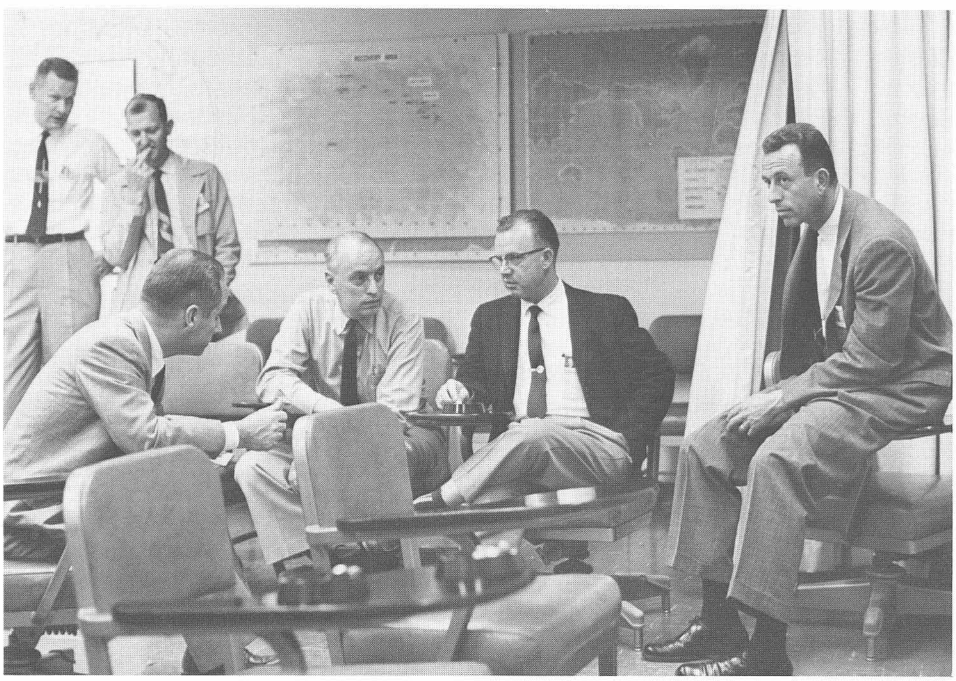
Not until February 1960, after two months of intensive corrective engineering, were the launchings resumed. Unhappily, neither of the boosters used in the February flights (Discoverers-IX and -X on 4 and 19 February) functioned properly and in neither case did the Agena go into orbit. Some additional complications were provided when it was necessary to destroy Discoverer-X during its climbout, and parts of Vandenberg Air Force Base were showered with assorted residuals of the flight vehicle. Special security precautions were quickly enforced to protect the project from compromise.[49]

One innovative design feature on Discoverer-IX deserves mention. A cooler was needed for the fairing interface, which was heating up during ascent. A water receptacle was installed around the leading edge of the fairing, the idea being that the water would boil during ascent, with steam carrying away the heat. In order to contain the water and prevent sloshing, something absorbent, soft, and easy to work with was required. After conducting a test program on various materials, the design engineer chose sanitary napkins.

Discoverer Flight Summary - 1959

Discoverer No.	Mission No.	Date	Camera	Remarks
I		28 Feb	N/A	No capsule flown.
II		13 Apr	N/A	Capsule ejected over Norway.
III		3 Jun	N/A	Agena did not orbit.
IV	9001	25 Jun	C	Agena did not orbit.
V	9002	13 Aug	C	Not recovered. Camera failed on Rev 1.
VI	9003	19 Aug	C	Retrorocket malfunction. Not recovered. Camera failed on Rev 2.
VII	9004	7 Nov	C	Agena failed to orbit.
VIII	9005	20 Nov	C	Bad orbit. Camera failure. No recovery.

Although there was little reason for optimism at this point, the AFBMD engineers continued to insist that the program would eventually be successful. In January, production and flight schedules had been expanded by four additional vehicles to accommodate the newly approved ARGON mapping camera program, an Army-sponsored covert effort. This change had been stipulated because Army mappers were increasingly restless in their claim that cartographic interests were underemphasized in CORONA's flight schedule. No additional resources, money, or people accompanied the program expansion. The total number of approved Discoverer launchings was now 29. (Of these, 20 were to be CORONA flights, four ARGON flights, and the remainder were biomedical and test vehicle flights.) CIA middle management began to show understandable discouragement, both over the flight vehicle failures and the parallel camera subsystem failures; by March, there was renewed discussion of cancelling the CORONA requirements in the Discoverer program. Hearing this, Colonel Paul Worthman, the Air Force CORONA Program Director (vice Colonel Sheppard) suggested that it was too early for a wake, reminding the agency that the Atlas, Thor, and Titan had all faced and survived demands for cancellation. AFBMD, said Worthman, had come to anticipate a panic response to development problems—problems that were inevitable in any program as rushed as CORONA. Characteristically, Bissell decided that the activity should press on with renewed vigor.[50]



AFBMD Officials Confer During CORONA Countdown: (Seated, left to right, BGen Richard Curtain, Cols Paul Worthman, Quentin Riepe, and Lee Battle)

On 15 April 1960, Discoverer-XI went into orbit and the recovery system malfunctioned again. The failure was particularly disappointing because telemetry indicated that for the first time the camera had operated perfectly, all 16 pounds of film passing into the recovery capsule. Much of the credit for successful camera operation was due to a change from acetate-base to polyester-base film. But the failure of the recovery system triggered a personal message from the AF Vice Chief of Staff, General Curtis LeMay, to Lockheed, urging "extraordinary corrective actions" and the personal attention of top Lockheed management to the elimination of defects in the system. Lockheed's response was to propose a further round of tests in environmental chambers plus diagnostic flights in which the capsule would be instrumented specifically for recovery system telemetry.[51]

Discoverer-XII, planned as a diagnostic flight, climbed very briefly from the Vandenberg launching stand on 29 June 1960: erratic horizon scanner operation caused a nose-down position during separation of the Agena from the Thor booster. In this instance, a 43-day delay in the next scheduled launching was imposed, permitting modification of several minor components to correct the problem. Key technical assistants suggested that the low reliability of Discoverer was sufficient cause for cancelling any further effort on CORONA past the scheduled 1960 flights; however, Bissell, who consistently fought for program continuance in the face of great odds, felt that the best course would be to concentrate on recovery subsystem perfection and to accept any recovered film as a program bonus rather than as an objective.[52]

During the summer of 1960, two circumstances quite independent of the Discoverer-CORONA program made the situation tense. The first was the 1 May shootdown of a U-2 reconnaissance aircraft well inside Soviet boundaries, which led President Eisenhower to cancel U-2 operations. The second was the approaching maiden flight of the first Samos (formerly Project Sentry) reconnaissance satellite, scheduled for September–October. There was a general feeling among CORONA-briefed Air Staff members that CORONA was a "poor man's" system which had slight prospect of achieving any real results. Weight-limited by the thrust of the Thor booster, the CORONA system was regarded as a handicapped competitor to the Atlas-boosted Samos. Additionally, early Samos flights were intended to demonstrate the effectiveness of a readout system and would possibly eliminate concern over complicated recovery techniques. Finally, the high-magnification camera (E-5) being developed under Samos in the late summer of 1960 was integrated with a recovery system considerably more sophisticated than that of CORONA in several important respects. On the whole, therefore, Samos offered a convenient alternative to CORONA and one which gained political attractiveness as CORONA difficulties persisted.[53]

As things continued going badly for the CORONA program, some Air Force officials considered reducing the number of test flights. However, the Air Force's own Samos program was also having its share of technical problems: the remote imagery transmission system was not working well. On 24 July 1959, Killian told President Eisenhower: "I have not seen evidence that [Samos] has had the hard-boiled technical review to determine what is realistically possible," adding that the program might be too costly. His view was seconded by members of the President's Science Advisory Committee.

The early failures of the CORONA program had a variety of causes. The engines on the Thor booster burned until all fuel was exhausted, at which point the Agena engine was fired to reach orbital velocity. This procedure was not always successful. On other occasions, the Thor engines would burn too long and cause the spacecraft to go in a higher than desired orbit. Some missions that succeeded in orbiting failed later, owing to malfunctions of the space platform's three-axis stabilization system (which caused the satellite to tumble). Even when the Thor-Agena and camera systems functioned perfectly, the mission could still be classified a failure because of malfunctions on the satellite recovery vehicle (SRV). In the latter case, Lockheed specialists theorized that the hot-gas spin rockets on the GE-designed SRV were not igniting simultaneously and, instead of spinning the SRV, were causing it to cartwheel and to enter unintended orbits, rather than return to earth. At the suggestion of Willis M. Hawkins, Lockheed's Manager of Space Systems, Lockheed engineers designed a cold-gas spin-stabilized rocket system that was retrofitted into the GE vehicles, beginning in June 1960. The use of these rockets was largely responsible for the initial success in recovering objects from space.

Cols Fritz Oder and Ed Blum Await Discoverer Launching

Because of the heavy pressure for at least some success, the launching of Discoverer-XIII — the second of two diagnostic flights — on 10 August 1960 took on great importance. The vehicle was successfully inserted into orbit. The recovery package was expected on revolution 17. Recovery and support elements were on station well before scheduled parachute deployment time. Capsule separation, retrofire, and reentry events were near perfect, with the predicted impact point (330 nautical miles northwest of Hawaii) being very close to plan. Because of some confusion in communication between the C-119s and the control RC-121, air recovery was not possible; however, splashdown was sufficiently close to sea-recovery elements that within a few hours the capsule had been retrieved from the water by helicopter and deposited on the deck of the surface recovery ship, *Haiti Victory*.

On the morning of August 12, Major R. J. Ford, of the Air Force CORONA office, sent a terse message across the cryptographic lines to Washington: "Capsule recovered undamaged." It was both the shortest and the most welcome of the thousands of communications over that network in the previous two years.[54]

Return of the capsule and its ultimate disposition were expected to conform to a plan laid down 18 months earlier which called for capsule delivery to a courier from BMD, the courier's return to California (probably by commercial airliner), and the surreptitious exchange of the container for a dummy, shortly thereafter. The regular capsule container would go to Lockheed by a rather obvious route, while the real capsule (repackaged so as not to resemble the original) would leave Sunnyvale, California, in an unmarked truck for covert shipment to the photographic-processing facility at Rochester, New York. These precautions were necessary because examination of the real capsule would disclose that it had a film-entry aperture.

Although Discoverer-XIII, being a diagnostic instrument, had no film aperture and carried neither camera nor film, the first recovery was intended to be a full-scale dress rehearsal for the handling of a "real" capsule. Immediately after XIII's successful recovery, Lieutenant Colonel Gus Ahola, Commander of the 6594th Recovery Control Group, in Honolulu, expected to meet the *Haiti Victory* at Pearl Harbor and arrange for one of his C-130s to return the capsule to LMSC engineers at Sunnyvale. On Friday, 12 August, Ahola was startled to learn that "Moose" Mathison, Vice Commander of the Sunnyvale 6594th Test Wing (previously mentioned as a Norway-bound capsule-hunter), had already landed by helicopter on the flight deck of the *Haiti Victory* and assumed charge. Mathison was about to put into effect a "Moose Courier Plan" which would be dramatically different from that authorized for the occasion. He had even told a newspaperman friend of his planned itinerary, to ensure good coverage.[55]

Later, in retrospect, it became clear that Mathison (not briefed on CORONA) had given a good deal of thought to how he believed the Air Force should handle the first Discoverer success. The occasion would offer an opportunity to redress certain inequities which had annoyed him for a long time. He had been morbidly concerned that the Air Force space program was receiving very little press exposure, and that the Air Force Systems Command, headed by his very close friend, Schriever, was not in the space limelight. The 6594th Test Wing, where Mathison normally spent his days, had not really had very much to test — its main project, Discoverer, was rarely getting into orbit. But now, with the availability of a capsule which had actually been in space, he had precisely the wedge he needed to draw attention to the fine work being done by all those people and organizations. Mathison also sensed that he was not part of an inner ring; perhaps personal capture of the capsule would bring him closer to some priviliged information.

Mathison accompanied the capsule to Pearl Harbor, arranging by radio to have the Commander, Pacific Air Force, General "Rosie" O'Donnell, meet him at the dock for a photographic opportunity. Then he transferred the capsule to one of Ahola's C-130s and began a flight to Sunnyvale, California. While airborne, he passed the time by breaking into the capsule, which he found to be almost empty. He sent a message ahead to General Ritland, and to Mr. Herschel Brown, general manager of LMSC, to meet him at Sunnyvale for another photo opportunity. During the stopover at LMSC, he did permit access to the capsule by Lockheed technicians, who removed a few items of instrumentation. [redacted]

By Saturday morning, 13 August, Mathison and capsule were landing at Andrews Air Force Base, providing a photo opportunity for the Commander,

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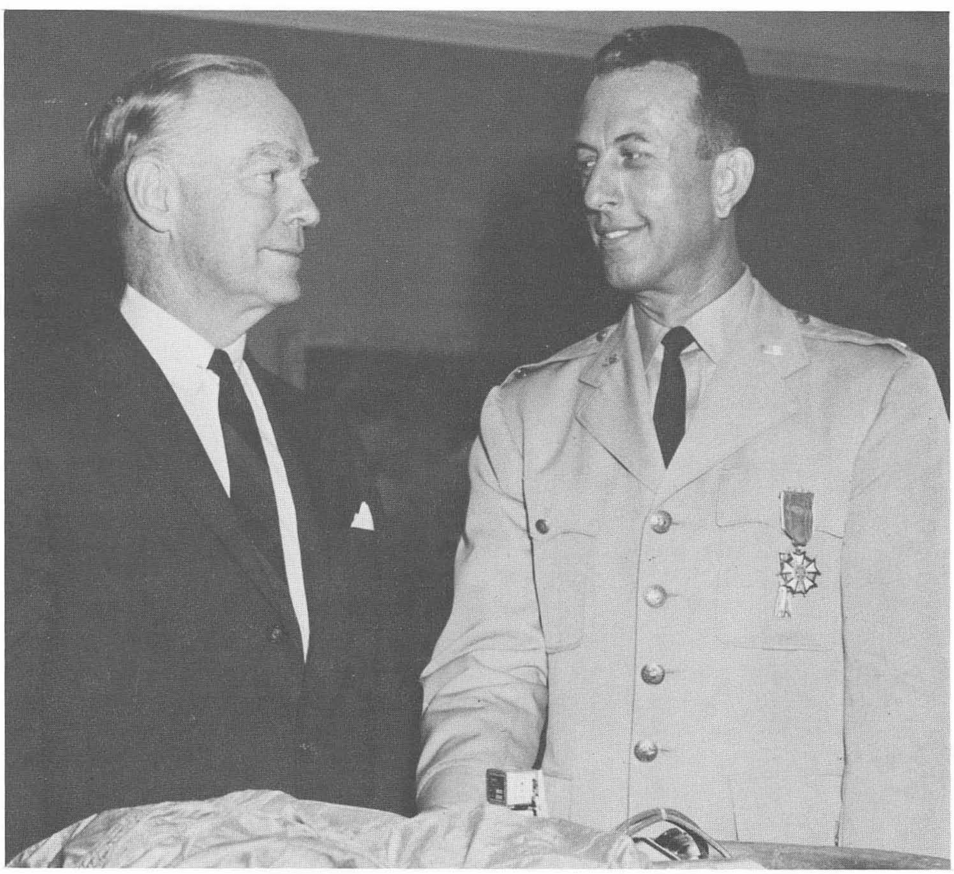
Pentagon Ceremony Marking First Recovered Discoverer Payload (left to right: MGen O. Ritland, Col C.L. Battle, AF Secy D. Sharp, Gen T.D. White, LGen B.A. Schriever, Col C.A. Mathison)

President Eisenhower Examines Contents of Discoverer Capsule on 15 August 1960 With Gen T.D. White and Col C.A. Mathison

Air Force Systems Command and the Chief of Staff of the Air Force (Generals Schriever and White). Plans for a White House ceremony were set for Monday, 15 August.

Thus a capsule which was to have been returned discreetly to Sunnyvale, for the benefit of the Air Force Program Office and Lockheed technicians who had instrumented it, made a noisy progress to the White House, where President Eisenhower hailed it as "historic." It continued to attract attention for weeks and months after Mathison released it, being displayed throughout the United States, finally coming to rest in the Smithsonian Institution's Air & Space Museum.

Mathison's unique mix of creative anarchy and casual effrontery impressed and confused the Air Force at every level from frogman to commander-in-chief. The word was out that something vaguely important had happened in the military space program and each new audience, hungry for an elusive success, assisted in raising that importance to a higher level. But the rationale for importance remained obscure, particularly to witting members of the Community. When Air Force Secretary Dudley Sharp pinned a Legion of Merit medal on Battle, citing him for "the successful recovery of a payload

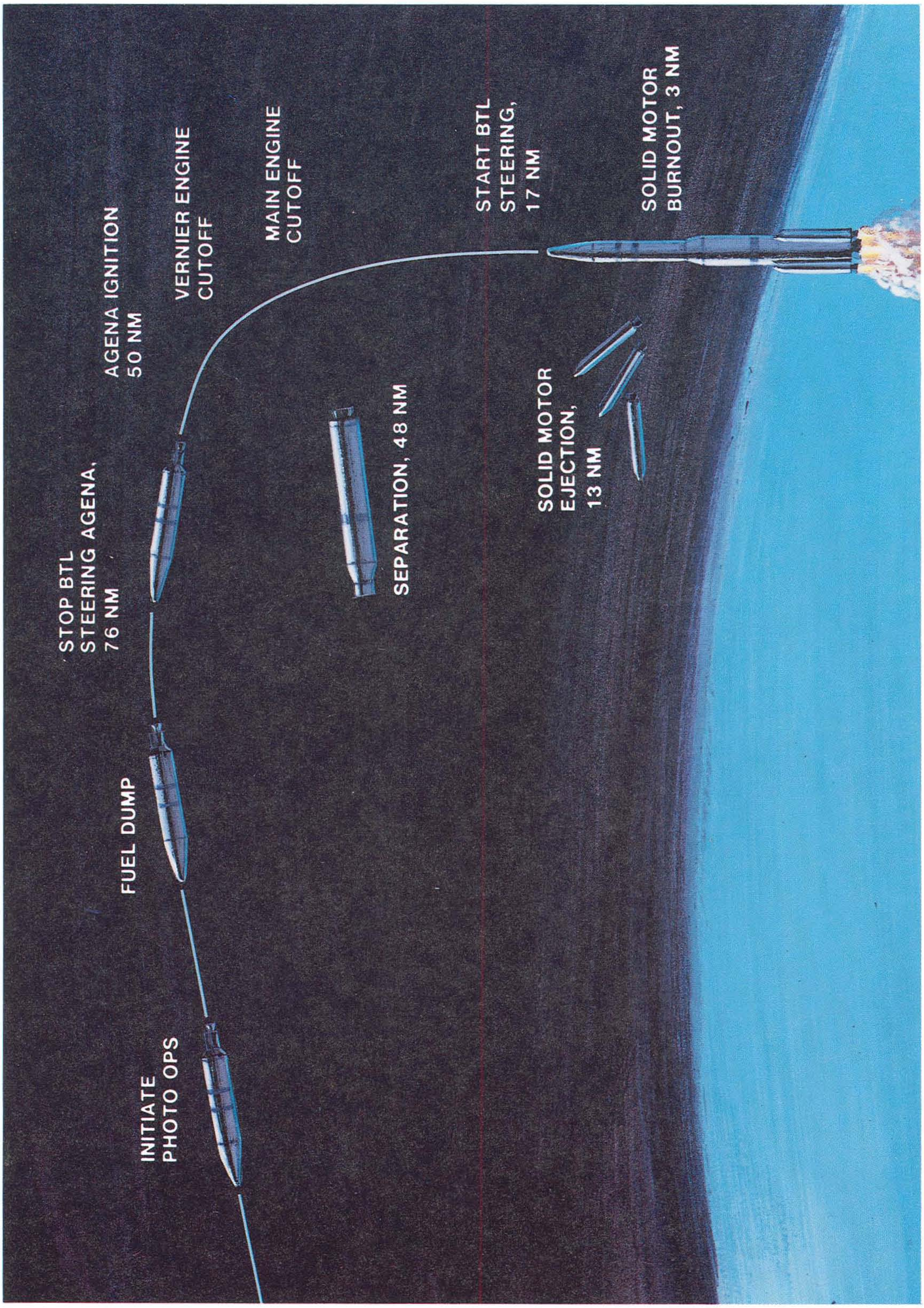


AF Secy Dudley Sharp Presents Col C.L. Battle, Jr., With Legion of Merit Medal

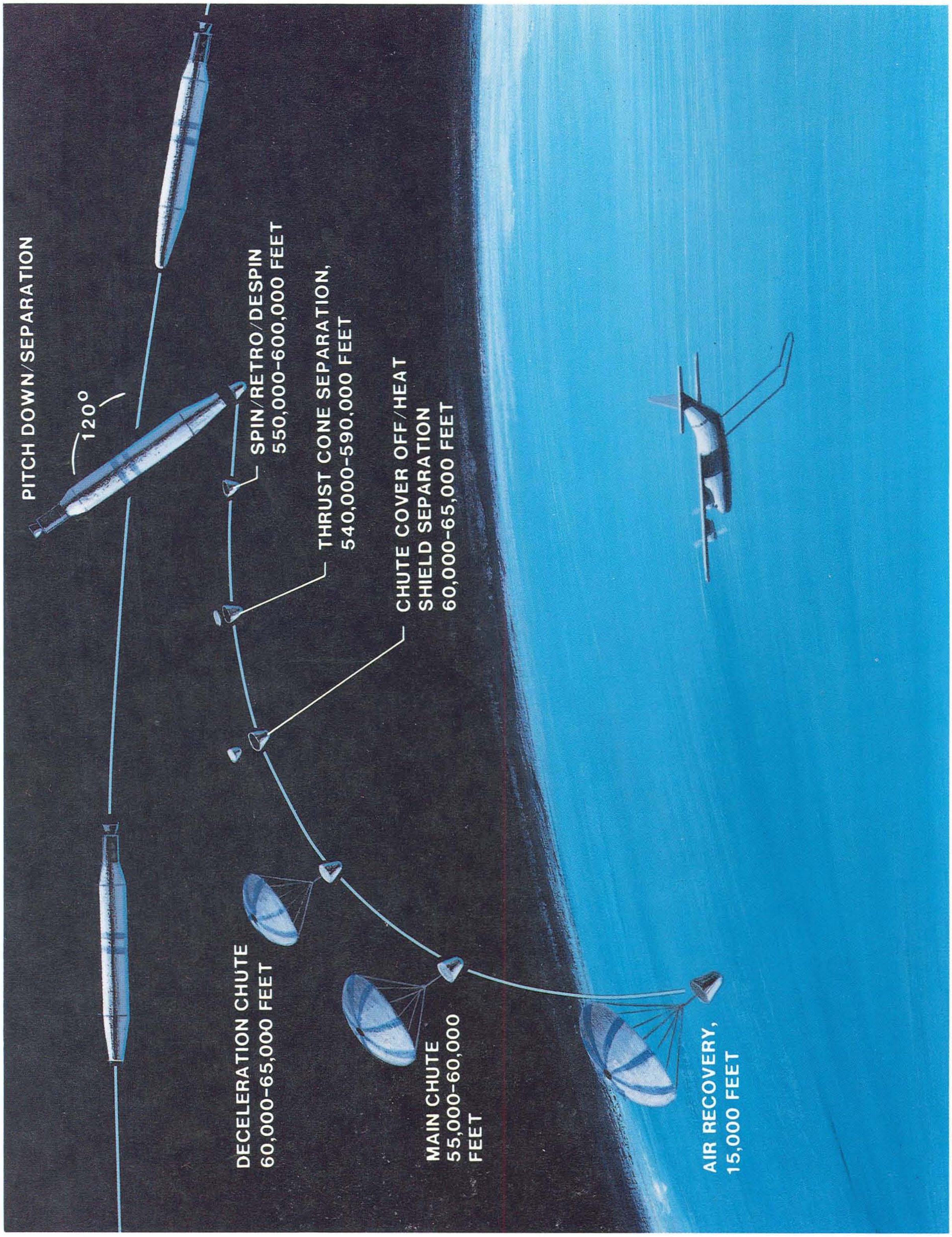
from the orbiting satellite," he was giving praise for the only part of the operation which Battle would have evaluated as embarassingly unsuccessful. Happily, the decoration was richly deserved for many other reasons, most of which occurred three days later, on 18 August, with the successful flight performance of Discoverer-XIV. The first photographic capsule was recovered, with dignity, in mid-air, and quietly couriered to Eastman Kodak for film processing.

There was to be a postscript to the Pentagon confusion. Some weeks later, the Air Force Public Information Office, still bemused by the drama of space objects being winched out of the Pacific, announced ". . . a new technique to speed the recovery of satellite capsules from space. The technique, known as 'sea-snatch,' complements the air-snatch procedure. . . ." The accompanying photographs showed a C-119 trailing its recovery trapeze, as it made a very low-level pass over the ocean. This totally spurious information might have annoyed the Discoverer office a few months earlier; now secure in the knowledge that aerial recovery was a proven procedure, the staff jovially suggested that all inquiries be addressed to Mathison.

A new official courier system had been put into effect, even while Mathison was airborne to Andrews AFB. Henceforth, there would be many Discoverer capsules couriered across the United States, but there would be no parades. Ruminating on the "parade" some months later, one of Mr. Bissell's aides (after asking if "Moose" were still alive) relented briefly to point out that the only persons more confused than Mathison must have been the Soviets, to whom he single-handedly and convincingly documented the innocent nature of a US space capsule. Clearly, it contained nothing noxious—no bomb, no camera, no leaflets—just one American flag. The aide speculated briefly that anyone so brilliant in cover and deception might find a home in the CIA's counter-counter-counter intelligence division. Then, thinking over what he had just said, he shuddered.



Corona Launching Sequence



Corona Recovery Sequence

Section 3

Achievement: A New Vantage

Discoverer-XIV, launched on 18 August 1960, paralleled the performance of its predecessor in most important respects. Additionally, it carried a CORONA camera, and the camera worked perfectly. Although the Agena had less than optimum pitch-down angle at the time of capsule separation (the capsule descended 430 miles south of the predicted impact area), the C-119s were able to complete a smooth aerial recovery. Captain Harold E. Mitchell and his crew successfully hooked the descending capsule on the third pass. Upon arrival at Hickam Air Force Base, Mitchell was decorated with the Distinguished Flying Cross and members of his crew were awarded the Air Medal.

This time, as it would henceforth, the capsule-handling procedure followed official plans. After an overt return to Moffett Naval Air Station, the capsule was taken to a Lockheed facility for removal of protective ordnance devices and radio-beacon equipment, then transferred to an unmarked container and sent to Rochester for film processing. Eastman Kodak's Ed Green and crew did all processing and duplication of CORONA film until 1962, after which the task was shared by EK and the Air Force Special Projects Production Facility (AFSPPF) at Westover Air Force Base, Massachusetts. The processed photography was finally delivered to the National Photographic Intelligence Center (NPIC), and other intelligence centers.

The fact that press photographs of the XIV capsule were forbidden was explained by citing the need for close examination of the instruments before they might be disturbed.

Initial reaction to the film from Discoverer-XIV was unbridled jubilation. CIA program officials told Colonel Worthman that photo interpreters had called the product "terrific, stupendous," and had said, "We are flabbergasted." Worthman's conservative report to General Ritland was that "apparently design specifications on resolution have been met. . . ." The photographs were of "very high quality," and, as a bonus, at least one-half of the frames exposed over the Soviet Union were clear of cloud-cover.

Detailed analysis of the XIV results showed that 3,000 feet of film had been recovered—essentially all of the 20 pounds stored in the cassettes. More than 1,650,000 square miles of Soviet territory had been acquired for photo-interpretation. Resolution was estimated conservatively at 55 lines per millimeter, and ground objects ranging upwards from 35-foot dimensions were identifiable.[57]

After President Eisenhower saw the photography from this flight, he let it be known that he wanted everything about the "take" kept secret, so as to avoid unnecessary affront to the Soviets. As this comment passed down the chain of command, his cautionary words were translated and amplified into "Destroy the capsule!" So the capsule was literally beaten to pieces and dumped into the Santa Barbara channel.

Capt Harold E. Mitchell and Crew Chief of Pelican 9

C-119 Making an Air-Catch of a CORONA Capsule

CORONA development had been persistently and energetically pursued, in the face of continuous adversity, because of the overwhelming urgency of the intelligence needs of the nation. The initial planning for CORONA began at a time when no one knew how many BEAR and BISON aircraft the Soviets had, whether they were introducing a new and far more advanced long-range bomber than the BISON, or whether they had largely skipped the buildup of a manned-bomber force in favor of missiles. There had been major changes in intelligence estimates of Soviet nuclear capabilities and of the scope of the Soviet missile program on the basis of photography from a relatively small number of U-2 missions approved for the summer of 1957. Furthermore, by 1959, the great "missile gap" controversy was very much in the forefront. The Soviets had tested ICBMs at ranges of 5,000 miles, proving they had the capability to build and fly them. What was not known was where those missiles were being deployed operationally and in what numbers. In the preparation of the National Intelligence Estimate for Guided Missiles during the fall of 1959, various intelligence agencies held widely diverse views on the Soviet missile situation. In an election year (1960) the "missile gap" became a grave political issue.* The U-2 had improved the Intelligence Community's knowledge of the Soviet Union, but it could not provide broad area coverage or the answers to most critical questions. Furthermore, all experts felt that it was only a matter of time until a U-2 was shot down. In May 1960, that dreaded event occurred, essentially ending overhead reconnaissance of the USSR by aircraft. Fortunately, Discoverer-XIV yielded much more Soviet coverage than the total of all U-2 missions.

Aside from the (expected) modest resolution of the CORONA "take," the only major deficiency was streaks of variation in density, running diagonally across the format. Some of this was due to minor light leaks and some was the result of either static electric (corona) discharge or roller pressure markings.

*In an episode reminiscent of the 1944 presidential election, when Thomas E. Dewey was constrained by wartime security from making potentially devastating revelations about Pearl Harbor, Richard M. Nixon in 1960 was constrained from revealing that the "missile gap," on which John F. Kennedy had earlier campaigned, was an illusion. The Discoverer-XIV payload was retrieved, and its intelligence information digested, two months before the 1960 election campaign ended. Kennedy, who had been made aware of the mission results, stopped talking about the missile gap. But some of his supporters did not, and Nixon's indirect assertions that there was no missile gap had little impact, because he had been saying this much earlier, when nobody really knew, and because he had subsequently adopted the policy of promising to enlarge the US missile program in much the way Kennedy proposed. In later years, when the August 1960 findings became more widely known, there was surprisingly little discussion of the potential change in election results that might have occurred if the information had been revealed.

The drought was over. Although two failures to recover and one camera breakdown kept photo interpreters waiting until the return of the XVIII capsule on 10 December 1960, there was no longer any question of the feasibility of any major element of the CORONA operation. Discoverer-XVIII, moreover, had carried an improved camera — C′ (called C-prime) and was loaded with nearly twice the weight of film used on XIV. It remained in orbit three days rather than one, provided roughly twice as much coverage (3,800,000 square miles), gave 20 percent better resolution (65 lines per millimeter for XVIII as opposed to the 55 of XIV), and its recovered photography permitted identification of some ground objects measuring only 25 feet on a side. This excellent photography dispelled all residual concern about a Soviet lead in the deployment of intercontinental missiles and provided the basic hard intelligence around which incoming President John F. Kennedy and his defense secretary constructed their massive overhaul of US defense priorities, goals, structures, and management processes.

There is a sardonic military cliche that "Success is a team effort, but failure must always be identified with a specific individual." CORONA was indeed a team effort, but basic responsibility for its success could be assigned to key individuals, particularly upon the occasion of Flight XIV, the first comprehensive success.

The first of these persons was Colonel Lee Battle, the System Officer. This title translated into his responsibility for taking an untested space booster, an untested spacecraft, an untested re-entry vehicle, an untested camera, untested photographic film, an untested control network — and making them perform correctly and harmoniously.

Total responsibility for elements of the system rested with Major Richard Moore (Thor), Lt. Colonel Roy Worthington (Agena), Captain William Johnson (Payload and Recovery), and Major Frank Buzard (System Integration and Operations). At the Vandenburg AFB launching site, Lt. Colonel William Heisler and Captains Ray Lefstad and William Diener had responsibility for preparing and launching the spacecraft.

Overall program responsibility was shared by Richard Bissell, for the CIA, and Colonel Worthman, for the Department of the Air Force. Lieutenant Colonel Ralph Ford was Worthman's deputy. Mr. Bissell's key staff persons, for this program, were Eugene P. Kiefer and John Parangosky. His field representative was Lieutenant Colonel Charles Murphy, who was in residence at LMSC.

If a single person were selected to be given the bulk of credit for the success of CORONA, it would be, by general acclaim, Richard Bissell. It was Bissell's vision, energy, and courage that gave the program the opportunity (time) required to move from failure to success. His intervention was vital, particularly at the White House level. When a string of one dozen failures was testing the nerve of key governmental officials, Bissell never faltered — and the program moved on.

Corona Security: Assessment and Conjectures

Between 21 January 1959 and 18 August 1960, 15 CORONA missions were attempted. Whether the Soviets believed that Discoverer was what it was publicly represented to be remains an intriguing question, withal one that had transient importance. Of course, the Soviets may have had "inside" intelligence by way of conventional espionage. In that case the question would be irrelevant. It is also possible that an intensive analysis of American purpose and capability might have induced the Soviets to accept early Discoverer flights at face value. It was by no means obvious that the United States, or anyone else, could actually build and operate a useful satellite-reconnaissance system based on the Thor-Agena booster-spacecraft combination and 1958 camera technology. Compared to other space-reconnaissance systems proposed earlier, CORONA was tiny. The camera weighed only 92 pounds, and the entire payload, including film, only 53 more. High-resolution photographic systems were known to be heavy. Soviet intelligence analysts could very reasonably conclude that Discoverer was intended to test the feasibility of various reconnaissance subsystems, perhaps even a limited capability prototype camera, but they would not necessarily think of Discoverer as an operationally useful system in its own right.

A second factor of importance was development style. All available evidence would suggest to the Soviets that the preferred (almost exclusive) strategy for US military systems development was the massive-resource approach which had been applied to widely-known programs, including Samos. The style of CORONA development was the antithesis of normal US practice. It was relatively cheap; limited resources and relatively few people were involved in its development, and, notwithstanding its clever design, it was a conservative extension of existing state-of-the-art. No other important American program of that time had those attributes, certainly no other military space program. (Knowledge of the results of the Vanguard and Explorer programs of 1957-60 would reinforce a Soviet assumption that "simple" American space systems were likely to be unimpressive in performance.)

Capability was a third factor. Although the Soviets had undamaged GENETRIX cameras to examine at their leisure (and, after May 1960, the U-2 camera), and had taken over most of the German optical and camera industry at the end of World War II, they nevertheless appeared to be well behind the United States in this technology and continued so until 1965. CORONA, despite its small size, was a very capable system. Its performance surprised even those who built it and that performance, once early development problems had been overcome, improved spectacularly. From the Soviet viewpoint, orbiting a camera system that was limited in weight by the payload capacity of the Thor-Agena combination might well have no operational significance. It was counter to good sense, as the Soviets may have seen it, to invest in such an unpromising undertaking; they might logically have concluded that the American government's reactions would be like their own.

Finally, there was the apparent nature of the Discoverer program. It was one of several "minor" space programs hastily composed in response to the stimulus of Sputnik late in 1957. The main thrust of the American reaction to Sputnik was to pour large resources into the development of much publicized missiles and military satellites — principally Atlas, Thor, and Samos — and to invest in some other systems which had only "image" value. Space launchings were widely publicized but there were many failures. Administration officials, legislators, and military spokesmen, concerned about American response to the Soviet "space threat," typically emphasized major programs and paid little attention to programs such as Discoverer, Explorer, Echo, and Pioneer, believing that they had no obvious military utility. Accustomed to the notorious American habit of publicizing the goals, status, and (often) details of major military programs, however sensitive, the Soviets might have considered any uncharacteristic departure from that pattern to be incredible.

Occasional European press references to Discoverer as a "spy satellite" signified little except that speculation was an entertaining diversion. Many of those who were privy to the inner workings of the US space effort between 1958 and 1964, and thought they had access to most of the classified details, never suspected Discoverer to be other than what it pretended to be. In fact, the more one knew about the US research and development process, the less likely he was to suspect that a CORONA program could ever be conducted. Perhaps the Soviets were similarly misled. The question was not likely to be answered for many years.

CORONA Security: The United Nations and National Policy

But there were still many threats to CORONA security. UN Resolution 1472 of the XIVth Session of the General Assembly, adopted on 12 December 1959, established a Committee on Peaceful Uses of Outer Space. It directed the Committee to review areas for international cooperation, to study the legal aspects of space exploration, and to prepare for an international scientific conference on peaceful uses of outer space to be held in 1960-61.[58]

Because of a boycott by the USSR, the Committee was not organized until 28 November 1961. The US Delegation had taken a leading role in establishing the Committee and, once the Soviet boycott was lifted, the Delegation maintained its position as a major advocate of international cooperation in peaceful space activities. Subsequently, Resolution 1721 of the XVIth Session, which the State Department took part in drafting, was adopted by the General Assembly on 20 December 1961. It aimed at making the Committee on Peaceful Uses of Outer Space a focal point for international cooperation and commended two principles to member-states: (a) that international law, including the Charter of the United Nations, applied to outer space and celestial bodies; and (b) outer space and celestial bodies were free for exploration and use by all states in conformity with international law and were not subject to national appropriation. An additional clause in the Resolution (drafted in the US State Department) called on member-states launching objects into orbit or beyond to furnish information promptly to the Committee on Peaceful Uses of Outer Space for a registry of such activities. A US position paper on this matter had been circulated in October 1961 to most interested agencies in the US Government, but not to the CIA.

The State Department consulted with the National Aeronautics and Space Administration and with the Department of Defense in January 1962 on the kinds of information which should be registered with the United Nations. The

Defense Department, while agreeing that the United States should take the lead in reporting space objects, suggested that only those in sustained orbit be registered, in order to allow freedom of action in the event it should be necessary to launch a two- or three-orbit satellite to minimize chance of hostile interdiction. The DoD did not agree to binding the United States to a precise reporting schedule or to furnishing information on the purpose of each launching.[59]

The first US report was submitted to the United Nations on 5 March 1962 and included only those objects in orbit as of 15 February 1962. The Ambassador to the United Nations, Adlai Stevenson, complained to State that the US shift—from apparent willingness to submit data on all launchings, to a position in which some short-term flights were not to be reported—would create serious difficulties with the Soviets, who were expected to exploit this US "concealment." The Soviets were insisting on a joint declaration banning the use of satellites for military reconnaissance and Ambassador Stevenson felt the best response was to say we were prepared to consider such a question in the context of disarmament in a proper forum, being careful to avoid the implication that such use was not peaceful within the meaning of the UN Charter, which permitted self-defense.[60]

Dr. Herbert "Pete" Scoville, CIA's Deputy Director for Research (DDR), who inherited responsibility for CIA participation in overhead reconnaissance from Richard Bissell, noted to the DCI on 27 April 1962, that he did not believe the proposal for considering such a joint declaration was wise; he believed the United States should continue to uphold the position that satellite activity was not a military action and that it would never agree that this activity should be renounced in the course of disarmament negotiations. He pointed out that observation satellites are in themselves a strong measure in favor of disarmament, since they tend to limit dangers from unknown enemy capabilities.[61]

At about the time that the UN Outer Space Committee was beginning to function, plans were developed for a National Reconnaissance Program (NRP), which would consist of all joint and unilateral US overhead reconnaissance projects. A strong White House interest in the security of these reconnaissance projects was stimulated late in 1961 by President John F. Kennedy's President's Foreign Intelligence Advisory Board (PFIAB), headed by Dr. Killian. A security control system (known as the BYEMAN System) was inaugurated for the specific purpose of protecting information pertaining to the joint DoD/CIA reconnaissance projects under the NRP. The CIA was given responsibility for security agreements for all reconnaissance projects falling within the NRP and for administering the new security system.

The attitude of Defense officials toward the security of the National Reconnaissance Program began, early in 1962, to lean from the use of plausible cover stories toward a philosophy of total security. When the Discoverer-XXXVIII was launched from Vandenberg on 27 February 1962, the Air Force barred all essential details other than the successful midair catch of the capsule, which had been in orbit for four days. Between that event and April 1962, publicity given to the "spy-in-the-sky" aspects of the Air Force Samos program (the residual WS-117L program), which the news media equated with Discoverer, led to the publication of what was referred to as the

"Gilpatric Directive." This DoD Directive 5200.13, dated 23 March 1962, established security policy for all military space programs and declared as classified the details of these programs, including identification, mission, scope, capability, payload, launching, control or recovery operations, and results.

After the launching of Discoverer-XXXIX on 17 April 1962, the following United Press International release appeared in the *New York Times,* 18 April edition:

> VAFB, Calif., 17 April (UPI) - The Air Force today launched a satellite toward polar orbit, but refused to say whether it was a Discoverer or "Sky Spy" vehicle in line with a new policy severely restricting information on military space shots.
>
> The Air Force would not even give the time of the launching.
>
> The brief prepared statement said only:
>
> "A satellite employing a Thor Agena A booster combination was launched today by the Air Force from Vandenberg Air Force Base, Calif."
>
> Asked whether the satellite was in orbit, the Air Force information officer referred to the directive released last Tuesday making information classified on all military satellites.
>
> The same directive eliminated names for satellite programs, such as the Discoverer and Samos-Midas Sky Spy vehicles launched from here previously.

On 10 April 1962, Deputy Defense Secretary Roswell Gilpatric wrote to General Maxwell Taylor (then Special Assistant to President Kennedy) saying that the State Department proposal on registration of space launchings could not be considered apart from the US satellite reconnaissance program, and forwarded a proposed paper on "National Policy on Satellite Reconnaissance," recommending that it be considered by the NSC 5412 Committee prior to any action with regard to other space matters, such as UN registration.[62]

Subsequent to Gilpatric's initiative, the NSC issued National Security Action Memorandum (NSAM) 156 which set up a committee under the chairmanship of U. Alexis Johnson, then Under Secretary of State, to develop US policy with respect to US reconnaissance programs and outer space. The policy aimed to maintain unilateral freedom of action to conduct space operations; prevent foreign political and physical interference with the conduct of these operations; prevent accidental or forced disclosure of details of such operations or their end-products; avoid situations, statements, or actions which, in the context of the satellite reconnaissance program could later be exploited as evidence either of alleged US aggressiveness or duplicity; and facilitate the resolution of any conflicts which might arise between the essential technical and security requirements of the US satellite-reconnaissance program and the international commitments and foreign policy objectives of the United States.[63]

On 16 May 1962, Dr. James Killian, whom President Kennedy had asked to continue as Chairman of the Foreign Intelligence Advisory Board, told the president of the Board's concern over the impact of discussions in the UN Outer Space Committee upon the US satellite-reconnaissance program. The Board urged that care be exercised to ensure that control of the development of space capabilities for national defense and national intelligence purposes would not be foreclosed, diminished, or compromised in any way. Killian said that if international agreements prohibiting the use of outer space for military purposes precluded continuance of the highly effective US intelligence reconnaissance activities, it would be the United States, not the Soviet Union, which would stand to lose a critically needed collection capability. The Board recommended that the president review US policy and approve a position (there were currently contending points of view varying from full revelation to complete secrecy).[64]

The DCI, John McCone, urged the same action in a letter to Special Assistant for National Security Affairs McGeorge Bundy, on 17 May 1962. McCone also obtained agreement from Secretary of Defense Robert S. McNamara that CIA as well as State and Defense should participate in the formulation of policies to be followed by the US Delegation to the UN Outer Space Committee. With the concurrence of State, McCone directed that DDR Pete Scoville arrange for CIA participation in the various working groups set up to comply with NSAM 156.[65] In passing this directive to Scoville, the DDCI underlined the importance of a carefully prepared position and cautious negotiation by the US Delegation, and mentioned the fact that prior action in the United Nations by the US Delegate had placed the satellite-reconnaissance program in a difficult position. He said the objective of the CIA was to ensure that the United States could continue a vital program.[66]

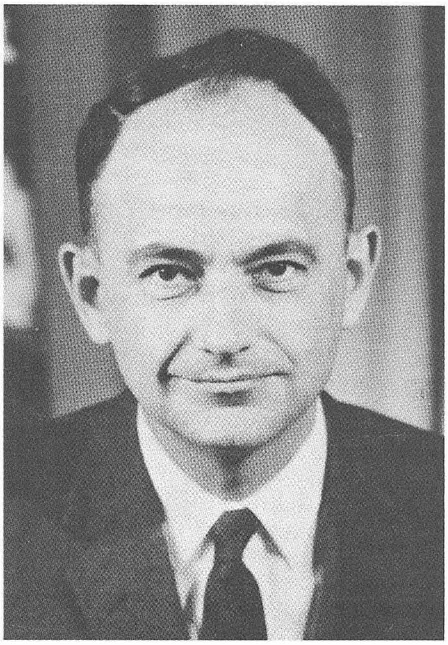
The report of the NSAM 156 Working Group and its recommendations for US policy on outer space were discussed at the 10 July 1962 meeting of the National Security Council, which approved 18 points of policy.[67] Among other decisions, the NSC accepted as sound practice the current procedure in effect as a result of the "Gilpatric Directive," whereby no identification was to be made of individual military space launchings by mission or purpose.

The US position with regard to satellite-reconnaissance security has continued in the same vein to the present, despite the fact that unofficial disclosures in the media, from time to time, have made the general matter a partially-open secret.

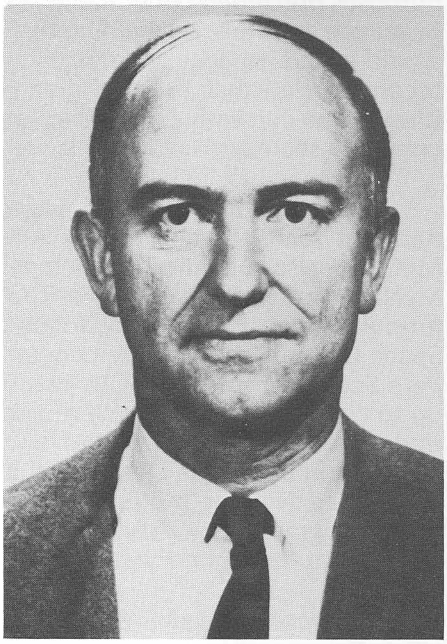
The National Reconnaissance Office

As the satellite and manned reconnaissance programs of the US Government evolved, an effort was made to find a common basis for coordinating, developing, and operating all strategic overhead reconnaissance systems. This effort was catalyzed by the fact that the cost of these systems had risen, by 1961, to almost $300 million (exclusive of Samos). In managing these costs, the Department of Defense and the CIA had cooperated on a cordial loosely-structured basis. Funds were transferred from the Department of Defense to the CIA to be expended on covert projects—of both the CIA and DoD—using

CIA's unvouchered, "black" contracting authority. The entire procedure was overseen by monthly "suppliers meetings" — an informal intergovernmental committee arrangement — which, in 1960, were attended by CIA's Bissell and Under Secretary of the Air Force Dr. Joseph V. Charyk* and their assistants. When these meetings were held, it was always with Bissell in the chair as the *primus inter pares*.



NRO Director Joseph V. CHARYK



DDR Herbert SCOVILLE

The Air Force, which had DoD responsibility for building and launching the rocket boosters that placed all spacecraft into orbit, and also for retrieving payloads when they were deorbited, considered its role preeminent. The major CIA effort, security, contracting, and mission planning was all but hidden from view.

Now that CORONA was "working," it began to attract attention and resources. One could predict that CORONA was going to grow into a major national activity. It was time to rethink CORONA roles and responsibilities with reference to the DoD and CIA. Indeed, there were events outside the "inner" CORONA realm which accelerated such thinking. For example, there was the "Moose" Mathison caper, still fresh in everyone's mind. Was rogue

*Dr. Charyk had previously served as Assistant Secretary of the Air Force for Research and Development. In this role he became a confidant of Dr. George B. Kistiakowsky, who succeeded James Killian as President Eisenhower's Science Advisor in 1959. Charyk was instrumental in developing the concept of a national office to conduct satellite reconnaissance.

elephantry encouraged by unorthodox management arrangements? Then there was the aggressive move by the Air Force to take over U-2 and OXCART resources and missions against the time when the current standdown might end. Should roles be more absolutely defined? Third, there was a burgeoning Air Force capability to monopolize space overflight missions: (a) Brigadier General Richard M. Curtin headed an Assistant Chief of Staff/Guided Missiles Office in the Pentagon and his interests were expanding rapidly, under Dr. Charyk's tutelage, into space activities, and (b) Brigadier General Robert Greer was heading a Los Angeles office, which was a field extension of the Secretary of the Air Force's Office, to develop the overflight systems of the Samos menage. Could a very few CIA people balance the Air Force multitude now appearing on the scene? Finally, such key intelligence advisors as Deputy Secretary of Defense Roswell Gilpatric, General James Doolittle, Dr. Killian, and Dr. Land were pressing the CIA to come forward with a more formal interagency agreement on overflight reconnaissance, whether by aircraft or satellite.

Most telling of all, Bissell's days were now spent almost entirely on what the CIA called "political action." He began to move away from CORONA management: after all, CORONA was doing its job and there were more important or more pressing matters in his in-basket.

Eventually responding to all the pressures, Bissell asked Gene Kiefer to draft a DoD-CIA agreement. Kiefer delayed, prudently awaiting a little more guidance and a few more details. Suddenly, Dr. Charyk appeared with his own proposal. It had been written by Colonel John Martin, of General Curtin's growing office. Charyk discussed the paper with Bissell and they worked out the details. What they produced was little more than a description of the effective partnership which then existed, but it was to become the basis for a later interagency statement establishing a National Reconnaissance Program (NRP). The document was signed on 6 September 1961, by General Cabell, the Acting DCI, and Deputy Secretary of Defense Roswell Gilpatric.[68] It contained six major elements:

- The National Reconnaissance Program (NRP) "will consist of all satellite and overflight (i.e., aircraft) reconnaissance projects whether overt or covert."

- The National Reconnaissance Office (NRO) will manage the program under the direction of the Under Secretary of the Air Force and CIA's Deputy Director for Plans, "acting jointly" with powers delegated to them by their superiors. It will include a small staff drawn from CIA and the Department of Defense. The NRO "will have direct control over all elements of the total program."

- The Under Secretary of the Air Force is designated Special Assistant for Reconnaissance to the Secretary of Defense and "delegated full authority" in this area by the Deputy Secretary of Defense.

- Within the Defense Department, the Department of the Air Force will be "the operational agency for management and conduct of the NRP, and will conduct this program through the use of streamlined special management procedures involving direct control from the Office of the Secretary of the Air Force to Reconnaissance System Project Directors in the field, without intervening reviews or approvals."

- The NRO "will be directly responsive to, and only to, the photographic and electronic signal collection requirements and priorities established by the US Intelligence Board."

- "The Directors of the NRO will establish detailed working procedures to ensure that the particular talents, experience, and capabilities within the Department of Defense and the Central Intelligence Agency are fully and most effectively utilized in this program."

This agreement made no mention of a single director for the new program, but assumed that the informal committee format which had evolved over previous years would continue—and it did. From September through the first month of the new year, Bissell and Charyk continued to meet, as they had during the past several years, to determine policy for the national program.

The very fact of the existence of the NRO was privileged information, closely held, and limited at first to a few leaders in the military and intelligence communities. Unwitting sectors of both communities saw only a few outer changes and believed what they saw, assuming that the birth of a Space Systems Office in the Secretary of the Air Force's household was at most, a maneuver to resolve some in-family Air Force problems. After all, events of the past five years had done much toward resolving similar problems among the three military services themselves, and their competition in space technology was now at a minimum.

True, in 1958, the US Army's Jupiter C had boosted the first US satellite (Explorer) into orbit. True, the Army had employed the most famous advocate of an American space program: Werner von Braun. And the US Navy had developed Vanguard as a space vehicle, and had proposed, in 1958, an ambitious manned earth-reconnaissance vehicle (MER-1). But the assignment of the total national *manned* space flight program to NASA and the transfer of the "Huntsville Group" to NASA in 1959 had muted Army and Navy space activity, almost to the vanishing point.

The Air Force situation was radically different: it had a huge and growing capability in space activity and had worked incessantly to achieve interservice primacy. It had built a large operational space detection and tracking capability at its Air Defense Command headquarters in Colorado. It had comprehensive electronic research centers, huge propulsion-research facilities, and an enormous capital investment at Cape Canaveral and Vandenberg AFB. Its ballistic missiles had become essential boosters for space flight; its Satellite Control Facility at Sunnyvale could handle complex on-orbit operation. It had system development programs in being: satellites for defense, rendezvous, patrol, communication, meteorology, navigation, geodesy, surveillance, and reconnaissance. It was contributing heavily to NASA's ventures into space. In 1961, for example, there were 52 space launchings made by the United States; the Air Force furnished "booster services" on 41 of these. The expression "booster service" referred to all procurement and launching services *through injection into orbit*. On Mercury, for instance, the Air Force provided a special

Atlas, determined the on-orbit trajectories, launched and controlled the system through injection, and (occasionally) furnished the astronaut.

In March 1961, Air Force dreams of primacy became real, as the Secretary of Defense assigned to it "research, development, test, and engineering of Department of Defense space programs." But Air Force Secretary Eugene Zuckert, who had the gift of seeing the defense scene in its broadest perspective, remarked that while he welcomed the assignment, there were actions underway which might make the mandate somewhat like "getting a franchise to run a bus line across the Sahara Desert."[69] His caution was confirmed when the Office of the Secretary of Defense proceeded to place existing Air Force (non-NRO) space activities under a most critical examination that ground away interminably and was very difficult for the Air Force to understand, let alone accept. Project after project was reviewed, revised, de-emphasized, or eliminated. In early 1961, for example, the Spaceborne Defense System was cancelled, in July the Attack Alarm System was savaged; in August, the Satellite Inspector was placed on a back-burner; and Dynasoar was under constant threat. Soon Air Force-OSD relationships were at nadir.

It was against this background that the Air Force learned that its most widely-publicized space project (Discoverer) and its most important space project (Samos) were to be lifted out of the Air Force Systems Command and deposited directly in the Office of the Secretary. No reason was given to the public or to the military for this action, although it was totally without precedent. Not even the ballistic-missile program, with its streamlined management and ultra-priority, had been handled in this way. To the Air-Force-at-large, the sequestering of these two systems could only be interpreted as one more (perhaps the ultimate) sign of distrust on the part of the OSD, skirting very close to harrassment or even persecution. Such was the general view taken by the unwitting Air Force.

For the (limited) witting audience, the view was even more bleak. People like Schriever, now commander of the Air Force System Command, knew that space-reconnaissance systems had not only been removed from his command—they had departed from the Air Force. The action was more than harassment—it was betrayal, particularly when one considered the record Schriever and the Air Force had established in delivering three ballistic missile systems to the nation. Indeed, Schriever had enjoyed "Gillette Procedures," which had permitted him direct access to the Secretary of Defense in carrying out the development of Atlas, Titan, and Thor. But he had always believed in keeping his Air Force Ballistic Missiles Division *within* the (then) Air Research and Development Command; he had been famous for handling his special access authority with utmost discretion. Now he had learned that "Gillette" had a second edge, which he had never felt before: when he totted up the amounts in covert satellite and aircraft work which had just moved away, he found the per annum loss from his budget to be at least a billion dollars.

Witting members of the Pentagon Air Staff were looking at the same script as Schriever. They did not like what they saw.

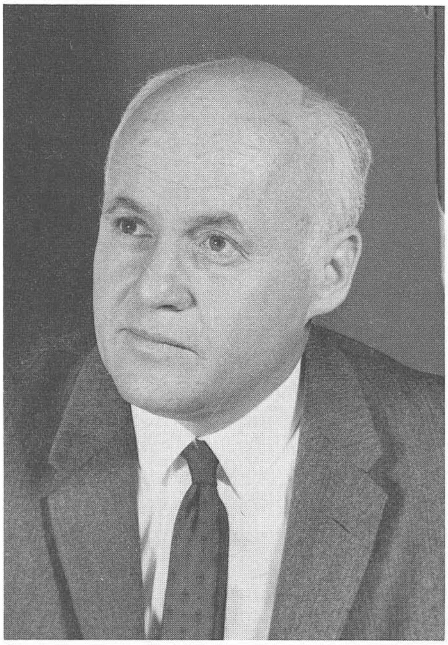
Outside the Washington area, the Strategic Air Command was dismayed by the announcement. Under the original Samos concept, SAC intelligence people were to own and man the readout stations and the Satellite Control

Facility. Under the new arrangement, SAC would find itself standing in line for its copy of the "take" — and standing in line was a novel and distasteful notion to the Air Force premier command.

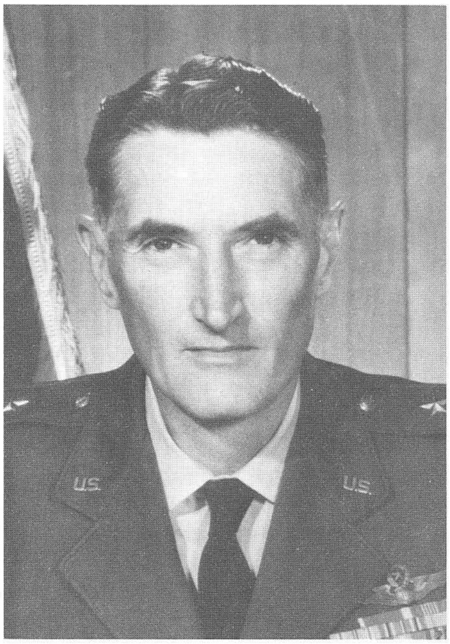
So, from the beginning, the NRO was an abomination in the eyes of the Air Force and Air Force officers selected to man the NRO knew that they did so at their own (career) risk.

Even Secretary Zuckert was uneasy with (although never obstructive to) the new arrangement. It was clear to him that the Air Force *per se* was losing control of an important new capability. Upon occasion, his annoyance would show rather directly. The Secretary's personal office was connected to Under Secretary Charyk's by a short, private corridor, just large enough for the desk of Charyk's Executive Officer. One morning in the fall of 1962, as the Secretary charged through the corridor, he noticed a strange face at the Executive Officer's desk, and said, "Good morning! And who the hell are you?" The strange face replied that he was from the Space Systems Office, filling in for the Executive Officer for two hours. Zuckert paused, his eyes went hard, and he muttered, "I see! Another member of Joe Charyk's private Air Force!"

On the West Coast, the Air Force CORONA Office was similarly annoyed; what was to be gained by transferring CORONA to the NRO? The existing management arrangment with the CIA CORONA Office was relaxed, friendly, and capable of producing coordinated decisions with unique responsiveness. Worthman and Battle both regarded the new NRO idea with suspicion and concern: it looked like the first step in moving CORONA freeform management toward the rigid patterns of classical bureaucracy. Brigadier General Robert E. Greer, then on location in Los Angeles as Director of the Samos



Air Force Secy Eugene ZUCKERT



USAF BGen. Robert E. GREER

Handle via BYEMAN-TALENT-KEYHOLE Control Systems Jointly BYE 140001-88

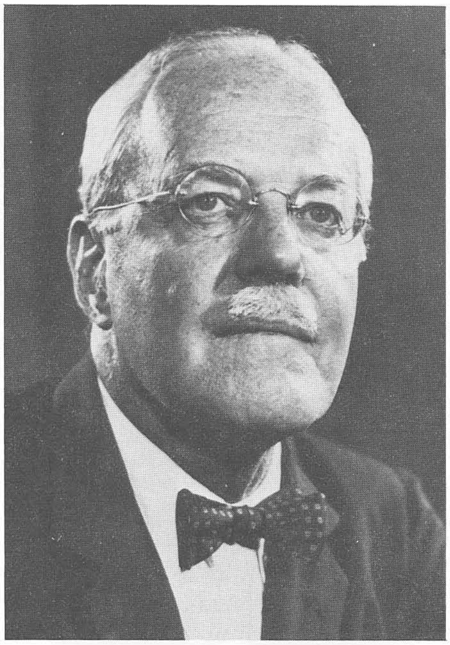
Project, shared their concern. Something (CORONA) was working quite well; why "fix" it? In conversations with Worthman, Greer encouraged him to "continue exactly as in the past."[70]

At the CIA, the advent of the NRO created middle management concern, but no outcry. After all, Bissell was an architect of the new structure, and Bissell was the boss. True, there were possible hazards in coordinating all schedule changes, dollars, payloads, and technical features with the new organization, but, if Bissell wanted an NRO, it had to be a good idea. And, characteristically, that was that.

And so it was. At the Agency, Bissell was locked in securely with the Director of Central Intelligence; in the Pentagon, Charyk was similarly postured with the Secretary of Defense. With anchor-points like those, the NRO was secure, no matter how much *anyone* objected.

But, someday, Bissell and Charyk would no longer be there.

At the end of 1961, a series of important personnel changes occurred in the CIA, leading to significantly altered NRO arrangements. DCI Dulles retired on 29 November 1961 and President Kennedy named the former head of the Atomic Energy Commission, John A. McCone, to replace him. At the end of December 1961, DDCI Cabell also retired. With the Dulles and Cabell retirements, Bissell, who had been smarting from the criticism aimed at him as a result of the Bay of Pigs venture, resigned. Killian and Land had expressed concern over the expanding scope of Bissell's office in which covert action activities and technical projects were affecting and impinging on each other.

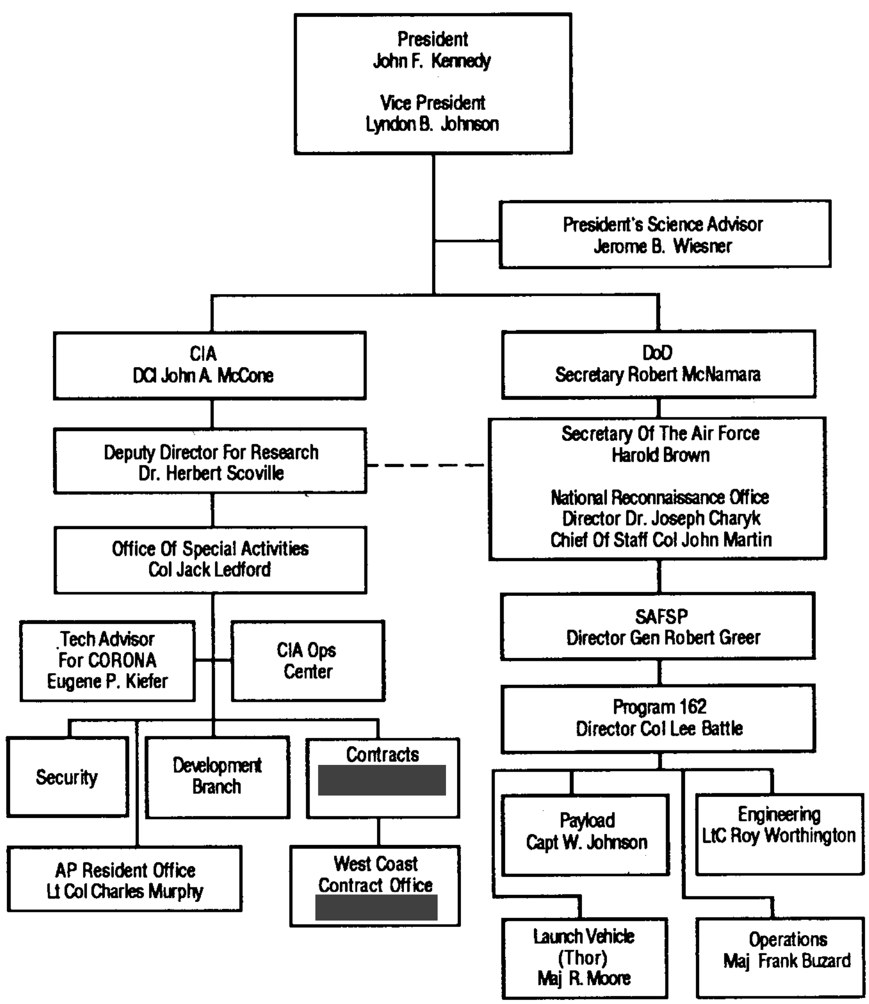


DCI Allen W.
DULLES

DCI John A.
McCONE

Bissell's departure meant that his influence and persuasiveness with higher authorities would no longer be evident at the conference table. Also, his abilities as a manager would be sorely missed by those CIA persons left to carry on a group of very secret and very expensive reconnaissance programs.

The 6 September 1961 NRP Agreement between the CIA and the Defense Department had been stated in very general terms: it was predicated on a program that would be managed jointly by Charyk, for the Defense Department, and Bissell, for the CIA. Thus, the 6 September 1961 NRP Agreement made reference to "directors" of the NRO. With Bissell's departure, the Agency not only lost some strength in representation at the NRO but it lost Bissell's *primus inter pares* position as well. Only Charyk remained and it was necessary to clarify his position with another agreement.



1962 CORONA Organization Chart

The second NRP Agreement, signed by DCI McCone and Deputy Defense Secretary Gilpatric on 2 May 1962, set forth the responsibilities of the NRO for the conduct of the NRP and established a single Director of the NRO (DNRO), jointly appointed by the Secretary of Defense and the DCI.[71] It made no mention of a Deputy Director of the NRO, because Charyk believed there would not be enough work to keep two people busy. No one from CIA contested Charyk's position on the matter at that time and the problem of a Deputy DNRO was set aside.

Charyk was appointed Director of the NRO by DoD directive on 14 June 1962. His first NRO directive, on organization and functions, established Program A (USAF satellite assets) under the Director, Special Projects, Office of the Secretary of the Air Force (SAFSP), and Program B (CIA assets), under the Deputy Director for Research (DDR), Program C (U.S. Navy assets), and Program D (USAF aircraft assets).[72] The directive also stated that the Director of Program B was responsible for the NRP effort conducted by the NRO through utilization of CIA resources and that the activities and office of the Director, Program B, were "covered" by his overt title as Deputy Director for Research, CIA.

As the NRO staff began to establish itself, it drew people from the Air Force, Navy, Army, CIA, and National Security Agency (NSA).

System Improvement: C′ to Mural

In early 1959, several assumptions were made by the CIA regarding the future of satellite reconnaissance: (1) lacking an international arms agreement, there would be continuing need for photo-reconnaissance of the Soviet Bloc; (2) if an arms agreement were reached, there would still be need for photo-reconnaissance for inspection purposes (using both manned lower-altitude flights to give high-resolution photography, and gross coverage by satellites to fill in time and area gaps between low-level flights); (3) if an arms agreement were reached, the necessity for *covert* reconnaissance satellites would probably disappear in view of the requirement for inspection, and international acceptance of reconnaissance as an inspection technique. The general conclusion was that the CIA would probably end its covert involvement in the reconnaissance satellite program by the close of calendar year 1961.[73]

These conclusions were shattered on 1 May 1960, when the Soviets shot down a U-2 over Sverdlovsk. Khrushchev's subsequent boycott caused the cancellation of a Summit Meeting in Paris and began a period of very strained relations between the United States and the Union of Soviet Socialist Republics. Any hope for an arms agreement was postponed; at the same time, the intelligence obtained from satellites became more vital than ever to the United States. There was a clear need to extend CORONA well beyond its originally planned short lifetime and to improve its capabilities immediately.

Discoverer-XVIII carried a C′ camera (called C-Prime). Both the original C and the subsequent C′ had lenses with f/5.0 maximum apertures and 24-inch focal lengths. C′ embodied structural and engineering changes that somewhat simplified the camera system and also returned a ground resolution averaging about 35 feet, as compared to the nominal 40 feet of the original C camera. (The original C camera, flown on the first 12 CORONA missions, produced the images recovered from Discoverer-XIV in August 1960. It saw no further operational use. Retroactively, the C camera was called KH-1.*)

The C′ camera was in development in mid-1959 and had been adopted by the time a second CORONA capsule was recovered, in December 1960. (Retroactively, the C′ was called the KH-2.) It was used on all subsequent CORONA operations until the newer C‴ (C-triple-prime) camera replaced it on the 29th CORONA mission, in August 1961. Three additional flights with C′ cameras followed, interspersed with three additional C‴ systems. Concurrently during 1961, in recognition of the desirability of having stereoscopic capability, Itek developed the Mural (M) camera system which consisted of two C‴ cameras on a common mount, one looking 15 degrees aft from vertical and the other 15 degrees forward. It is an axiom of aerial reconnaissance that the information content of photography is improved by a factor of two and one-half times with stereo coverage. (The C‴ was also known as the KH-3, the Mural as the KH-4.) By February 1962, the Mural system was a reality; thereafter all CORONA missions were to produce stereo coverage.

Between the appearance of C′ and its eventual replacement by C‴, there occurred more than six months of debate about the merits of two competing approaches to an improved CORONA. Disagreement about what was needed was compounded by uncertainty over the need to invest funds in *any* further improvement of CORONA. In 1960 the reconnaissance community still held rather generally to the assumption that E-1 and E-2 (Samos) readout systems would become available for operational use in 1961 and 1962; the E-2, in particular, promised to provide resolution somewhat better than that of CORONA C′ with the further attraction of near-real-time data accessibility through readout. Additionally, the E-5 stereo system, a recovery system with potentially much greater resolution and area coverage capability than CORONA, was progressing toward a 1962 or 1963 operational readiness date. In late 1960, high-resolution systems E-6 and GAMBIT were in development, and, while neither was in any sense a CORONA replacement, it was assumed that the combination of any of the high-resolution film recovery systems with one or both of the readout systems would almost surely make a follow-on CORONA superfluous.

All this reasoning was predicated on the plausible assumption that the various Samos camera systems would satisfy performance, cost, and schedule expectations. Nevertheless, there was some justification for improving CORONA so as to enhance the quality of satellite photography during 1961; E-1, the only Samos system certain to be available that year, had only a 100-foot resolution capability. Yet neither large investments nor high risks seemed warranted, even though some members of the CORONA project group, and others in the general satellite reconnaissance community, had healthy doubts about the validity of expectations for the Samos systems.

*KH was the system designator used in the overhead reconnaissance product security system. For additional information refer to section on overhead reconnaissance product security system, Appendix A.

Both Itek and Fairchild Camera and Instrument Company had been involved in CORONA from its start. They were cooperative, but not cheerful, collaborators; each would have preferred, of course, to be the sole supplier. Each, therefore, proposed modifications to the C' camera in early 1961. Itek advocated a major redesign of the optics and a substantial modification of other aspects of the camera, as a means of improving both resolution and reliability. Fairchild, then a component supplier to Itek, but earlier a competitor for the entire CORONA camera system, urged a different approach, suggesting retention of the original lens and image-motion-compensation system, with alterations that would result in the substitution of five-inch film for the three-inch (70 millimeter) then in use. Both were responding to urging from the CORONA program office to provide an improved CORONA capability for 1961. Both proposals were referrred to as C-61 or C'' systems, on the assumption that one would be chosen and would carry that designation.

Independent assessment of the two approaches was initially unfavorable to the Itek concept; the Aerial Reconnaissance Laboratory at Wright Field concluded that the Itek design was too complex and too advanced to be reliable, while Lockheed judged (on much the same ground) that, although neither Itek nor Fairchild had a fully acceptable design, the Fairchild design was more promising. In consequence, a cautious start on the Fairchild system was authorized.

Eventual adoption of the Fairchild design would probably have resulted in a CORONA resolution improvement on the order of that experienced in the transition from C to C', about 15 percent. Such modest goals were abandoned in the wake of the first successful CORONA operation in August 1960 when President Eisenhower sat through a private showing of the first recovered photography and, in the discussion that followed, was advised by Land that a 100 percent improvement in the quality of CORONA photography was possible by Christmas. Impressed, Eisenhower authorized him to act, and subsequently confirmed Land's authority in correspondence with Allen Dulles and Richard Bissell.

The basis of Land's optimism was his earlier exposure to an updating of an Itek proposal by Walter Levison for the inclusion of a faster lens (f/3.5 rather than the f/5.0 of the C') which could be used with slower and finer grain film than that required for the existing (f/5.0) lens system.

With Eisenhower's endorsement, Land proceeded to Boston and authorized Itek to develop its camera. Both the CIA's Bissell (who had learned of Eisenhower's action after the fact) and the Air Force's Worthman, had reservations about Itek's ability to carry out Land's promise but, under the circumstances, all they could do was to urge purchase of additional C' camera systems as a hedge against a potential slippage resulting from the sudden introduction of a camera improvement program. They commiserated briefly: as part of a planned system improvement program, modifications to elements of the Agena and the Thor were already in work. Now, with Land's intrusion, an unsolicited and unappreciated "opportunity" was being mandated to add the camera and film to the change list.

Earlier orders for long-lead-time items needed for the Fairchild C'' camera were cancelled late in September 1960, and three additional C' cameras were ordered to protect launching schedules against slippages that might occur in the Itek program. The prospective bill for development of what was by then called C''' came to $6.95 million; the three "reserve" C' cameras cost about $250,000 each (about $500,000 was retrieved from the cancelled C'' development). Because previously programmed Agenas and Thors would serve all probable C''' and C' needs, no new vehicle costs were incurred at this time.

As generally happens in such affairs, original estimates proved to be understated; by February 1961, Itek was anticipating an increase of about $300,000 in the basic costs and had reduced the quantity to be delivered from 11 cameras (including three test items) to eight (with two test articles). CIA program monitors expected the eventual costs to be more nearly $5 million for cameras, versus Itek's original estimate of $3.5 million. In the end, the CIA was proved correct.

When delivered, the C''' camera and its faster lens system performed as promised, though not with complete initial reliability. The faster optics, in combination with slower film, and improvements in image-motion compensation, did have the effect of reducing smear and improving resolution. Film transport was greatly improved by the introduction of air twists for turning the film as it moved from storage to take-up cassette. Fortunately, C''' occupied the same space and could use the same cassettes as C'. The combination of all these improvements enhanced ground resolution to an average 20 to 25 feet (down from about 35 feet for C').* Meanwhile, the site program, having demonstrated initial success with Discoverer-XIV, began to experience a series of failures in the first half of 1961.

In the interval between the successful recovery of a CORONA capsule on 10 December 1960, and the next operational success (a water pickup on 18 June 1961), four mission failures of various origins and two Discoverer launchings with other than CORONA payloads had occurred.

The first 26 Discoverer mission attempts included eight operations without camera payloads. (Most program records show 25 Discoverer operations by the end of June 1961. As noted earlier, there were 26, counting the vehicle destroyed by a launching pad explosion on 21 January 1959. That operation is sometimes listed as Discoverer-0; the vehicle successfully launched on 28 February 1959 was called Discoverer-I.) Of the 18 that actually represented attempts at CORONA and ARGON operations, three returned film properly

*Resolution figures are those generally cited for "ground resolution" of the complete system. Under ideal conditions the C and C' cameras were capable of reproducing 100 to 130 lines per millimeter on the film, representing a 14- to 17-foot lens-film resolution, and a system resolution of 19 to 22 feet. The C''' had a lines-per-millimeter capability of 180 to 200, a seven- to nine-foot camera-film resolution potential, and a 10- to 12-foot system resolution potential. CORONA-M, to be discussed later, had about the same lines-per-millimeter capability but because of its convergent stereo configuration would nominally provide from 3.5- to 4.5-foot camera-film resolution and six- to seven-foot in its original resolution. In practice, the "ground resolution" for CORONA-M in its original configuration was generally from 12 to 17 feet. The gap between "system resolution" and "ground resolution" was largely a reflection of smear effects, contrast and sun-angle phenomena, and performance anomalies characteristic of individual camera systems.

exposed over the Soviet Union. The 26 Discoverer (including three ARGON) missions extended over a period of almost precisely 30 months. Although the ratio of CORONA successes to failures seemed appalling by later standards, and ARGON (retroactively called the KH-5 camera) was barely successful, the three successful CORONA missions provided an enormous fund of intelligence information—about 13 million square miles of coverage.

The successful recovery of Discoverer-XXV (18 June 1961) signaled the start of a far better record. Counting that flight, seven successful capsule recoveries in 13 missions marked the remainder of 1961. Half of the camera payloads were in the C′ configuration and the remainder of C‴ vintage; three of the five failures involved C′ instruments. The ARGON failure (21 July 1961) was caused by loss of guidance on the Thor booster, followed by a destruct signal. All the CORONA mission failures were chargeable to one or another of the Agena subsystems, with difficulties such as guidance failure, early gas exhaustion, and ignition malfunctioning. In three instances, the Agena did not achieve orbit, and in the fourth an Agena power failure precluded separation and recovery of the capsule. No problems attributable solely to the camera system were experienced, and, although none of the successful missions was untroubled by difficulty of one sort or another, the returns were quite good.

In summary, 10 C cameras, 10 C′ cameras, and six C‴ cameras were involved in the 26 monoscopic CORONA mission attempts. Only one of the C missions returned film, but seven of C′ and four of the C‴ missions ended successfully. Of the 30 photographic missions that were attempted in the first two years of the program, 12 were in large part successful; and of the 18 failures, 12 occurred in the first of the two years.

Discoverer Flight Summary - 1960

Discoverer No.	Mission No	Date	Camera	Remarks
IX	9006	4 Feb	C	Agena failed to orbit.
X	9007	19 Feb	C	Agena failed to orbit.
XI	9008	15 Apr	C	Spin rocket failure. Camera operated OK. No recovery.
XII		29 June	N/A	Diagnostic flight. Agena failed to orbit.
XIII		10 Aug	N/A	First successful diagnostic flight. Successful water pick-up.
XIV	9009	18 Aug	C	First successful operational aircatch. Camera operated OK.
XV	9010	13 Sep	C	Wrong pitch attitude on reentry. No recovery. Camera operated OK.
XVI	9011	26 Oct	C′	Agena failed to orbit. "D"-timer malfunction.
XVII	9012	12 Nov	C′	Air catch. Payload malfunction.
XVIII	9013	7 Dec	C′	Air catch. 1st successful C′ flight.
XIX		20 Dec	N/A	Radiometric payload. No photo mission or recovery planned.

CORONA-Mural

The idea of combining two original CORONA cameras into a stereo system surfaced in July 1960, a month before the first recovery of CORONA film. Its formal appearance was a proposal by Lockheed Missiles and Space Division in the fall of 1960. Lockheed suggested using either a C′ or C‴ camera as each element of a stereo system, boosting the combination into orbit with a DM-21 Thor and a modestly improved Agena. The system would be designed for a four-day flight.

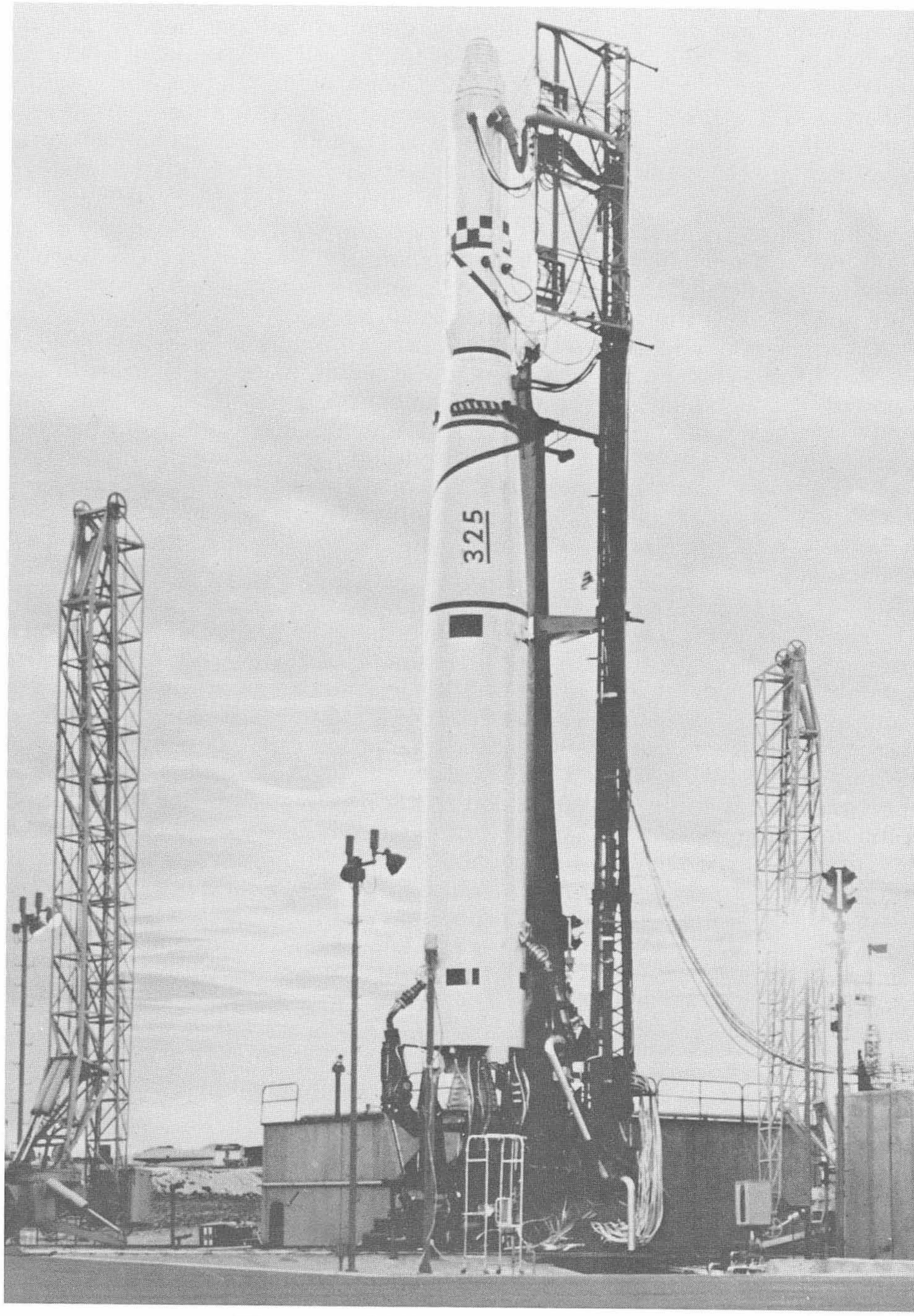
By early 1961, the Lockheed proposal had received working-level endorsement. At the time, it appeared that an eight-flight program (over FY-61 through FY-63) would cost about $50 million. Charyk quashed a suggestion that the new system should be developed and operated "in the white," although he doubted the feasibility of indefinitely continuing the original management arrangement and planned to eventually discontinue the "Discoverer" fiction.

Lockheed called the proposed system "GEMINI," to distinguish it from CORONA (NASA had not yet adopted that name for the second in a series of US manned spaceflight systems). Lockheed's concept was to conjoin two of the f/3.5 Petzval-lens cameras of 24-inch focal length in a faired module, using two recovery spools in a single recovery capsule (which would weigh 94 pounds plus film weight). The rearmost camera would look forward and the foremost camera backward.

As a way of testing the concept inexpensively, Lockheed proposed diverting the last two C‴ cameras to GEMINI and using an available C′ camera to fly in place of one of the C‴ payloads. Theoretically, the GEMINI combination could return ground resolutions on the order of about six feet, though few program persons believed such results would be achieved immediately.

Charyk approved work on six stereo C‴ systems on 24 February, pending receipt of approval by President John F. Kennedy, who had taken office only a month earlier. The formal request for approval went from Charyk to the new Secretary of Defense, Robert S. McNamara, early in March. Charyk observed at that point that the stereo system was needed because even with recent improvements CORONA did not distinguish "small" objects with proper precision. He felt that because the C‴ system was relatively well-proven, the creation of a stereo capability was not "a significant R&D problem."[74]

As formally approved in April 1961, the C‴ stereo program (not yet known as Mural) involved the fabrication of one engineering vehicle carrying C‴ cameras originally intended for individual flight and the procurement of five additional sets of cameras to be launched between April and August 1962. In actuality, the CIA had provided initial funds to Lockheed a month earlier, with the proviso that not more than $1.4 million should be spent in what remained of fiscal year 1961. That action proved premature; on 28 March the agency abruptly instructed Lockheed to halt all work on the stereo system.[75] The sudden reversal seemed to have been occasioned by Charyk's objection to the unauthorized and premature expenditure approval and by a general realization that neither specifications nor program structure had been re-



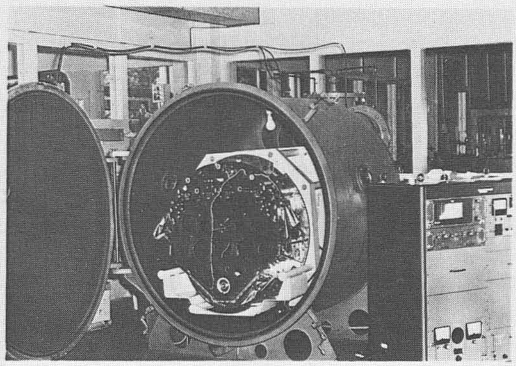
Discoverer-XXXVI Ready For Launching

viewed at the higher levels of the CIA and the DoD. Charyk also had reservations about the agency's unilateral decision that Lockheed would be system manager and Itek an associate contractor, a departure from the arrangement used earlier in CORONA. Charyk (with the support of CIA Richard Bissell) wanted the Air Force-CIA program office, supported by the Air Force Ballistic Missile Division, to act as a "system engineering/ technical direction" authority. The Charyk-Bissell preference carried the day.

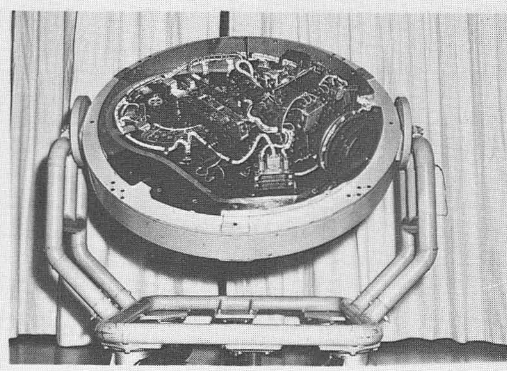
For the moment, Mural was security-compartmented separately from CORONA and only about 1 in 10 of the various CORONA participants was aware of the details and plans agreed to in the Spring of 1961. Not until January 1962 were the several agencies involved in CORONA all told of the improved capability to be provided by Mural, although as early as July 1961 details of the Mural program were made available to senior officials in the National Photographic Interpretation Center, the Army Map Service, and similar organizations. The Map Service subsequently protested that it had not been adequately advised on Mural matters, perhaps because it anticipated interference with plans to fly more ARGON missions. In February 1962, Charyk and Bissell were obliged to emphasize that Mural was in no respect a dedicated mapping system and probably had little application to that function.[76]

The Map Service's anxiety may have been occasioned by measures leading to incorporation of a framing camera (an Itek stellar-indexing camera system) in the Mural payload. The preliminary decision to add that capability came in October 1961 and was formally confirmed the following December. The framing camera provided "a fixed geometric reference to be used in plotting and rectifying the longer focal length higher-resolution panoramic photographs." It could aid in the construction of maps (so, for that matter, could any mono or stereo imagery), but as Charyk subsequently explained to the Director of the Defense Intelligence Agency, "the framing camera is not and never has been considered a substitute for the mapping projects such as ARGON . . . ." (Much later, the incorporation of a considerably better stellar-indexing camera, DISIC [Dual-Integrated-Stellar-Index Camera] gave CORONA a mapping capability somewhat superior to that of ARGON, but such quality was not available in 1961. DISIC had a three-inch lens, equal in focal length to that of ARGON and somewhat superior in resolution.) The underlying problem was that the Army and the DIA still wanted to develop and operate a satellite mapping system that would be independent of the embryonic National Reconnaissance Office, and any actions that tended to reduce the possibility of such an outcome raised objections from the Army Map Service. The subsequent disappearance of ARGON's proposed successor (called VAULT/TOMAS) and the cancellation of the E-4 (mapping camera) phase of Samos, even after four cameras actually had been procured and checked out, had the effect of eliminating flights by dedicated mapping-camera systems, but that, too, was still in the future in 1961.[77]

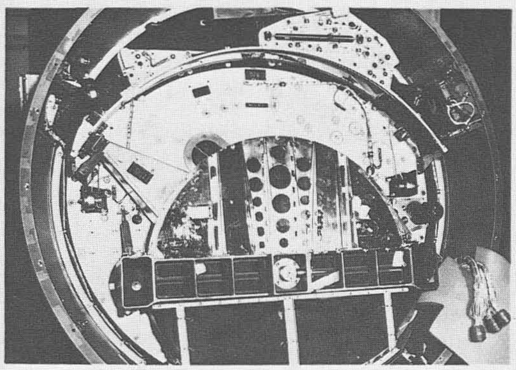
Like the original CORONA, CORONA-M was intended to be an interim, transitional means of satellite reconnaissance. It was conceived as an expedient device for temporarily providing stereo coverage of denied areas. That, at least, was the view from the upper echelons. In the CORONA office, and in Itek and Lockheed project organizations, CORONA-M represented an expedient way of providing for the continued production of a successful system, one



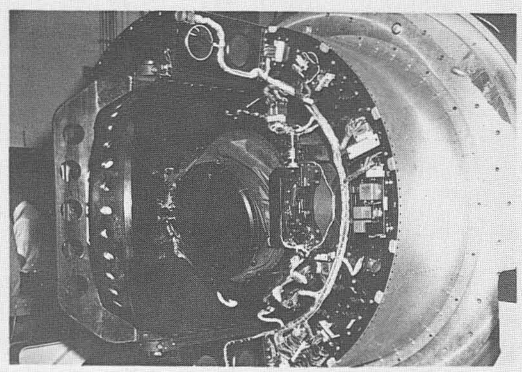
The Original CORONA (C)



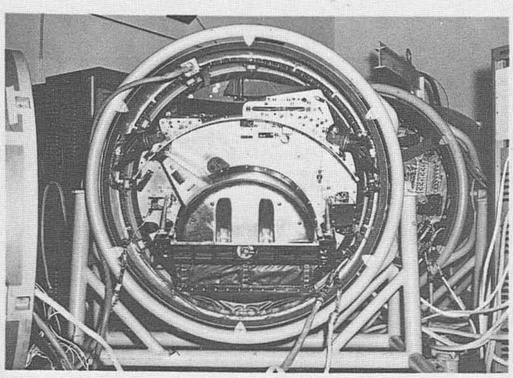
The ARGON (A)



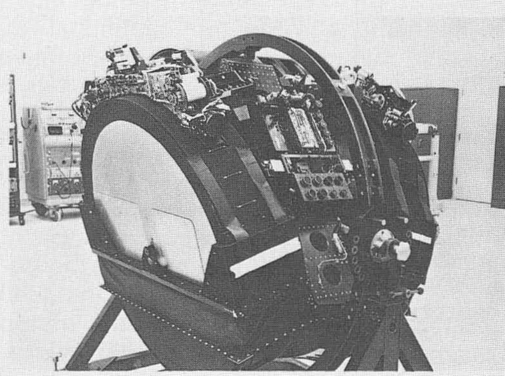
The Mural (M)



The LANYARD (L)

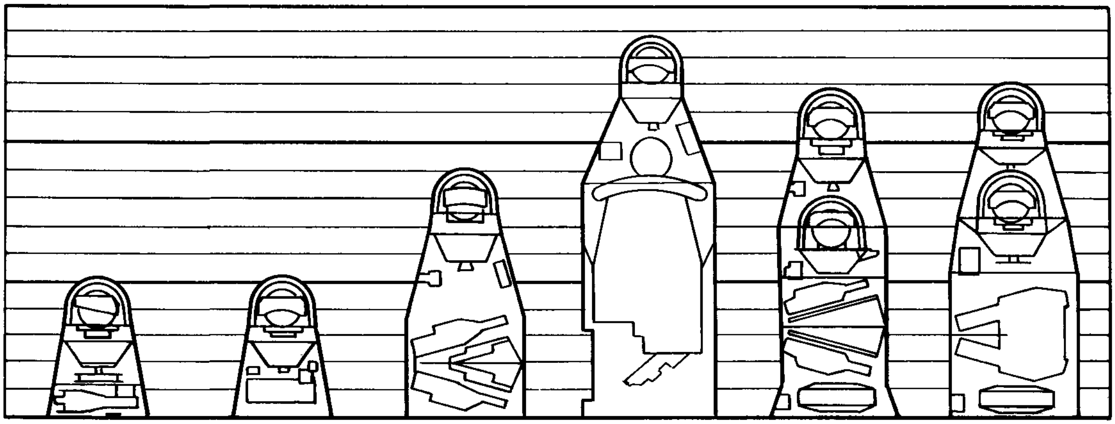


The J-1



The Constant Rotator or J-3

The CORONA Cameras



CORONA	ARGON	MURAL	LANYARD	J-1	J-3
40 LB FILM 26 SYSTEMS 11 RECOVERIES 1959-1961	40 LB FILM 12 SYSTEMS 5 RECOVERIES 1961-1964	80 LB FILM 26 SYSTEMS 20 RECOVERIES 1961-1963	80 LB FILM 3 SYSTEMS 2 RECOVERIES 1983	160 LB FILM 52 SYSTEMS 94 RECOVERIES 1963-1969	160 LB FILM 17 SYSTEMS 32 RECOVERIES 1967-1972

CHARAC-TERISTICS	C	C'	C'''	M	J(J-1)	J-3
CAMERA MANU-FACTURER	FAIRCHILD	FAIRCHILD	ITEK	ITEK	ITEK	ITEK
UNITS LAUNCHED	10	10	6	26	52	17
LENS MANU-FACTURER	ITEK	ITEK	ITEK	ITEK	ITEK	ITEK
DESIGN TYPE	TESSAR, 24 IN., f/5.0	TESSAR, 24 IN., f/5.0	PETZVAL, 24 IN., f/3.5	PETZVAL, 24 IN., f/3.5	PETZVAL, 24 IN., f/3.5	PETZVAL, 24 IN., f/3.5
CAMERA TYPE	70° PAN, VERTICAL, RECIPRO-CATING	70° PAN VERTICAL, RECIPRO-CATING	70° PAN, VERTICAL, RECIPRO-CATING	70° PAN, 30° STEREO, RECIPRO-CATING	70° PAN, 30° STEREO, RECIPRO-CATING	70° PAN, 30° STEREO, ROTATING
EXPOSURE CONTROL	FIXED	FIXED	FIXED	FIXED	FIXED	(4) SLITS SELECTABLE
FILTER CONTROL	FIXED	FIXED	FIXED	FIXED	FIXED	(2) FILTERS SELECTABLE
PRIMARY FILM (FILM/BASE)	1213/ ACETATE	1221/ POLYESTER	4404/ POLYESTER	4404/ POLYESTER	3404/ POLYESTER	3404, 3414/ POLYESTER
RECOVERY VEHICLES	1	1	1	1	1	2
SUBSYSTEM (STELLAR/INDEX)	NONE	NONE	0/1	1/1	2/2	2/1
TIME PERIOD	1959-1960	1960-1961	1961-1962	1962-1963	1964-1969	1967-1972

Camera Configurations and Characteristics

that might, with relatively slight investment, compete successfully with more costly and complex systems in development elsewhere. Thus, as early as March 1962, shortly after the first CORONA-M mission, Itek proposed (with CIA sponsorship) an "M-2" (Mural-2) system consisting of a re-engineered Mural with one 40-inch, f/3.5 tube of optics serving two platens. Itek suggested that the system could provide resolution on the order of four to five feet. The M-2 proposal, as such, remained a contender for development until June 1963, when a special panel headed by Edward M. Purcell, professor of physics at Harvard and member of the President's Science Advisory Committee, formally told CIA that the "M-2" was "not a wise investment," when compared to various alternative ways of improving CORONA performance. It did not vanish, however; in a different guise, the original Itek proposal surfaced a year later as the genesis of CORONA J-4.

The assumption that CORONA-M would be no more than a stopgap system stemmed from the continued existence of the Samos E-5, which was intended to be a considerably more sophisticated, higher-resolution search system. Unfortunately, E-5 development was frustratingly unsuccessful.

One of the principal problems facing the intelligence community was the absence of high-resolution photographs of suspected ABM sites at Leningrad. CORONA-M could not meet this need. Charyk and Scoville attempted to adapt the E-5 system, on a crash basis, to close the gap, but the performance of the adaptation (called LANYARD or KH-6) was disappointing.

In February 1962, the first CORONA-M mission, using KH-4 cameras, was essentially successful, although the auxiliary framing camera did not operate correctly. At that time, Itek was assembling the 16th and last of the then-scheduled CORONA-M systems, with delivery scheduled for late June. Payloads had been produced at about three per month, and Itek was preparing to assign its CORONA-M production personnel to other tasks, or to dismiss them. CORONA-M launchings were scheduled at intervals of about two weeks through exhaustion of the inventory; reordering, if required, had to be decided by April 1962 in order to avoid interruption in the regime of regular launchings.

Another probable successor to CORONA-M was the E-6 payload, the last survivor of the original Samos Program. It was intended to be an area coverage system with 8- to 10-foot resolution. Its development had begun in October 1960 and initial operations were scheduled for March 1962. The first E-6 launching was conducted in April 1962, and, with a frustrating similarity to the experience of the cancelled E-5 program, was marked by indicated success in camera functioning and total failure in recovery. Notwithstanding that beginning, the NRO ordered 19 follow-on E-6 systems early in 1962, augmenting the original order for five systems. But given the singular lack of success in all reconnaissance-satellite recovery operations to that time, except in the case of CORONA, prudence seemed desirable. Therefore, Charyk approved an order for six additional CORONA-M systems. The schedules then in existence called for one CORONA-M and one E-6 system to be orbited each month, starting in July 1962. Together they were to provide about the same coverage as a two- to three-per-month launching schedule for CORONA-M. (The CORONA-M system then had typical stereo resolution ranging from 10 feet to about 15 feet; E-6 was designed to provide 10-foot or better resolution, in stereo.)

Discoverer Flight Summary - 1961

Discoverer No.	Mission No.	Date	Camera	Remarks
XX	9014A	17 Feb	A	1st ARGON flight. Orbital programmer failed. Camera failed. No recovery.
XXI		18 Feb	N/A	Radiometric payload. No photo mission or recovery planned.
XXII	9015	30 Mar	C'	Agena failure. No orbit.
XXIII	9016A	8 Apr	A	Camera operated OK. No recovery.
XXIV	9018A	8 Jun	A	Agena failure, power failure, guidance failure. No recovery.
XXV	9017	16 Jun	C'	Water landing. Camera operated OK. Capsule pickup OK.
XXVI	9019	7 Jul	C'	Camera failed on Rev 22. Successful recovery.
XXVII	9020A	21 Jul	A	No orbit. Thor problem.
XXVIII	9021	3 Aug	C'	No orbit. Agena guidance failure.
XXIX	9023	30 Aug	C'''	1st C''' flight. Air recovery. Camera operated OK.
XXX	9022	12 Sep	C'	Air recovery. Camera OK.
XXXI	9024	17 Sep	C'	No recovery. Power failure.
XXXII	9025	13 Oct	C'''	Air recovery. Camera OK.
XXXIII	9026	23 Oct	C'	Agena failed to orbit.
XXXIV	9027	5 Nov	C'''	Gas valve failure. No recovery. Camera OK.
XXXV	9028	15 Nov	C'''	Camera OK. Recovery OK.
XXXVI	9029	12 Dec	C'''	Water pickup. Camera OK.

CORONA payloads were substituted for the ARGONs originally scheduled, to the vocal distress of the Army's mapping specialists. There had been four successive ARGON mission failures between February and July 1961—all of which would probably have been CORONA failures had that payload been orbited—and not until May 1962 did an ARGON mission end in apparent success. Even then, stellar and terrain camera malfunctions degraded the recovered film.[78]

The second CORONA-M operation (Mission 9032) began with a 17 April 1962 launching and ended with successful aerial recovery of the capsule on 20 April. The returned film included images of Sacramento metropolitan airport taken from a height of 115 nautical miles. On the prints were impressions that interpreters could identify as runway markings, small civilian aircraft, and automobiles ("just at the detection threshold"). Twin-engined aircraft could be distinguished from four-engined aircraft, which encouraged the somewhat optimistic estimate that CORONA-M could resolve objects seven feet on a side.[79]

Between the initial success of CORONA-M in February and the end of June 1962, six additional reconnaissance vehicles in that configuration were launched from Vandenberg AF Base. Of that set, four were successful to the extent that useful film was retrieved, although only in one instance did the accessory framing camera operate correctly. A 28 April launching (Mission 9033) ended with failure of the recovery parachute, and the very successful orbital operations of Mission 9036 (2 June launching) were capped by a recovery misadventure: one of the extended booms on the aircraft's recovery apparatus hit and collapsed the parachute and the capsule fell 12,000 feet into the ocean, sinking before frogmen could reach it. The flotation devices were damaged, either by the boom or from the extended fall. Three of the four otherwise successful missions were marred by various malfunctions of the framing camera—a disorder eventually traced to faulty shutter design.

In the same period, from February through June, a second E-6 mission was attempted. Orbital operation was erratic, owing to an Agena gas leak; fuel depletion prompted the decision to attempt early recovery (at night), and, ultimately, an electrical failure in the squib circuitry kept the reentry vehicle from separating. The Agena and capsule reentered as a unit and were lost some 600 miles north of the planned recovery area.

The third, fourth, and fifth E-6 Samos missions were attempted between 18 July and 11 November 1962. In one instance the Agena would not refire and no reentry maneuver could be conducted; in the others the recovery system malfunctioned. In no instance was film retrieved, despite the fact that cameras operated properly.

While E-6 was having these unhappy experiences, CORONA-M was extending its record of successful operations to 10. Given such diametrically different program results, the consequences were inevitable: General Greer recommended a cancellation of E-6 and Charyk unhesitatingly agreed. As a consequence, the "interim" CORONA-M program became the sole wide-area search system in the reconnaissance satellite inventory (or in development). Its string of 10 successive "good" missions was not a record of complete excellence, of course. Except for Mission 9037 (launched on 23 June 1962), each of the 10 experienced some major or minor difficulty, framing camera failure being the most common. (A new camera introduced late in 1962 largely eliminated that source of difficulty.) One mission in July 1962 (9039) experienced programmer failure and was forced to early recovery. Another payload, orbited in September (9043), stabilized in an unexpectedly high orbit—following a malfunction of a velocity meter—and began to pass repeatedly through the residual radiation of the 19 July 1962 "Starfish" high-altitude [redacted] In other respects, and particularly in terms of quantities of highly useful photographs of denied areas, these CORONA-M operations were very successful.[80]

An additional reason for reliance on CORONA-M, rather than on the unpromising E-6, or even the attractive but troublesome LANYARD, was the continued evolutionary improvement in CORONA capability. By the summer of 1962, the concept of a CORONA-J system had emerged, been evaluated, and was approved for development and procurement.[81] CORONA-J was to be a CORONA-M payload with two recovery capsules, separately recovered, and capable of being "stored" in orbit between two intervals of camera operations. (Such inactive storage in orbit was called "zombie" operation.) The additional weight, created by essentially doubling the film load and adding one complete additional recovery system, was to be offset by launching the Agena-CORONA combination as the upper stage of an augmented Thor, the booster originally created to provide a launching capability for the relatively heavy LANYARD.

The success of selective and evolutionary inbreeding of technology, an example of a positive development strategy, was well-illustrated in the CORONA-LANYARD programs. LANYARD, the transform of the Samos E-5 effort, used a high-thrust version of the Thor booster and demonstrated that a relatively small CORONA recovery capsule could be successfully adapted to the needs of a wide-film, big-optics, photoreconnaissance system. The influence of E-5 and GAMBIT (also known as the KH-7) concepts on CORONA-M could be postulated reasonably.

It is not entirely possible to prove that the adaptation of an E-5 (LANYARD) camera to the Discoverer-CORONA reentry system prompted later attention to the prospect of similarly converting GAMBIT; but when E-5 and E-6 experience demonstrated the inherent frailties of "big capsule" reentry systems, GAMBIT was adapted to the CORONA capsule, which helped it elude the unhappy fate of earlier "big" systems. Similarly, the feasibility of operating in a double-bucket mode had been extensively demonstrated through CORONA-J more than four years before the first double-bucket GAMBIT reached its launching stand.

The technique of incremental and sequential development, and of building carefully on a base of demonstrated technology, was epitomized by CORONA and GAMBIT, in their various models, and was also exploited for other satellite systems developed under the aegis of the NRO in the years before 1967.

Discoverer Flight Summary - 1962

Discoverer No.	Mission No.	Date	Camera	Remarks
XXXVII	9030	13 Jan	C'''	Agena failed to orbit.
XXXVIII	9031	27 Feb	M	Air recovery. Camera OK. First CORONA M flight.
	9032	18 Apr	M	Air recovery. Camera OK.
	9033	28 Apr	M	Failed to eject parachute. No recovery.
	9034A	15 May	A	Success.
	9035	30 May	M	Success.
	9036	02 Jun	M	Torn parachute. No recovery.
	9037	23 Jun	M	Success.
	9038	28 Jun	M	Success.
	9039	21 Jul	M	Success.
	9040	28 Jul	M	Success.
	9041	2 Aug	M	Success.
	9044	29 Aug	M	Success.
	9042A	1 Sep	A	Success.
	9043	17 Sep	M	Success.
	9045	29 Sep	M	Success.
	9046A	9 Oct	A	Success.
		26 Oct	N/A	Starfish radiation assessment. No photos or recovery planned.
	9047	5 Nov	M	Success.
	9048	24 Nov	M	Success.
	9049	4 Dec	M	Success.
	9050	14 Dec	M	Success.

CORONA and the NRO

The National Reconnaissance Office operated smoothly under the aegis of Charyk and Bissell. Bissell was a model manager, moving his organization's people toward corporate goals, rather than bureaucratic franchises. One testament to the scope of his managerial capability was demonstrated when, upon his departure in early 1962, the CIA divided his office—the Deputy Director for Plans—into two new offices: a Deputy Director for Plans (this went to Richard Helms, later to become DCI) and a Deputy Director for Research (to Dr. Herbert Scoville). Killian and Land had also urged this separation of technical from operational activities.

Within his organization, Bissell had a spartan, streamlined command structure and a surprisingly small staff. During his CORONA regime (the "tough" years) he never allowed anyone to establish that program as a separate organization. It never had a full-time staff: a person working on CORONA was sure to be working, in addition, on the IDEALIST or OXCART aircraft programs. (Four of Bissell's *field* employees were full-time: Lt. Colonels Charles Murphy and Vern Webb, both in place after July 1959 at Lockheed, coordinating CIA's CORONA interests, and Majors Arthur Dulac and John Schadegg, planning mission operations.)

In 1962, as the new Directorate of Research began its separate existence, it started, by its own assessment, to change its character, losing much of its cohesiveness and flexibility.[82] The loss was understandable; Bissell's relaxed management arrangements had worked because *he* was the manager, completely confident of rapport with the DCI and completely competent in what he was doing.

For four years, the Discoverer Office, at AFBMD, had considered itself responsible for all elements of the CORONA satellite, including the payload. While grateful for the streamlined procurement channel opened by the CIA, Captain Johnson, who worked for Colonel Battle, was the final responsible governmental person to sign off on each contractor delivery of cameras and recovery capsules. Other persons, like Lt. Colonel Murphy (CIA) or Major Edward Conway (USAF), might join in the review process, but their (welcome) assistance was fraternal, rather than mandatory. Bissell had always seen matters in this light. To him, the specific goal of CORONA was to open a closed society. The engineering required to get CORONA functioning was essential, but would never become a goal in itself. As early as 1958, his memoranda to General Smart, Assistant Vice Chief of Staff/Air Force (and Bissell's key contact in the DoD), reflected this firm distinction. He promised to provide "covert procurement, cover, and security" to the program, but believed that "responsibility for day-to-day management decisions could revert in most matters to the AFBMD." At the same time, he expressed "the hope that the CIA's role in this particular activity and others of a similar nature, could be progressively reduced and eventually be limited to receipt of the operational product as one of our customers."[83]

Scoville, as head of a new organization, with a new mission, quite naturally looked with personal interest in the direction of satellite technology. As a scientist, he was puzzled by Bissell's laissez-faire attitude toward CORONA. Although he was ostensibly the Director of Program B, Scoville delegated this assignment, with its day-to-day operational functions, to Colonel Jack Ledford, thus inadvertently placing Program B at an organizational disadvantage among its peers. (Subsequent realization of this fact was a major factor in the CIA's later request for a Deputy Director's position on the NRO.)

One adverse affect of any agreement is unavoidable: agreements set up boundaries. The CIA and DoD were beginning to look, for the first time, at what they were assigned; "task" was being translated into "jurisdiction" or "franchise." An example of this shift was not long in arriving, as a mantle of ownership began to fall over the payload. As second-generation CIA CORONA-ites came into employment, they absorbed a mythology that the CORONA payload was a CIA development, rather than a CIA procurement. Previously, everyone was helping to develop everything; now, parts of CORONA became "personal" acquisitions. "Normalcy" walked in when Bissell walked out.

Another subtle, but very important, shift in emphasis began with CIA references to "problems with the Air Force," rather than their "problems with the DoD." This was a case where the NRO's excellent security cover was backfiring: it was too good for its own good. The Director of the NRO was actually

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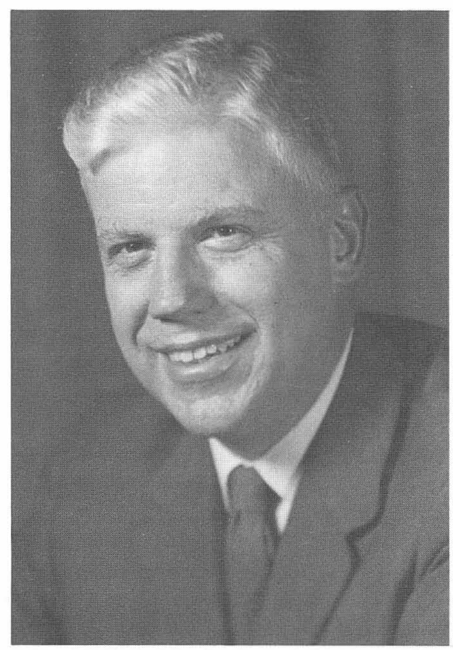
the Special Assistant for Reconnaissance to the Secretary of Defense. Locating this person in an office in the Air Force seemed efficient from the point of view of security and for ready access to Air Force development, launching, and recovery resources. The same logic seemed to apply to having the NRO Staff look like a Space Systems Office in the Air Force. But both actions vitiated the prestige and authority of the NRO. It became convenient for a CIA representative to complain to Secretary McNamara about the offenses "of the Air Force"; it would have required a good deal of courage to substitute the words "of your office."

In 1963, James Cunningham, Deputy Assistant Director (Special Activities), CIA, stated the situtation well, when he said, "It is difficult to isolate a turning point in the USAF/CIA relationship and to point to any one or series of acts which have prompted the erosion that has taken place [note the use of the expression "USAF/CIA"]. Whatever the reason, it is fair statement of fact to conclude frankly that during the short reign of the NRO the USAF/CIA [again] relationship has deteriorated to the point where mutual trust is now hesitant and there is speculation on either side of 'power grabs' by the other."[84] (Among suggestions toward improving the situation, Cunningham recommended a full-time Director, NRO [no collateral duties], a CIA employee as Deputy Director, NRO, removal of command functions from the NRO staff, equal representation from each agency on the NRO staff, and location of DNRO and Staff in a separate building.)

Charyk left his newly-established Director's position at the end of January 1963 to head the Comsat Corporation. His replacement, Dr. Brockway McMillan from Bell Labs, did not arrive until 1 March. McMillan's introduction

James A. CUNNINGHAM



NRO Director Brockway McMILLAN

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to the NRO world was without benefit of indoctrination by Charyk concerning previous cooperative methods of operation. Now that all the original players were gone, there was no one left at higher echelons who remembered the relaxed management era of 1954-1962. McMillan, as a newcomer, made the understandable error of reading his NRP Directive very literally, assuming he could proceed to exercise impersonal, rational judgments and have the unswerving support of the DCI and the Secretary of Defense.

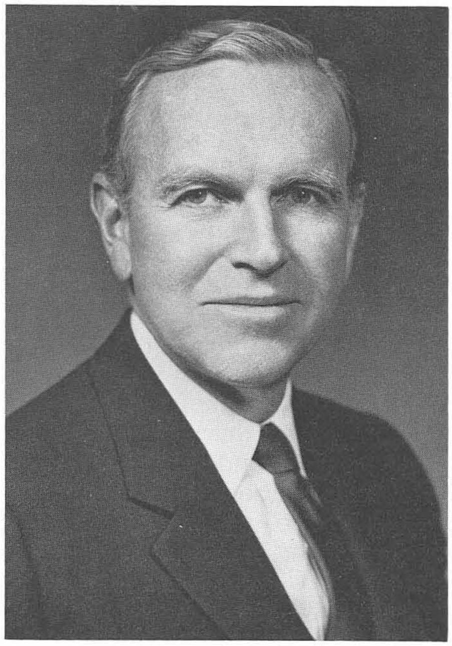
For instance, it seemed totally rational, to the new DNRO, to move the CORONA project to General Greer's Program A office and to place authority over all its elements in Greer's hands. McMillan took a number of minor, but unilateral, actions to bring this about and was shocked when each of them triggered strong protest from Scoville. What was missing in McMillan's *modus operandi* was the social camraderie which lubricates life within the Washington Beltway: the executive lunch, the friendly drop-in at Langley, or the newsy telephone call. McMillan's response to Scoville's protests was to inhibit Colonel Murphy and Lt. Colonel Webb, assigned to CIA's Sunnyvale operation, in communicating with their own headquarters (at Langley) and finally to transfer Webb, without coordinating the move with CIA.

In Los Angeles, General Greer was using the Aerospace Corporation to do Systems Engineering/Technical Direction for his programs and felt a natural urge to add CORONA to the Aerospace list. The CIA office saw this as another "take-over" maneuver and fought it bitterly.

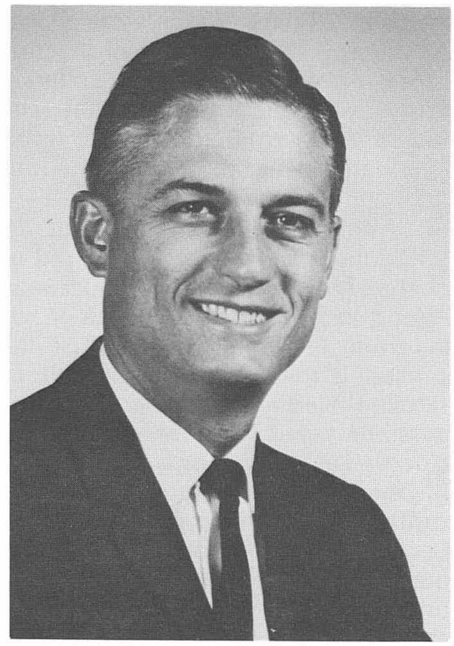
McMillan also assumed a strict interpretation of his review authority over release of NRP funds, an agreement having been signed by McCone and Gilpatric on 5 April 1963 giving the NRO complete authority over all funds supporting the NRP, regardless of source. The CIA believed funds marked for projects or studies they "owned" should come to them automatically; McMillan thought otherwise. He also considered a Deputy Director position excessive to his needs, but such a position had been established by the Third Agreement signed on 13 March 1963.[85] The position was finally filled by CIA's Eugene Kiefer.

Negotiations on matters such as these seemed endless and very wearing: Scoville resigned as the Deputy for Research in April 1963, saying that the stormy history of his interaction with the NRO had made his position "unrewarding."[86] Between the signing of the March NRP Agreement and the 5 April Funding Agreement, President Johnson's PFIAB entered the fray. A panel, headed by Dr. William Baker, reviewed the management and operation of the NRO and criticized McCone's "stewardship" of the program. The Panel also urged McCone to create an organization for research and development within the CIA.

At the same time, McCone was keenly aware that none of the satellite projects was going very well. On 1 August 1963, he told his staff that something had to be done "to get the CIA back into the satellite business, including developing proposals for new and better system beyond CORONA." Four days later he named OSI Director Albert D. "Bud" Wheelon as Scoville's successor in a re-named and greatly expanded Directorate of Science and Technology. Prior to Wheelon's arrival in the Agency, he had been in charge of Space Technology Laboratory's [redacted] program, which was the major analytical effort in ballistic missile intelligence. He had also been chairman of the US Intelligence Board's (USIB) Guided Missiles and Astronautics Intelligence Committee (GMAIC). Wheelon responded at once to DCI McCone's remarks. He believed reconnaissance systems should actually be built by the CIA and he argued for a totally independent capability.



Deputy Defense Secy Roswell GILPATRIC



DDS&T Albert D. WHEELON

CORONA-J

CORONA-J, the latest configuration in the CORONA series, was to consist of a thrust-augmented-Thor, an Agena-D, two modified MK-Ia recovery systems, and a modified CORONA-M camera. In effect, a CORONA-J mission would provide the capability of performing two CORONA-M missions at the cost of one booster, one Mural camera system, two reentry vehicles, and two stellar-index cameras (one for each capsule).

Although CORONA-J was not formally approved for development until October 1962, the CIA, in July 1962, authorized Lockheed, as the prime contractor, to proceed with preliminary engineering design of the system. First launching was planned for May 1963 with a one-per-month initial launching rate following, but with provisions for a two-per-month rate starting as early as July 1963. The short lead-time was made possible by converting previously built CORONA-M systems to the CORONA-J configuration. Formal notification of the imminence of CORONA-J operations reached NPIC, the CIA, and

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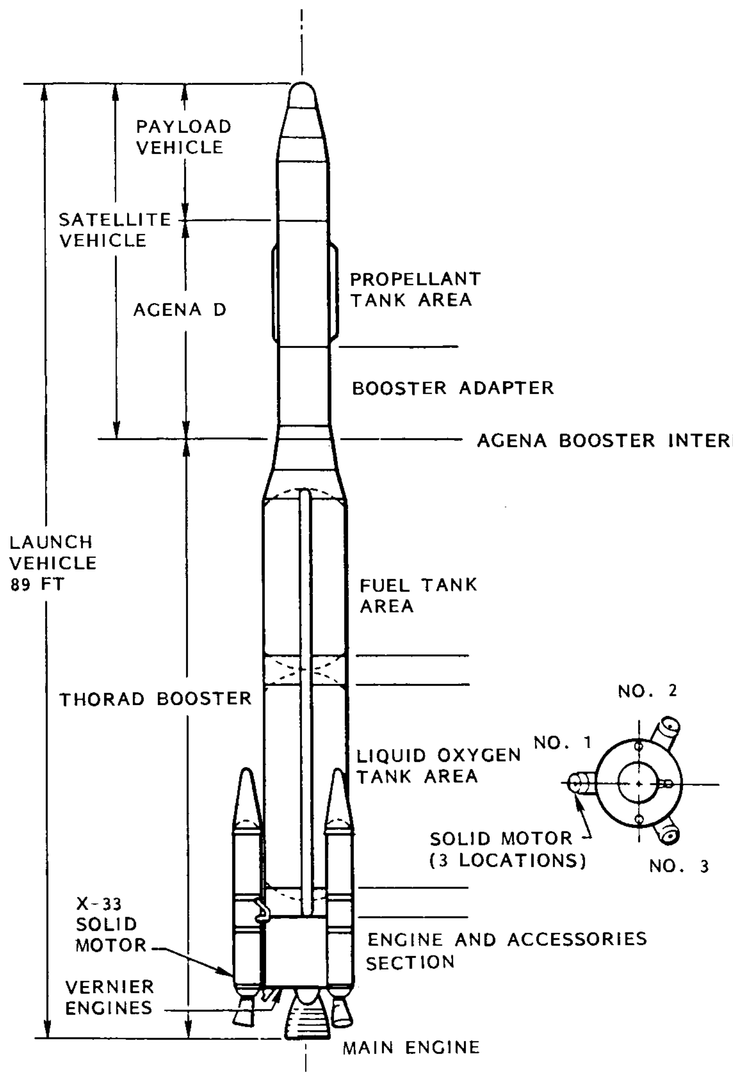
the USIB's Committee on Overhead Reconnaissance (COMOR) early in December—by which time it seemed clear that first flight would occur in "early summer," rather than May 1963.

The rationale for the CORONA-J program was heavily dependent on assumptions about the utility of zombie-mode operations. Effectively, the plan was to use the system in a four-day mission, recover the forward capsule, and program the remaining on-orbit elements for a "controlled tumble" of as much as 20 days (with electrical power and stabilization control gas shut off). At the end of the period of inaction, but one day before further reconnaissance use was planned, controllers would reactivate the satellite for a second four-day period of photography. The camera program for the second mission would be determined from the results of the first mission. Some 15,000 feet of film were carried for each of the four-day periods of camera operation.

Although the first of eight 1963 CORONA-J missions was originally scheduled for May, launching did not occur until August, a delay only partly chargeable to payload development difficulties. A rash of problems with the Agena in both the CORONA-M and LANYARD programs and a launching failure in the first attempt to use the TAT (Thrust-Augmented Thor*) booster caused a sudden and alarming interruption of intelligence returns from satellite overflights during the early months of 1963. The first two LANYARD missions failed because of Agena breakdown and the third experienced a camera failure after only 32 hours in orbit. One ARGON and three CORONA-M operations between January and April 1963 were either failures or significantly disappointing, three because of Agena problems and the fourth because of a TAT failure caused by error on the part of a launching crew member. In light of that sequence of events, McMillan decided to launch proven CORONA-Ms rather than untried CORONA-Js during the early summer of the year. The success of CORONA-M Missions 9054, 9056, and 9057 renewed the flow of photography on which intelligence analysts had become increasingly dependent and encouraged McMillan to approve the first CORONA-J mission. (Mission 9055, the missing number in the series, was actually the ARGON mission of 26 April, the sixth ARGON failure against one "good" operation and one "partial success.")

If the dependence of the United States on CORONA satellite photography had not been fully acknowledged earlier, the sudden cessation of the flow of intelligence from that resource in early 1963 corrected such a misperception. DCI McCone wrote McMillan that "the importance of this type of intelligence to our National Security cannot be over-emphasized and it is essential that there be no repetition of the hiatus in this type of coverage such as has existed for the past three months." McCone added (referring to various procedural changes introduced in an effort to eliminate CORONA problems), "in view of the overriding importance of this type of intelligence, . . . [Deputy Defense Secretary Roswell] Gilpatric and I have agreed that the NRO will continue to employ the special inspection procedures on all forthcoming flights in order to ensure that the possibility of failure is minimized. We desire that action be taken accordingly."[87] An additional precaution, immediately instituted by McMillan, instructed Greer that "experiments and additional payloads" were

*The term "Thrust-Augmented Thor" refers to a modified Thor configuration which incorporated three Sergeant (X-33) solid rocket motors



Thorad-Agena Launching Vehicle

not to be carried on future CORONA or GAMBIT flights if there was any possibility that their inclusion would jeopardize the primary mission" —the successful recovery of photography from the main payloads."[88]

In spite of such precautions, CORONA-J (this is also known as the KH-4A) operations began inauspiciously, somewhat akin to the original series of CORONA launchings four years earlier. Not until the third mission (1004), in February 1964, did the planned and the actual sequence of events come into acceptable correspondence. In each of the first two flights, capsule No. 1 was recovered complete with four days of film take, but the second capsule was lost. In some respects, these first two attempts to operate CORONA-J could not be counted as *major* failures, because one capsule, complete with film, was recovered in each instance and such a recovery represented an achievement comparable to the success of any earlier CORONA mission. But the cost was substantially greater, and it was also a fact that each of the first CORONA-J missions had been intended to provide more and better data than could have been obtained from two of the earlier CORONA-M operations.

The fourth CORONA-J (24 March 1964) mission was catastrophically brief; Agena guidance failed shortly after launching. The fifth (1005, on 27 April 1964) had an uneventful launching, but, after 350 camera operations, the film broke; then the Agena power supply failed; and finally the capsule ignored signals to deboost and reenter. Unlike other failed units, the stubborn reentry capsule did appear later, with panache. Calculations of the anticipated decay of the capsule orbit predicted initially that it would impact in the Pacific, west of the coast of South America and about 10 degrees north of the Pole. A later calculation, based on better orbital trace measurements, indicated probable impact of fragments somewhere in Venezuela. Observation stations in the Caribbean area were alerted to watch the skies on 26 May 1964, and, on that date, reports from Maracaibo, Venezuela, said that five bright objects had passed overhead, presumably on their way to impact in the ocean off the South American coast. That seemed to be that.

More than two months later, on 1 August 1964, a Venezuelan commercial photographer, Leonardo Davilla, telephoned the US Army Attache in Caracas to report that an object which appeared to be part of a space vehicle had been found, nearly a month earlier, 500 miles south of Caracas in a remote rural region of the Andes near the Columbian border. The object carried, among other markings, one that read "United States," and another that read "Secret." Davilla did not mention that he had photographed the object or that the farmer on whose land it lay had been trying to sell it—in whole or in part.

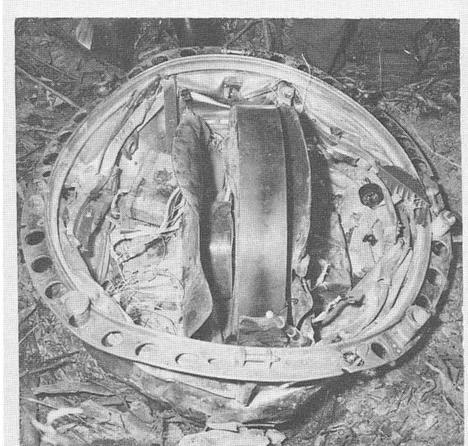
Not until 3 August, after a second call from Davilla, did the Army Attache notify the assistant Air Attache of the reported find. On 4 August, after interviewing a commercial pilot who had also viewed the object at close range and predictably had returned to Caracas with a souvenir, the Army Attache flew to La Fria, the village nearest the find, only to discover that the Venezuelan army had arrived first and had taken to object to San Cristobal, the provincial capital.

Interviews showed that on 7 July, 14-year-old Eladio Becerra and 40-year-old Gabino Mora had stumbled upon a battered gold object. They reported their find to their employer, who had the object moved onto his own property and put up for sale. Since it was an unknown object, in terms of value, there were no worthwhile offers, so efforts were made to dismantle it. By hacking and prying, a radio transmitter was removed and various pieces dislodged to be used as household utensils and toys for children. Local farmers, attracted by one of the gold discs attached to the upper section of the capsule, hacked away to get at more gold. (The gold disks, approximately the size of a quarter, were a part of a heat transmission experiment; one of many mini space experiments regularly flown on early flights, not only to provide valuable data, but also to reinforce the Discoverer program cover story.) One farmer had transformed the parachute lines into a harness for his horse.

On 4 August, the local Reuters correspondent reported the find in a dispatch picked up by several wire services. It appeared in the Washington *Star* and the New York *Times* on 5 August. The Pentagon issued a "No comment."

The US Army Attache noted finding an American five-cent piece and a quarter among the odds and ends in the wreckage. (Two quarters and a

SRV being carried out of La Fria on foot by Campesions



On location in La Fria, Tachira

Sold to the U.S. Air Force

Recovery of CORONA Mission 1005

buffalo nickel had been found in one of the capsules recovered in 1961.) He also took possession of the film that remained in the fractured canisters. It was "well-cooked."

CIA agents sent to Caracas reported that "the ground impact and the farmers have pretty well reduced internal equipment to junk." But great numbers of people had seen the capsule, photographs had been circulated in Caracas and printed in the local newspaper (although it was incorrectly reported to the NRO that all known photos and negatives had been retrieved), and it was obvious that local Communist bloc people could easily have seen the remains and certainly had copies of the photographs. The capsule had been compressed to about two-thirds its original length by the impact, and the spooled film was beyond salvage. But, in McMillan's ironic phrase, the experience had redeeming features because it "provided valuable engineering data on non-optimum re-entry survivability." The incident also demonstrated that the inherent stability and good ablative shielding of the capsule made random-entry survival a very real possibility—an idea naturally disconcerting to security people.

Security had yet another epilogic trauma even after the remains had been retrieved from the Venezuelan Ministry of Defense. In order to obscure the destination of the packaged capsule wreckage, the real CORONA parts were sent to Lockheed by way of a secure air route and a dummy package containing paper, odds and ends of metal scrap, and pieces of wood was boxed for shipment to the home address of a DIA officer assigned to the Pentagon. Unhappily, the scrap fill plus the carton weighed only 80 pounds although the shipping manifest specified a 250-pound cargo. Alert customs officials at McGuire Air Force Base decided they had uncovered a narcotic cache and opened the box. After fruitlessly sorting through the expensively freighted junk, they contacted the addressee and advised him sternly that they were "going to investigate." Stalling customs for the moment, the officer put through a frantic call to the CIA to "cut this one off." The Agency, with its own contacts in the Customs Bureau, retrieved and destroyed the box six days later.

In the end, two positive actions resulted from the 1005 incident. First, all classification markings were removed from orbital CORONA vehicles before launching and a notice of reward for return, in eight languages, was substituted. Second, inspection procedures were reinforced to protect against the stowage of more American souvenir coins during fabrication and checkout. (An earlier official injunction against spaceborne souvenirs had perhaps lost its effectiveness.)

In the wake of the first two CORONA-J flights, both rated partially successful, ground tests of J-systems had been disappointing. Program managers, therefore, decided to use CORONA-M flights to provide the required reconnaissance coverage, while extended development and fixes of J-system technology continued. Apart from the operating defects that had prevented recovery of the second capsule in each of the first two CORONA-J operations, there was also a camera problem, which engineers diagnosed as incorrect tension in the film-transport system. The Agena flight problems involving inverter operation and command system responsiveness were countered by installing redundant equipment.

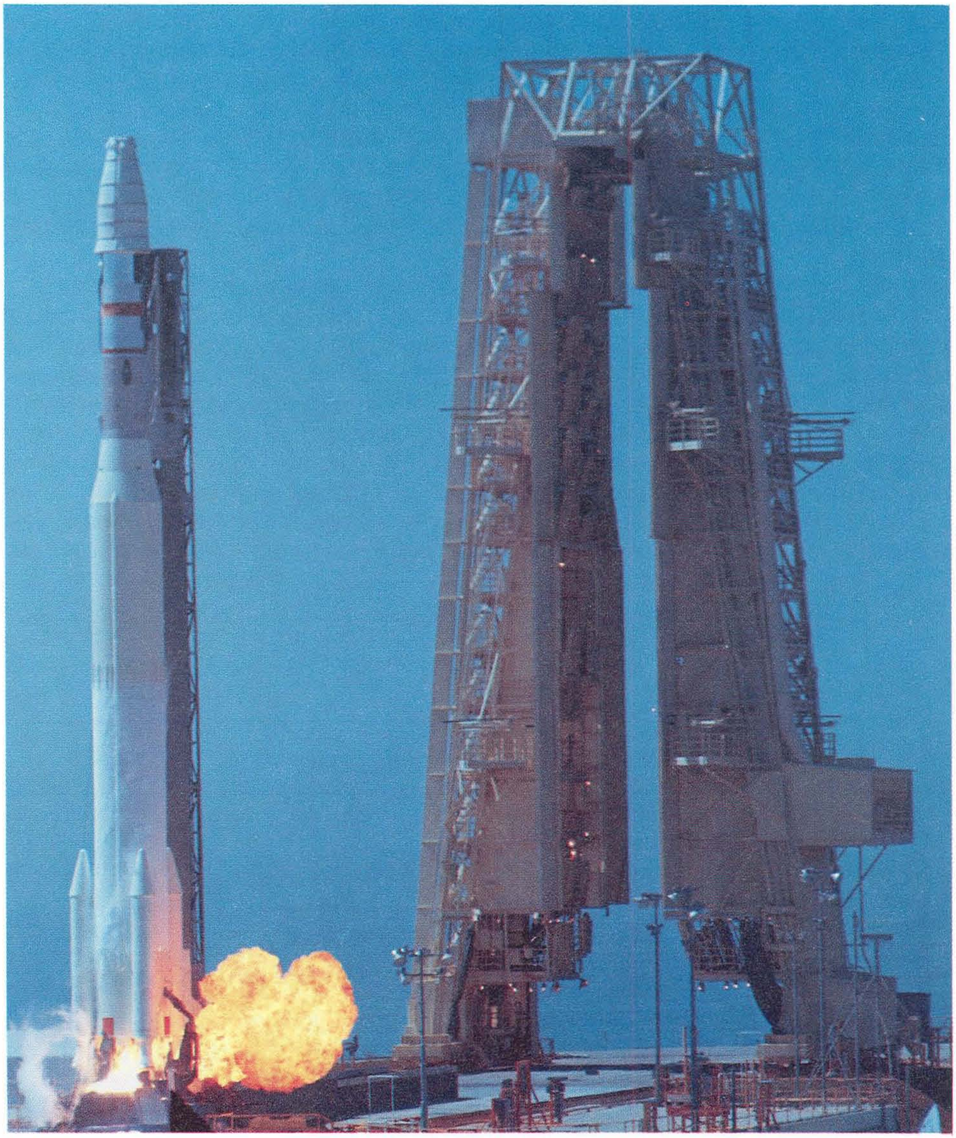
As happened with infuriating regularity in the satellite-reconnaissance program, perverse fates seemed to intervene in the sensible decision to revert to reliance on CORONA-M so that CORONA-J problems could be resolved in an atmosphere free from pressure for immediate operational returns. Two of the last three CORONA-M missions (9060 and 9061) were unsuccessful—one because of a Thor failure (the second in two years and only the fifth in 79 attempted Thor-Agena launchings). Cancellation of LANYARD, following its third launching and first partial success, had made two additional TAT vehicles available and indirectly accounted for the allocation of two basic Thor-Agena combinations to the ARGON program for August and October 1963 launchings. Perversity appeared here also; both went well, providing the second and third largely successful ARGON operations in 10 mission attempts. (Another ARGON was charitably accounted a partial success.) The CORONA-M launchings of November 1963 were failures. Apart from the Thor malfunction, an Agena breakdown caused failure of capsule reentry as the climax of a mission that began with a 27 November launching. But the final CORONA-M (9062) redeemed its breed, operating almost flawlessly from its 21 December launching to capsule recovery on 26 December 1963. The paradox remained, however; in its final days the nominally reliable CORONA-M experienced major mission problems, while the almost untested CORONA-J operated reasonably well. Two CORONA-J capsules and one CORONA-M capsule were recovered between August and December 1963, and two were lost in each program.

That the zombie mode itself, or the effort to operate CORONA-J in a zombie mode, was fundamentally unavailing had become apparent with the second successive failure. Reactivation after storage on orbit was more difficult than had been anticipated. On 13 February 1964, McMillan issued instructions that until further notice all CORONA-J systems were to be operated on continuous missions interrupted only to the extent necessary to recover the first capsule, after which they were to resume photographic operations. After recovery of the second capsule, McMillan ruled, such zombie-mode experiments as were necessary and appropriate could be done.[89]

CORONA Flight Summary — 1963

Mission No.	Date	Camera	Remarks
9051	8 Jan 1963	M	Success
9052	28 Feb	M	First TAT. One TAT failed to separate. Destroyed.
8001	18 Mar	L	1st LANYARD flight. No orbit. Guidance failure (Agena)
9053	1 Apr	M	Success.
9055A	26 Apr	A	No orbit. Attitude sensor problem.
8002	18 May	L	Orbit achieved. Agena failed in flight
9054	13 Jun	M	Success.
9056	26 Jun	M	Success.
9057	18 Jul	M	Success.
8003	31 Jul	L	Success. Camera failed after 32 hrs.
1001	24 Aug	J	Success. 1st J Flight; 2 RV's; RV-2 Lost
9058A	29 Aug	A	Success
1002	23 Sep	J	RV-1 recovered; RV-2 lost.
9059A	29 Oct	A	Success.
9060	9 Nov	M	Failure. Unstable launching.
9061	27 Nov	M	Agena failed in flight; prevented recovery.
9062	21 Dec	M	Success. Last CORONA M.

CORONA-J utility was demonstrated in April 1965, when a complete system was kept in one-day-from-launching (R-1) status for two weeks. Gradual extension of mission life for CORONA-J, from its original six days to 10 days, was one product of the proven zombie mode operation. Minor enhancement of the thrust capacity of TAT (by means of a Thor fuel tank



CORONA J-3 Being Launched Atop Thorad Booster

enlargement, the vehicles being called Thorad*) and of the orbital durability of the Agena was undertaken early in 1965, the goal now being 14-day mission operations. Launchings of the improved system were scheduled to begin in July 1967.

These improvements were relatively modest, especially when compared to earlier efforts to advance CORONA-C and CORONA-M capabilities. The conservatism was a reflection of the possible imminence of a new search system development, considered for possible start in 1964 or soon thereafter. The prime candidates were FULCRUM and S-2 and preliminary discussion was underway over (1) choice of system and (2) who should have payload development responsibility: the CIA (FULCRUM) or the Air Force Special Projects Office (S-2). As the months passed, these discussions became spirited, as well as frustrating, and extended to broad questions of organizational responsibility for the CORONA payload.

Despite significant tensions between the DNRO and Program B, CORONA had made remarkable operational progress during the McMillan era. In terms of capsules launched against capsules successfully retrieved, the record from March 1963 to February 1964 was nine successes in 13 trials; for the following 12 months, it was 23 successes in 28 trials. This represented an increase of successes from 69 percent to 82 percent.

CORONA Flight Summary — 1964-1965

Mission No.	Date	Camera	Remarks
1004	15 Feb 1964	J	Success.
1003	24 Mar	J	No orbit. Agena power failure.
1005	27 Apr	J	No on-orbit operation. Agena failure. RV impacted in Venezuela.
1006	4 Jun	J	Success.
9063A	13 Jun	A	Success.
1007	19 Jun	J	Success.
1008	10 Jul	J	Success.
1009	5 Aug	J	Success.
9064A	21 Aug	A	Success.
1010	14 Sep	J	Success.
1011	5 Oct	J	Success on RV-1. No RV-2 recovery separation from Agena; battery failure.

*Thorad differed from the original TAT (Thrust-Augmented-Thor) in having 13 feet more length to accommodate additional fuel and oxidizer, with some relocation of components. With Sergeant strap-on solid rocket boosters attached, a Thorad-Agena D combination could put 400 more pounds into orbit than could TAT-Agena. Modification of launching facilities at Vandenberg (to accommodate the taller Thorad) and the engineering required to transform TAT into Thorad cost about $2.8 million. The unit cost of a Thorad was only about $75,000 more than the cost of a TAT.

CORONA Flight Summary — 1964-1965 (continued)

Mission No.	Date	Camera	Remarks
1012	17 Oct	J	Success on RV-1; RV-2 water recovery due to bad weather.
1013	2 Nov	J	Both cameras failed on Rev 52
1014	18 Nov	J	Success.
1015	19 Dec	J	Success. Zombie mode used.
1016	15 Jan 1965	J	Success.
1017	25 Feb	J	Success.
1018	25 Mar	J	Success.
1019	29 Apr	J	Success. No RV-2 recovery
1021	18 May	J	Success.
1020	9 Jun	J	Success on RV-1. Water recovery on RV-2.
1022	19 Jul	J	Success.
1023	17 Aug	J	Success. Forward camera failed.
	2 Sep	N/A	Destroyed on launching by range safety.
1024	22 Sep	J	Success.
1025	5 Oct	J	Success.
1026	28 Oct	J	Success.
1027	9 Dec	J	Success. Control gas loss.
1028	24 Dec	J	Success.

The J-1 CORONA had gradually been improved during its operational life. Lifeboat, developed early in the CORONA program as a backup system for ensuring deorbit of the RV in the event of Agena power failure, continued to provide emergency capability and was responsible in four separate instances for the successful recovery of J-1 missions. From eight days of operational camera life in 1964, the J-1 extended its mission capability to 15 days during 1967. The J-1 was a participant in the remarkable series of successes from 1966 to 1970, when 28 capsules were placed in orbit and 28 capsules were recovered. Reliability had improved substantially since 1962, when a single one-day mission success in four attempts had been hailed as a spectacular triumph.

Relations between the NRO and CIA, however, did not improve. DCI McCone reached agreement with Defense Secretary McNamara, in autumn of 1964, to begin discussions looking to the realignment of the NRO structure. But the NRO-CIA impasse continued into the new year and resulted in President Johnson's Science Adviser, Dr. Hornig, proposing to establish a National Reconnaissance Panel, under Dr. Land, to look into this matter.

As a result of these cross-currents, the NRO charter was under continuous study. An Executive Committee, made up of the Deputy Secretary of Defense, the DCI, and the President's Science Adviser was established in 1964 to make key NRP decisions. A new NRO Agreement was signed on 13 August 1965 by the new DCI, Admiral William F. Raborn, and Deputy Defense Secretary Cyrus Vance. Under its terms, these responsibilities were assigned:

For the Secretary of Defense:

- Establishing the NRO as a separate agency of the Defense Department
- Choosing the DNRO, "who will report to him and be responsive to his instructions"
- Concurring in the choice of the DDNRO, "who will report to the DNRO and be responsive to his instructions"
- Reviewing and having the final power to approve the NRP budget

The DCI was made responsible for:

- Establishing collection requirements and priorities
- Reviewing the results of collection and recommending steps to improve them
- Appointing the DDNRO with the concurrence of the Deputy Secretary of Defense. The DDNRO was to serve full time in a line position directly under the DNRO and "shall act for and exercise the powers of the DNRO during his absence."[90]

By 1965, DDS&T Wheelon was in the midst of building a large organization to study, design, develop, and produce reconnaissance satellite systems. He liked to compare the success of what he termed "CIA developments"—the U-2, the OXCART/SR-71, and CORONA—with the lack of success of early Air Force programs, specifying Samos. He said,

> The demonstrated performance of CIA is clearly superior to that of the Air Force. We believe that this is attributable to three basic factors. The most important is that the collection and the analysis of intelligence is the only business the CIA has. The second asset is the continuity of its professional staff. The last is its unique legislative authority to pursue programs promptly with confidential funds and to manage them in a streamlined way.[91]

There were other advantages Wheelon did not cite: he could begin new studies more easily than could the Department of Defense (he had a very short chain-of-command to convince), his hirings would be sheltered by a Special Schedule in the Civil Service system, he could offer higher salaries than the DoD, and he had the enthusiastic support of his boss.

On 15 September, a senior career intelligence officer, Huntington D. Sheldon, was named Director of Reconnaissance, CIA, on an interim basis by

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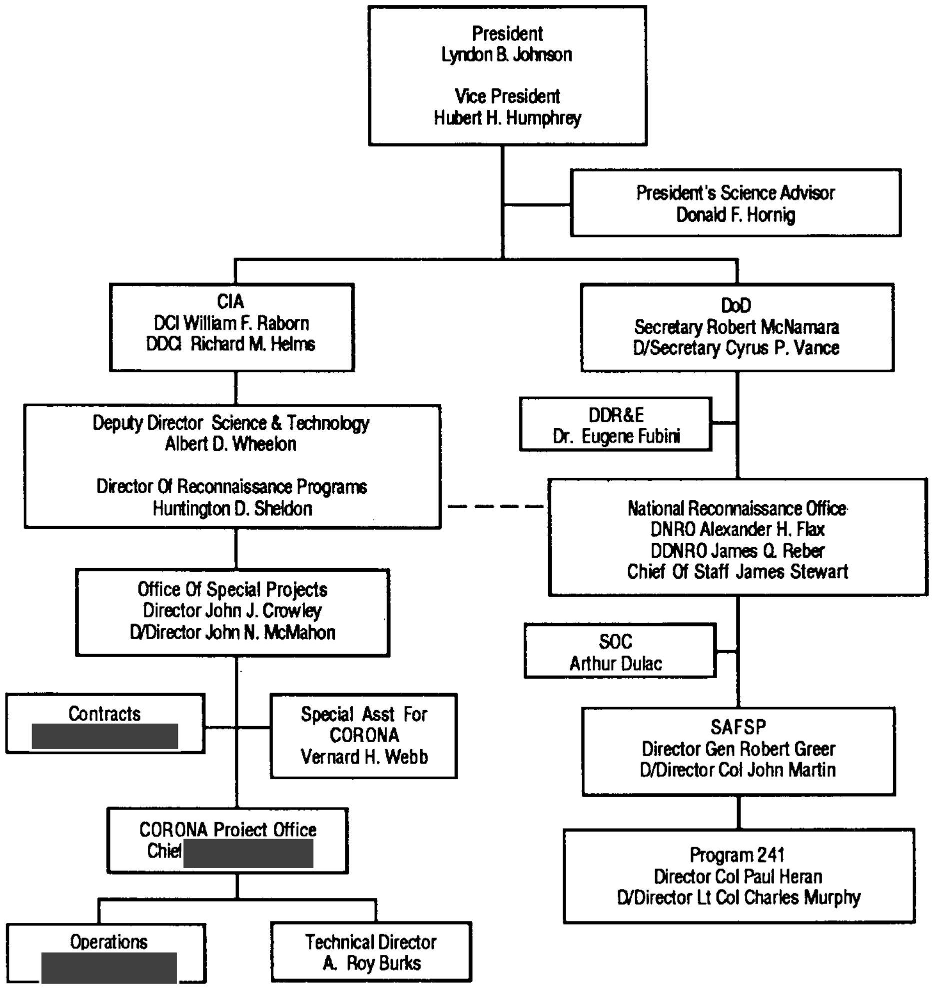
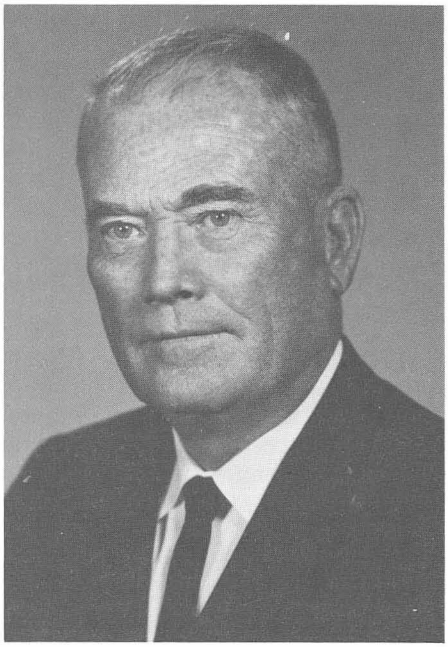


1965 CORONA Organizational Chart



DCI William F. RABORN

Deputy Defense Secy Cyrus VANCE

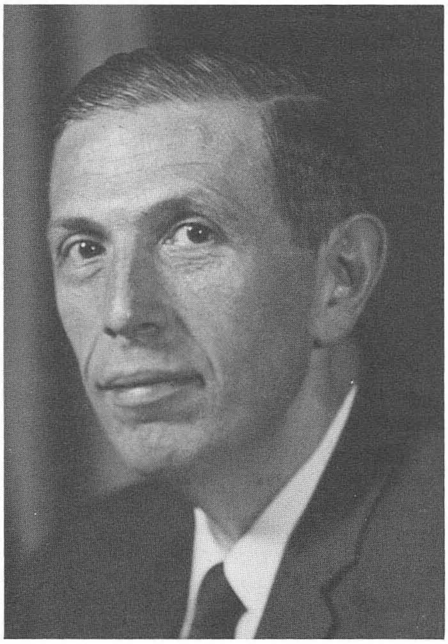
DCI Raborn. In that capacity Sheldon was responsible to Wheelon for the activities of the Office of Special Projects (OSP) and other related activities within O/DDS&T. As noted in the history of the OSP "Mr. Sheldon would provide the DNRO with a single authoritative point of contact within the CIA for all reconnaissance programs, and the assignment of Mr. Sheldon was in the nature of adding a diplomatic negotiator to balance the aggressiveness of the DDS&T in handling NRP matters."[92] On 16 May 1966, Sheldon was "relieved of duties as Special Assistant to the DDS&T and transferred with his reconnaissance and SIGINT duties to the position of Special Assistant to the Director."[93]

As another part of the general shifting of people during this period, on 1 September 1965 James Q. Reber, CIA, replaced E. P. Kiefer as Deputy Director, NRO.

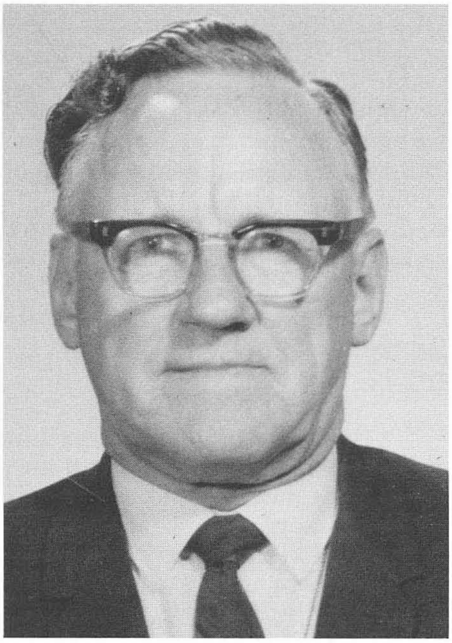
It had taken only three post-Charyk/Bissell years to cement the concept of rigid ownership over what had once been a casual, friendly, free-form structure. Every move in the degenerative process had been made by unusually talented people, whose common problem was that a gleam in the eye was accompanied by a rigid set of the jaw. Both sides were perennially indignant, and the alarming fact was that the indignation was, always, deeply righteous. Above all the turmoil, CORONA floated in serene success.

Dr. Alexander Flax, Assistant Secretary of the Air Force for Research & Development, was named to succeed McMillan on 1 October 1965. After assuming his new position (while still retaining his responsibilities as Assistant Secretary for R&D), Flax soon realized that he had inherited a host of problems involving technology, organization, and future system planning (although the decision to proceed with what later became known as HEXAGON had been essentially confirmed at the time of his appointment). In addition, the future of CORONA was not quite as certain as was assumed in August 1965, and that, too, became an item of concern for the new Director.

The deficiencies existing in the CORONA program management arrangement had long been recognized. As early as August 1963, DNRO McMillian proposed his solution to the problem: namely, transfer the entire program management responsibility for CORONA to the DoD in the person of General Greer. Predictably, this proposal was vigorously rebutted by DCI McCone and DDCI Lieutenant General Marshall S. Carter. Even though the debate as to how to properly resolve the issue continued for months, no substantial proposal, acceptable to all parties, was made until Flax, early in his tenure, asked CIA's John J. Crowley to conduct a thorough review of the subject. Crowley's report and suggestions were the basis of Flax's 22 April 1966 memorandum to the NRP Executive Committee (ExCom).[94] The document identified the basic underlying source of problems as the lack of clearly established and/or agreed-to management responsibilities and relationships.



NRO Director Alexander FLAX



John J. CROWLEY

In developing his own proposed arrangements, Flax was guided by the following criteria: (1) no serious consideration would be given to any management plan and/or rearrangement of responsibilities which would unduly disrupt the ongoing programs; and (2) to the extent possible, the solutions were to be in accord with the specifics, as well as the spirit and intent, of the 1965 NRP Agreement. With the concurrence of the ExCom, a directive was issued by Dr. Flax on 22 June 1966[95] for the purpose of establishing new organizational relationships and responsibilities.

The main provisions of this directive were as follows:

A. The Director of SAFSP was designated CORONA System Project Director (SPD) with responsibility for overall system engineering and system integration; overall system master planning and budgeting; assembly and checkout of the system at the launching pad; launching and mission operations; capsule recovery; and delivery of film to the DNRO-designated processing facilities (EK or Air Force Special Projects Processing Facility). The SPD's use of the services of Aerospace Corporation in a general systems-engineering role was accepted, with Aerospace engineers having free access to information and data from the payload contractors, but exercising no technical influence on matters wholly within the payload sphere.

B. The Director of Reconnaissance, CIA, was made responsible for direction and supervision of the development and production of the CORONA Payload Sub-Assembly (PSA) reporting directly to the DNRO. He was to establish a CORONA Payload Sub-Assembly Project Office (PSAPO) and designate a Director thereof, responsible through the Director of Reconnaissance, CIA, to the DNRO for the total PSA development and production, and to the SPD for overall system matters.

C. Additional specific responsibilities were assigned to the SPD, including the Thrust-Augmented Thor and Thorad boosters; the Agena booster/spacecraft; procurement of the DISIC; acquisition and operation of system assembly facilities (excluding the Lockheed AP Facility) and launching facilities; on-orbit command and control facilities; and capsule recovery forces and equipment.

D. Specific responsibilities were assigned to the Director PSAPO, through the Director of Reconnaissance, CIA, for the total PSA development, production (excluding the DISIC), and assembly and test; operation of the AP Facility; adherence to master system specifications, interface specifications, and master project plans established by the SPD; provision of software support to the Satellite Operations Center before, during, and after missions; assistance to the SPD with regard to prelaunching activities in the Payload Sub-Assembly area at Vandenberg, certifying to its readiness and acting as principal PSA assistant to the SPD during pre-mission planning, on-orbit operations, and post-mission analyses.

E. The basic PSA structural, dynamic, thermal, power, and other requirements were to be given proper weight in determining overall system configuration and characteristics. In tradeoffs within the system, the SPD was directed to attempt to resolve problems with a minimum effect on the sensor. However, both the SPD and the PSAPO were directed to analyze their interface and tradeoff problems in terms of a successful overall system performance.

In clarifying the division of responsibilities, Flax's directive emphasized that each party must honor the other's prerogatives, granting full and free access to all data, and carrying on properly coordinated informal and direct communication at all levels. In the way of general guidance, Flax cautioned both agencies:

> Despite good intentions on both sides, differences in interpretation of this management directive, the question of whether or not a problem has interface implications, etc., probably will occur periodically. When such an instance arises and cannot be settled in the field, I desire that the problem be called to my attention promptly for resolution. The successful implementation of this management arrangement will require the wholehearted cooperation of both CIA and SAFSP. I enjoin each of you to ensure that your respective subordinates put forth every effort in that vein.

With the management responsibilities clarified, it remained only to be seen if the human factor in the relations between CIA and the Air Force could be "directed" back to the truly cooperative spirit which had prevailed during the very early days of this joint endeavor. Fortunately for CORONA and for the nation this proved not to be a problem. The DoD/CIA cooperation on the CORONA Program improved significantly thoughout the remainder of the program.

During late 1965 and 1966, the CIA had significantly reorganized its space activities. The Office of Special Projects was established on 15 September 1965 by Deputy Director for Science and Technology Wheelon, and John Crowley was appointed Director of Special Projects and John N. McMahon, the Deputy Director. Soon thereafter, Lt. Colonel "Curly" Webb (USAF Ret.) was named Headquarters Project Officer for CORONA. Crowley appointed Captain [redacted] (USN, Ret.) as West Coast CORONA Program Manager, A. Roy Burks as Technical Director, and continued Colonel [redacted] (USAF Ret.) as Operations Officer.

Having seen the CORONA program through some of the most eventful and turbulent periods of its existence, Bud Wheelon, who had served for three years as DDS&T, resigned on 26 September 1966 to return to private industry. Wheelon's deputy, Carl E. Duckett, was named acting DDS&T and was subsequently confirmed to that position on 20 April 1967.

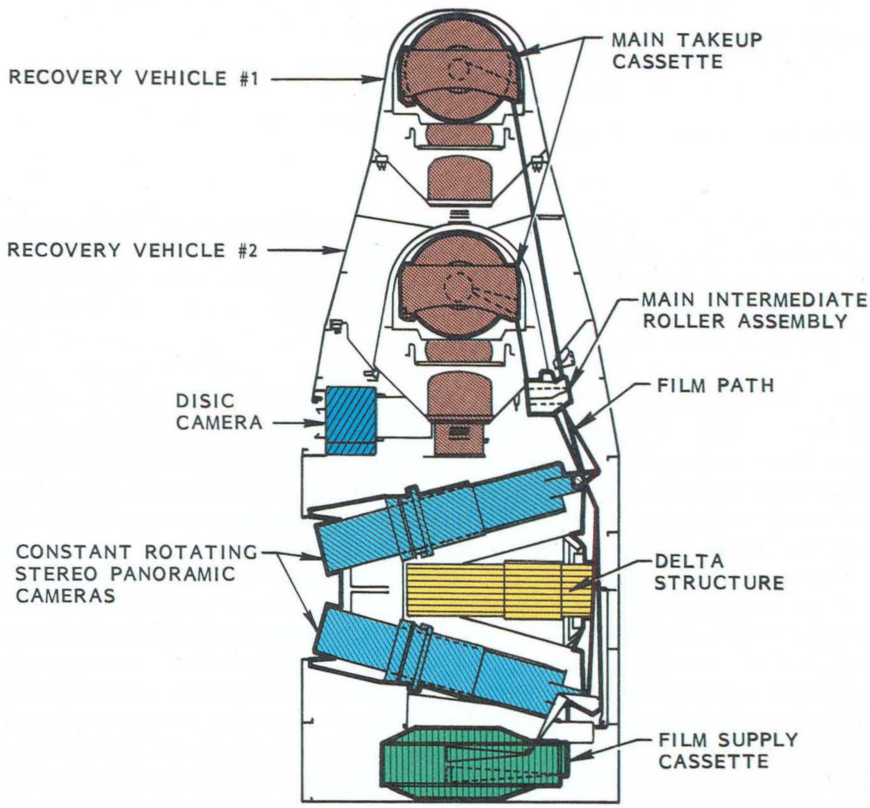
Section 4

Fulfillment: The Struggle To Maturity

CORONA Improvement Program (J-3)

Early in 1965, CIA's John Crowley and Dr. Eugene Fubini, DDR&E, agreed that studies should be made of the weaknesses and technical limitations of the current "J" system. Crowley directed his West Coast Resident Officers, Roy Burks and [redacted] to complete such studies and report back to him no later than 1 June 1965. A series of meetings followed with contractor representatives from LMSC, GE, Itek, Colonel Paul J. Heran's SAFSP Program Office, and the CIA Project Office. (Colonel Heran had replaced Colonel Roy Worthington as CORONA Project Officer.) Failure modes and operational deficiencies of the existing "J" system were analyzed as were the CORONA system coverage requirements, weather data, reliability data, and so forth. A matrix of feasible system designs was developed with all the recommended design features, including an improved panoramic camera (it had long been recognized that constantly rotating the complete lens and scan-arm assembly, rather than coupling and uncoupling a rotating lens and an oscillating scan arm, would improve camera performance). The selected configuration incorporated (a) the constant-rotator camera design by Itek with a camera cycle-rate-control capability for flying the system at altitudes as low as 85 nautical miles; (b) improvement in vertical/horizontal control and vibration to improve photographic quality; (c) incorporation of the Dual-Integrated Stellar-Index Camera (DISIC) to improve attitude determination and allow better use of the system by the mapping community; (d) development of the Mark VIII recovery capsule to provide a 300 percent increase in film-recovery capability; (e) on-orbit lifetime extension to 30 days to allow efficient film utilization; and (f) use of the Atlas or Thorad Sr. booster to provide the required lift margin for the increased payload and to allow for higher inclination orbits (up to 96 degrees).

DNRO McMillan, was briefed on the recommended improvements on 21 June 1965 by the CIA and Colonel Heran. On 29 June he approved procurement of the constant-rotating camera from Itek, the improvement in vertical/horizontal control, and incorporation of the DISIC (procurement of which was later assigned to SAFSP); however, he decided to keep the Douglas Thor as the booster, with a modest upgrading to allow for increased payload weight of the new rotator and stellar-index cameras. The reason for rejection of recommendations d, e, and f, above, according to Roy Burks, was primarily that official Washington held the view, in June 1965, that it was preferable to retain a launching rate of 12 systems per year rather than increase the film capacity and mission life, and reduce the launching rate. (This view was modified for the sake of economy during the CORONA stretchout, 1968–70.)[96]



Major Components of the J-3 System

Between the summer of 1965 and the end of March 1966, major progress was made on the design and development of the J-3 constant-rotator camera and all camera interfaces were completed. Subsequent to formal establishment of the CORONA Management Plan, the final go-ahead was given for the CORONA Improvement Program; however, the delay in this action had caused the first expected launching to slip from January 1967 to July 1967. The J-3 qualification program went smoothly to July 1967 when first launching was anticipated; however, in thermal altitude testing both the panoramic and stellar-index cameras had problems and, therefore, the first J-3 was delayed another six weeks. The first J-3 launching (Mission 1101) took place on 15 September 1967, and recovery of both buckets was completed on 28 September 1967. The J-3 (also known as KH-4B) was considered an outstanding success from a technical standpoint, since all design goals were achieved. Minor problems experienced on the first mission were correctable without major rework before the next flight of a constant-rotator camera was scheduled. The performance was judged to be the best ever from a CORONA system. The J-3 was able to fly a lower orbit and obtain better photographic scale and more information content per picture (with a resolution of six feet being achieved) than its predecessors.

By late 1968, CORONA was being treated as a terminal system. On the occasion of the 100th CORONA flight, in December 1968, a review of program performance, sent to all program participants by the CIA's Director of Special Projects, emphasized two basic CORONA achievements: one, the significant coverage of Soviet SS-9 and SS-11 ICBM sites, the other, the coverage of the Middle East crises and the Arab-Israeli War of 1967 (The Six-Day War). (CORONA photography had confirmed Israeli claims of extensive damage to Arab airfields which otherwise would have [understandably] been treated as an exaggeration of facts.)[97] Technical problems were relatively minor: the introduction of SO-380 ultra-thin-base film on CORONA flights late in 1968 caused some difficulties that attracted management attention; four years earlier, such problems would scarcely have merited mention in monthly program summaries. At this juncture, CORONA was, to all intents and purposes, a fully mature system—and one with no real prospects of enduring in operation past the introduction of its eventual successor, HEXAGON, an event that was apparently imminent. The possibility that additional CORONAs might be needed to provide an adequate overlap with HEXAGON received careful scrutiny between June 1969 and January 1970, and on three occasions the review committee concluded that no additional CORONAs need be purchased.[98] Although there were dissenting opinions here and there, particularly in the Bureau of the Budget (later known as Office of Management and Budget) and in the Office of the President's Science Adviser, the decision was repeatedly reaffirmed.

Yet, through and past all that, efforts continued for preserving and extending CORONA capability. Between May 1967 and October 1968, consideration of an improved CORONA-J, eventually to be called CORONA J-4, reached the stage of serious evaluation of performance potential and probable costs. The system being considered would include an improved camera—one of two Itek designs with focal lengths of 32 and 40 inches—with central resolution of 4.5 feet or better, a 12-inch focal length stellar-indexing camera, and a more powerful booster than required for the J-3 model. That combination of elements would provide a potential 18-day orbital lifetime for a CORONA J-4 system.The assumption underlying consideration of a still further improved CORONA was that it could enter use between January and April 1971, initially supplementing and finally supplanting the J-3 CORONA which was providing basic search coverage. Program plans current in 1968 showed the last CORONA-J systems scheduled for launching by June 1971; procurement of 20 CORONA systems in a J-4 configuration would permit CORONA operations to continue through mid-1973. Development and procurement of the camera systems had an estimated cost of \$37 to \$38.7 million, to which would be added recovery vehicle and orbital vehicle costs (about \$54 million) and the cost of 20 booster systems. Buying the J-4 in preference to additional J-3 CORONAs would effectively create an enhanced search capability at an estimated additional cost of about \$1.3 million per launching; however, it was virtually certain that real costs would exceed estimates by 15 to 20 percent.

By June 1967, initial expectations of quick progress in HEXAGON development had largely dissipated. Acknowledgement of difficulties came late in the month, when DNRO Flax formally advised Deputy Defense Secretary Vance that the first launching of HEXAGON had been deferred from April 1969 to October 1969. The extension relaxed funding pressures created by technical problems in HEXAGON development, but it also required a further extension in the use of CORONA to December 1970, the least overlap with HEXAGON that Flax deemed prudent.[99]

By July 1967, a crisis in the Perkin-Elmer production of the HEXAGON camera had further slipped the anticipated date for the first HEXAGON launching to April 1970; actual CORONA launchings in FY-67 were reduced from 10 to eight, and further stretching of the schedule was in store. Further slippage in the HEXAGON program occurred: in February 1968, a three-month delay to June or July 1970; by July 1968 slippage to October 1970; and by April 1969, after reprogramming the camera contract, the first flight schedule had become December 1970.

In OSP's FY-69 budget submittal to the NRO, a requirement was included for the procurement of three additional CORONA systems, to provide an overlap with HEXAGON. The DNRO preferred to stretch the CORONA launching schedule; in doing so no provision was made for any launching or system failures which might occur (which in turn could result in failure to meet search and surveillance requirements). Two particular weak points in the system were weight constraints, due to use of the medium-thrust launching vehicle assigned to CORONA, and the shelf age of system hardware. The earlier plan for CORONA had been to schedule 13 flights to assure 12 successes, but, in the critical overlap period now developing, the DNRO called for a "zero defects" program, even though the demonstrated reliability of the CORONA system was about 85-90 percent. Crowley felt strongly that three more CORONA systems should be procured while the contractors were still tooled to supply them.

It was at this time that CORONA J-4 made its last serious bid for consideration as an alternative to HEXAGON, along with several other potentially expensive system options which were being evaluated for later development (particularly a readout system). There was considerable concern in executive quarters about the inability of budget managers to provide the very large additional sums needed to exploit such options.[100]

In August 1967, more than a year after the formal start of the HEXAGON program, but while the camera subsystem was still the only element in accelerated development, the NRP Executive Committee examined five alternative approaches to providing adequate satellite reconnaissance capability for the 1970s. The most extreme of the options was to develop a CORONA variant capable of producing resolution of about 4.5 feet. This was disapproved on the ground that development of an improved CORONA would cost about as much as completing the HEXAGON project. (This observation emerged in November 1968, after HEXAGON had made some progress toward initial operational capability, but before an initial schedule slippage of more than one year had been acknowledged and before facing the prospect that another schedule slippage of about the same magnitude was pending.)

The second option, considered in August 1967, was simply to delay HEXAGON availability for a year—a contingency then discarded as unnecessarily costly, but subsequently imposed on the HEXAGON program by necessity, rather than choice. In November 1968, a further option proposed was to cancel HEXAGON and substitute for the planned HEXAGON operations (four or five flights per year) a CORONA operation involving seven flights annually. What made the cancellation attractive in 1968 was the prospect that it would permit a budget saving of between $680 and $775 million in fiscal years 1968 through 1973. But the offset would be expressed in ground resolution: there was virtually no possibility of improving CORONA to the point of providing resolution better than about 4.5 feet, and in the view of CIA, DIA, and NPIC analysts, search resolution as good as 3.0 feet was needed.

Finally, the NRO concluded (in a position paper for the use of the Deputy Secretary of Defense during an Executive Committee meeting of mid-November 1968) that "the CORONA system has reached the limit of its improvement. The current system uses Thor-Agena launches with a fixed-film panoramic camera. A significant improvement to the system to bring resolution below five feet would require a new booster and an optical-bar camera. This . . . would entail a development costing several hundred million dollars." The judgment: an austere HEXAGON program was preferable to cancelling HEXAGON and relying on CORONA for the 1970s.[101]

In cost-effectiveness terms, the comparison had this appearance:

CORONA-HEXAGON Cost Comparison

System	Resolution Ground (Feet)	New or Remaining Cost for Development ($ Million)	Operational Costs ($ Million per Year)	Contract Implications
CORONA J-3	7-10	0	72	None
HEXAGON	2-5	150-200	140	None
CORONA J-3 Mod	5.5-8	75-100	100	Sole source
CORONA J-4	4.7	150-250	110	New competition

In other words, the CORONA modification would provide "marginally better resolution at much higher operating costs . . . " while the radically changed CORONA J-4 "would have development costs as high or higher than HEXAGON."

In the end, HEXAGON survived the 1967-68 pressures for cancellation and CORONA remained a terminal system. Apart from technical and requirements considerations, and institutional preferences, the issue hinged on budgetary provisions, and, at the time, the proposed fiscal year 1970-71 budgets seemed adequate. That HEXAGON would cost more than originally estimated was apparent; the extent of that cost growth was not. Nor had the satellite-reconnaissance program yet begun to experience the considerably more severe budgetary pressures that accompanied the change in administration following the 1968 election. Such influences were nearly certain to reopen what were widely assumed to be closed issues—including the future of CORONA.

As mentioned earlier, a HEXAGON Review Committee was convened in June 1969 to study the status of the system and the prospects for meeting the first launching date of December 1970. On the strength of its report, the NRO ExCom decided to approve a recommended stretchout of the remaining CORONA vehicles to allow a one-year overlap of CORONA with HEXAGON, and not to order any more CORONA systems, but to reconsider the situation in December 1969.

Thus, toward the middle of 1969, as the CORONA program once again wound down toward finality, some of the various problems normal to that phase in any major program began to have their effect. In the period between September 1968 and August 1969, three camera failures and three lesser malfunctions had significantly lessened the value of six CORONA missions. In July 1969 (mission 1107) a mechanical failure interrupted operation of the forward-looking camera almost as soon as the operate command was sent. A similar failure in September 1968 (mission 1048) had occurred after about two-thirds of the film had been expended, and in February 1969 (mission 1106) the aft-looking camera had failed, probably because of a break in the film at a splice point. Mission 1050, in March 1969, ended prematurely after a failure of the Agena guidance system, and two other missions (1049, December 1968, and 1051, May 1969) returned degraded film. Although all represented serious problems in varying degree, the fact that mission 1107 was the first in more than five years to be marked by failure of the camera system heightened the concern felt by Crowley for the critical aspects of the CORONA phaseout, particularly those of personnel attrition at the AP Facility, the quality assurance program, and the availability of spares. A meeting held on 25 July 1969 examined closely these three major problems and, as a result, the following actions were taken: (a) a previously-planned reorganization was carried out to integrate the CIA HEXAGON and CORONA staffs into a Photographic Systems Division, effective 1 August 1969, in order to make the most efficient use of the experienced personnel available to the Director of Special Projects; (b) planning began for the physical transfer of the AP Facility from Palo Alto to Lockheed Sunnyvale in order to have available a supply of technicians to replace those Hiller Aircraft employees who were leaving the program as they saw it moving toward termination (because of labor union regulations, Lockheed employees could not be placed in the Hiller facility); and (c) planning was initiated for the procurement of spares and refurbishment of systems, including cost and reliability considerations.

When the HEXAGON Review Committee was reconvened in December 1969, the possibility of meeting the December 1970 first flight was considered slightly improved and the Committee recommended against further procurement of CORONA systems. The DNRO, on 2 February 1970, submitted the Committee's report to the DCI and encouraged acceptance of its recommendation against additional CORONA procurement. By 12 February, DCI Richard Helms and Dr. Lee DuBridge, President Nixon's Science Adviser, had concurred in the recommendation. The CORONA schedule stretchout, as approved by the NRP Executive Committee in June 1969, had shifted from six flights each in FY-70 and 71, to five each in FY-70 and 71, and two carried over into FY-72. This was a calculated risk, taken in the face of all relevant concerns: the requirements, the cost, and the state of the HEXAGON system.[102]

Actual CORONA launchings during calendar 1968 were five J-1s and three J-3 constant-rotator cameras, all successfully retrieved, with 97 to 99 percent usable film recovered. In calendar 1969, the last three of the J-1 systems and three J-3s were launched and retrieved, although several malfunctions caused the usable film to drop to about 83 percent for the J-3s and 94 percent for the J-1s.

A series of important tests was run in conjunction with flights of the first five J-3 systems (missions 1101 through 1105). These were instigated by the US Intelligence Board (USIB), which in February 1966 had directed CIA to develop techniques for estimating crop yields from satellite photography. The payloads of J-3 systems were specially instrumented and contained tag-on lengths of special film, including 50121 conventional color, 50180 near-IR-sensitive color, and 50230 high-speed black and white. The test series accomplished its fundamental purpose of demonstrating the J-3 camera's capability to handle new photographic techniques, facilitated by the flexibility of two changeable filters and four changeable exposure slits on each camera (which allowed the use of mixed film loads and/or different filters). None of the missions concerned had their main intelligence purpose degraded by the conduct of these tests.

At Crowley's instigation, a CORONA J-3 Ad Hoc Committee was informally convened by the DNRO in December 1967, and formally constituted in February 1968. Its purpose was to analyze and evaluate experiments conducted on these five test flights. The committee concluded that color would, in the long run, provide significant added information for the intelligence production process; however, it was not a question of color in place of black and white, but rather a question of when color should be used, and for what kind of targets it should provide additional information. Specific findings of the committee included recommendations that a logical test program, involving various color films and techniques, should be conducted against specific intelligence requirements; that a special subcommittee of the USIB's Committee on Imagery Requirements and Exploitation (COMIREX) should be constituted to evaluate the utility of satellite color photography; and that a well-planned color-collection program should be worked out with the close cooperation of the System Program Offices, the Satellite Operations Center (SOC), intelligence analysts, and photo interpreters.[103]

One other remote possibility remained for the continued use of CORONA (though surely not under that name, and not with CORONA operational objectives). NASA had approached the NRO in 1969 with a tentative plan to satisfy requirements for an earth-resources survey satellite by adapting CORONA systems and technology. The notion intrigued the NRO because that option would effectively preserve a CORONA manufacturing capability against some contingency that might warrant later use of the system. CORONA superbly satisfied NASA's basic requirements for multispectral imagery and for stereoscopic coverage. And because CORONA was a thoroughly reliable, fully developed system for which complete fabrication and testing facilities existed, it would provide a most inexpensive way of satisfying NASA needs. But NASA had to choose between CORONA and alternative specialized earth-resources survey systems: the NASA budget could not support both. Given the institutional tendencies of both NASA and the NRO, the outcome was predictable.

In early March 1970, NASA advised the new DNRO, Dr. John McLucas, formerly of Mitre Corporation, that no money for the procurement of CORONA systems could be included in the FY-72 NASA budget. Homer Newell, NASA's Associate Administrator, asked McLucas to preserve CORONA production capability against a possible budget allocation for a NASA-CORONA in fiscal 1972. But the NRO budget was no more flexible than the NASA budget in such matters. Although McLucas assured Newell that the NRO would attempt to make surplus CORONA vehicles available to NASA, in actual fact that contingency could be considered only if HEXAGON were to become fully operational in accordance with optimistic 1970 schedules.[104] Should that occur, two or more CORONA missions might well be scrubbed, there being little value in operating CORONA, once HEXAGON's superior capability became available.

Expectations continued into the early months of 1970 that some surplus CORONAs might become available, as evidenced by a March 1970 request from the Defense Intelligence Agency that the NRO fly DISIC packages early in 1971, rather than as part of the CORONA missions intended for the late months of that year. The rationale: ". . . uncertainty as to whether the last few CORONA systems may be operated."

In the fall of 1970, too late to have any impact on the program, the State Department provided an unexpected but interesting post-wake commentary on the value of the CORONA in applications not contemplated when the

DCI Richard M. HELMS

NRO Director John McLUCAS

program began. Ray S. Cline, State's Director of Intelligence and Research, wrote DCI Richard Helms in September 1970 " . . . the gap . . . between what policy-level officers in our government expect to be able to demand from our satellite reconnaissance program and what it actually can deliver in the next six to twelve months" had begun to concern him deeply. Cline explained that only "the unusual political circumstances in the current Arab-Israeli crisis" had permitted the United States to use the old workhorse, the U-2. Otherwise, coverage would have been grossly inadequate—owing to a restricted flexibility in reconnaissance satellites that stemmed directly from the limited residuum of CORONA vehicles. When HEXAGON became operational (and Cline suggested as an aside that he did not expect that to happen until well into 1971), coverage would be excellent—but, at a cost of $65 million for launching, HEXAGON was not suited to crisis scheduling. Given the probable five- to six-year wait for an operational readout system, Cline suggested that it might be advisable to "reassess [the] need for a satellite crisis capability at least as good as that previously provided by the CORONA standby." Cline's object was to stimulate a new examination of the basic issue, but he conceded that funding problems and previous commitments made a satisfactory solution unlikely.[105*]

Cline sent copies of his letter to both Lieutenant General D. V. Bennett, Director of the Defense Intelligence Agency, and R. H. Froehlke, who was charged by Deputy Secretary of Defense David Packard with integrating various defense intelligence activities. Bennett promptly contacted McLucas and Deputy Secretary of Defense Packard to express basic agreement with Cline's stand, again expressing concern over the potential intelligence gap that would be created by exhaustion of the CORONA inventory.[106] Packard responded by suggesting that McLucas "look at cost and schedule problems with more CORONA insurance." He reiterated the suggestion during a meeting with McLucas shortly thereafter. Indeed, by early October Packard had concluded that CORONAs might be needed " . . . for a long time, either to cover a launch failure or operational failure, or to cover a crisis situation where there is nothing scheduled and we might want to launch an extra photo bird."

Packard pressed DCI Helms on that issue in November. Helms responded that additional CORONA vehicles could not be obtained in less than 24 months because of manufacturing lead time considerations and that HEXAGON was virtually certain to be satisfactorily operational by then (1973). He further suggested that CORONA vehicles would have limited usefulness in the sorts of crises the United States had experienced in the preceding five years, a conclusion based on the findings of a yet-to-be-completed study being conducted by the CIA. On such grounds, he doubted that the utility of

*An interesting footnote to the concerns expressed by Cline occurred during the Arab-Israeli Six-Day War. An urgent White House request was received by the NRO to obtain photo coverage of the Cairo International Airport during that evening's operation of the GAMBIT high-resolution photoreconnaissance system (on orbit at the time). DNRO McLucas personally conveyed the message via secure phone to Brigadier General William King, then Director of SAFSP. King responded, "Sir, I would be most happy to satisfy the request if you could arrange to move Cairo Airport 150 miles to the north and 200 miles to the east." General King's droll sense of humor served to highlight the inherent limitations imposed by the laws of orbital mechanics on a low-earth satellite's ability to access any point on the earth's surface at will.

additional CORONAs would be worth the $20 million each would probably cost (a cost driven substantially higher by the necessity of reestablishing production facilities). He added, if HEXAGON continued to conform to its schedule, CORONAs would be left over for crisis use should that need arise. Finally, Helms concluded, he " . . . would prefer not to spend any of the intelligence budget at this time for additional CORONA vehicles, [instead believing] our objective will be better served by planning to use such funds as can be made available to help cure any HEXAGON problems that might arise in the early flight program."[107] Again it appeared the subject had been closed. And again, appearances proved deceptive.

Late in December 1970, Dr. John Martin (not Major General John L. Martin, Jr., former NRO Director of Special Projects) in President Nixon's Office of Science and Technology suggested consideration of a new CORONA option: ordering a small number of CORONA vehicles under a contingency plan that would call for cancelling the order once complete HEXAGON operational readiness had been demonstrated.[108] The option was considered in some detail during the NRP Executive Committee meeting of 29 January 1971. In the course of discussion, [redacted], the NRO Comptroller, estimated that additional CORONA systems could be purchased and operated at costs ranging from $20 million each in lots of two, to $15.1 million each in lots of six. Assuming an immediate decision to proceed with the purchase of three systems (an optimum number representing the crossover between high unit costs for fewer systems and a package price for so many systems that the total would perturbate FY-1971 and 1972 budget ceilings), cancellation after two months would cost about $15 million and after five months about $25 million. That calculation had been performed in direct response to a question from Dr. E. E. David, the President's Science Adviser (and a member of the NRP Executive Committee): if additional CORONA systems were immediately ordered, but a successful HEXAGON launching in March 1971 allowed termination of the procurement, what would be the costs? What if in June or July?

The basic reason for Dr. David's concern was the HEXAGON overlap with CORONA. When HEXAGON had been scheduled for December 1970 launching, CORONA launchings were planned so as to provide an 11-month overlap. When HEXAGON incurred another schedule slip, the response was to order a special GAMBIT Higherboy kit that would permit GAMBIT, operating at an altitude of 525 miles, to take relatively wide-area photographs that would partly satisfy an interim search-capability requirement, thus protecting the 11-month overlap through March 1971. A HEXAGON slip to June or July 1971 would leave a potential seven-month overlap. In the worst case, if HEXAGON did not become operational until late 1971, a coverage gap of five to 11 months conceivably could result. Protective measures included further stretchout of CORONA launchings (awkward at a time when, as it happened, there were rising demands for a greater frequency of CORONA missions), or buying another Higherboy kit and substituting a Higherboy-GAMBIT for a scheduled GAMBIT-3. (Again in February, the Defense Intelligence Agency urged Deputy Defense Secretary David Packard to schedule an additional and early CORONA operation to satisfy immediate and urgent requirements arising, in part, from the untimely flight failure of CORONA mission 1112.)

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In the end, it appeared to Dr. David that insurance against a major HEXAGON slippage could be purchased for between $14 and $20 million—if the decision to order more CORONA systems were taken at once. He asked McLucas to poll the Executive Committee on the advisability of taking such action. The negative response disposed of the question and wrote finis to CORONA.

CORONA Flight Summary — 1966–1972

Mission No.	Date	Camera	Remarks
1029	2 Feb 1966	J	Success
1030	9 Mar	J	Success
1031	7 Apr	J	Success
1032	3 May	J	Agena failed to separate from booster.
1033	24 May	J	Success
1034	21 Jun	J	Success
1036	9 Aug	J	Success
1035	20 Sep	J	Success
1037	8 Nov	J	Success
1038	14 Jan 1967	J	Success
1039	22 Feb	J	Success
1040	30 Mar	J	Success
1041	9 May	J	Success
1042	16 Jun	J	Success on RV-1, with water pick-up on RV-2.
1043	7 Aug	J	Success
1101	15 Sep	J-3	Success. 1st J-3 flight.
1044	2 Nov	J	Success
1102	9 Dec	J-3	Success
1045	24 Jan 1968	J	Success
1046	14 Mar	J	Success
1103	1 May	J-3	Success
1047	20 Jun	J	Success
1104	7 Aug	J-3	Success
1048	18 Sep	J	Success. Forward camera failed.
1105	3 Nov	J-3	Success; first use of UTB film.
1049	12 Dec	J	Success. Degraded film.
1106	5 Feb 1969		Success. Aft camera failed.
1050	19 Mar	J	Success. Terminated: Agena failure.
1051	2 May	J	Success. Degraded film.
1107	24 Jul	J-3	Success. Forward camera failed. RV-1 water recovery.
1052	22 Sep	J	Success. Last J flight.
1108	4 Dec	J-3	Success
1109	4 Mar 1970	J-3	Success
1110	20 May	J-3	Success
1111	23 Jul	J-3	Success
1112	18 Nov	J-3	Success
1113	17 Feb 1971	J-3	Failure of Thor booster.
1114	24 Mar	J-3	Success
1115	10 Sep	J-3	Success
1116	19 Apr 1972	J-3	Success
1117	25 May	J-3	Success

Section 5

Summary

CORONA was born in 1958, in the hope that spacecraft could be used to pry the lid from closed societies. That hope became reality in 1960, when the first successfully recovered space capsule brought reconnaissance photographs back to earth.

The ground resolution of those early photographs was in the range of 35 to 40 feet. Within 12 years, CORONA delivered resolutions of six to 10 feet, routinely.[109, 110] Early capsules carried 10 to 16 pounds of film; toward the end of the program they carried 80 pounds (16,000 feet).[111] In the 1970s, flights could remain on orbit for 19 days, make operational responses to changes in cloud-cover, provide very accurate attitude, position, and mapping information, and return coverage of 8,400,000 square nautical miles (nm^2) with an average of 3,000,000 nm^2 cloud-free.[112]

Thus, during the 1960s, the hopes of 1958 became an impressive reality. The "temporary expedient" of a "small, interim" CORONA program eventually extended to 145 launchings and used 2 million feet of film.[113] The cumulative coverage was 750 million nm^2. [114]

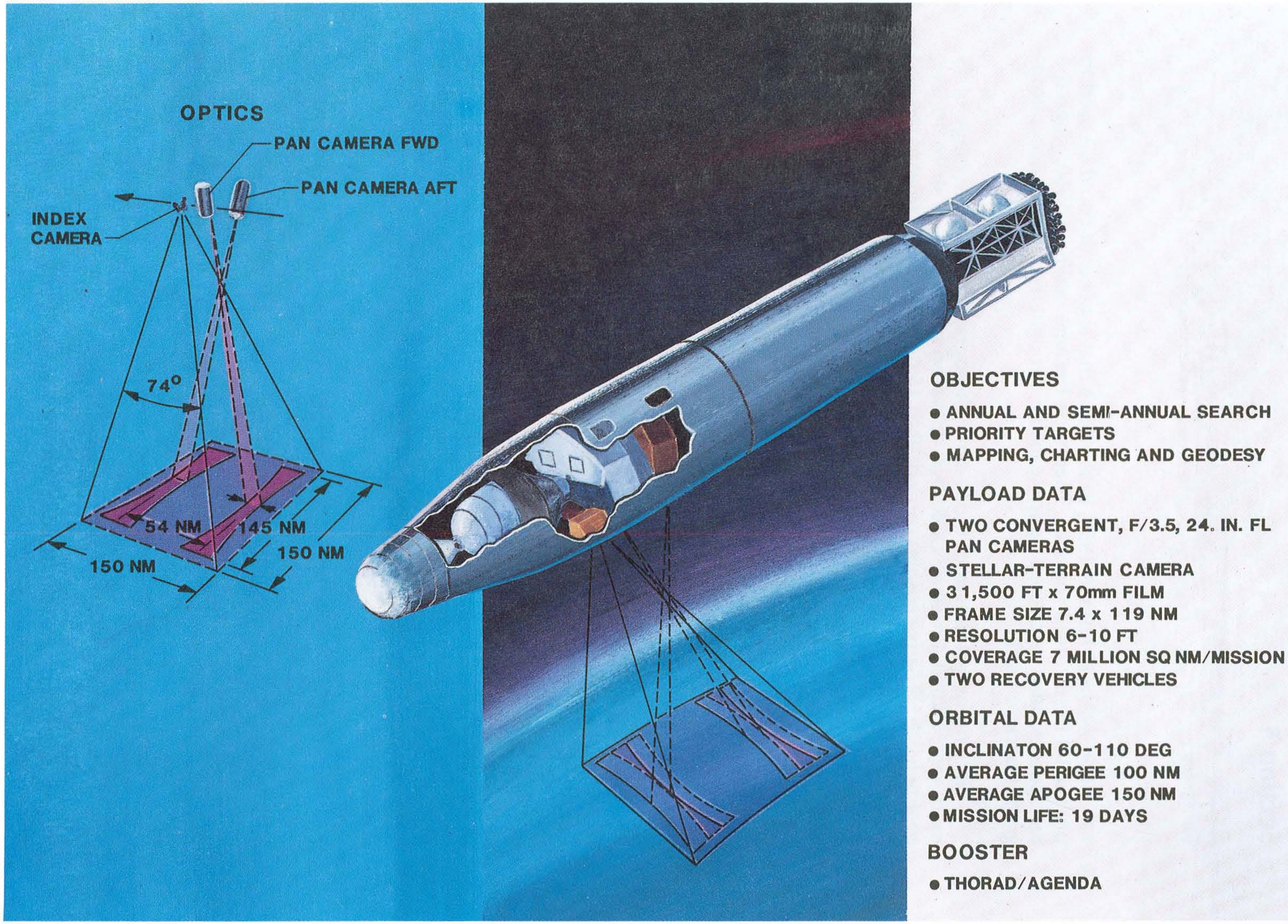
The 1958 estimate of $59 million for a four-flight test program and a 12-flight operation was extended to $850 million.[115] The average cost of a mission became $7 to $8 million.

The CIA described the CORONA contribution to US intelligence holdings as "virtually immeasurable."[116] By June 1964, CORONA had delivered photos of every Soviet ICBM complex in existence; using these data as a benchmark, the United States was in a position to follow the course of Soviet buildup, item by item. CORONA provided priceless coverage of the Middle East during the 1967 War and in 1970 was used to test Israeli-Egyptian claims regarding cease-fire compliance.

The list goes on and on. In essence, the United States of America, confronted by the problem of a closed society, was once blind, but now it could see.

Parallel contributions were made by CORONA in the impetus which its success provided to systems contemporary with it. GAMBIT and HEXAGON, in particular, could thank CORONA for making their basic concepts credible and for leading the way technologically.

Those who shared from the beginning in the CORONA enterprise sensed that a unique opportunity had claimed their energies. They believed they would always be proud of their share in a momentous achievement. They were right.



CORONA Reconnaissance System

Appendix A

The Intelligence Community and CORONA

ARC, COMOR and COMIREX

On 1 December 1955, Allen Dulles, Director of Central Intelligence (DCI), acting in his capacity as chairman of the Intelligence Advisory Committee (IAC), the predecessor body to the US Intelligence Board (USIB), established an Ad Hoc Requirements Committee (ARC) to handle all requests levied on the new U-2 program. Under its first and only chairman, James Q. Reber, the ARC had a broad representation from all the member-organizations of the intelligence community. The ARC gathered, prioritized, and approved all collection and exploitation requirements for the U-2 program and was responsible to approving U-2 flight plans.

With the advent of the CORONA satellite program in 1958, DCI Dulles established, in January 1959, a Satellite Intelligence Requirements Committee (SIRC). This unit, formed with the concurrence of the USIB (it had superseded the IAC in 1958), was specifically charged with providing intelligence guidance and support to US reconnaissance-satellite programs. Of course, at this time the United States did not possess a working satellite system: CORONA had yet to be launched and the Air Force's Sentry/Samos effort was still earth-bound.

The ARC and SIRC continued operating side-by-side until 5 July 1960, when the USIB decided to study the possibility of combining the two units. A month later, on 9 August 1960, the USIB approved establishment of a Committee on Overhead Reconnaissance (COMOR), to provide a focal point for information on, and requirements for, overhead-reconnaissance of denied areas. Both COMOR's responsibilities and membership were broadened. It was placed in charge of all reconnaissance for intelligence by satellite, or by any vehicle over denied areas, whether by photography, ELINT, COMINT, infrared, RADINT, or other means. The new unit was also charged with recommending dissemination and special security controls needed to provide operational guidance.

COMOR's membership was extended to include all USIB agencies and Jim Reber, who had been ARC chairman since 1955, became its first chairman; his deputy was Air Force Colonel L.E. May. At the time of its establishment, the only operational national asset was a small CIA effort involving a P2V aircraft. The U-2 had been grounded since 1 May 1960 and the first CORONA success was nine days away. In 1961, after several CORONA successes, COMOR delineated the Sino-Soviet bloc landmass into two general categories to guide future reconnaissance activities: built-up areas and undeveloped areas.

During the next five years, strategic and tactical photo reconnaissance by aircraft and satellite grew in direct proportion to the escalation of the war in Vietnam, as did the expense. As a consequence, in September 1965, Bureau of the Budget Director Charles L. Schultze asked Deputy Defense Secretary Cyrus Vance to examine the various requirements for national-level imagery interpretation with a view to eliminating duplication. This led to a Joint

Imagery Interpretation Review Group (JIIRG) under USIB auspices. Upon completion of the JIIRG study, DCI Helms and Deputy Defense Secretary Vance signed an agreement known as the National Tasking Plan (NTP) for the Exploitation of Multi-Sensor Imagery, which delineated the responsibilities of the three major parts of the imagery community: the CIA's NPIC, the DIA, and the three armed forces.

Previously, the USIB had been interested only in requirements for obtaining imagery; now it was moving into the arena of exploiting that same imagery. Consequently, the USIB decided to vest responsibility for imagery-collection and imagery-exploitation in a new entity called the Committee on Imagery Requirements and Exploitation (COMIREX), whose first chairman would be CIA's Roland S. Inlow. The SIGINT responsibility previously vested in COMOR was assigned to a new unit known as the SIGINT Overhead Reconnaissance Subcommittee (SORS).

In addressing national exploitation of overhead imagery it is appropriate to mention the first director of the National Photographic Interpretation Center (NPIC), Arthur C. Lundahl. A superb technician in the science of photographic interpretation and photogrammetry, Lundahl effectively organized a staff that included experts from diverse disciplines — photointerpretation, photogrammetry, printing and photo-processing, automatic data processing, communication and graphic arts, collateral and analytical research, and technical analysis for extracting the maximum intelligence from imagery. During his remarkable career, Lundahl deservedly enjoyed the confidence of Presidents Eisenhower, Kennedy, Johnson, and Nixon, as well as that of senior intelligence managers within CIA and the Defense Department.

First COMOR, and later COMIREX, functioned successfully in managing the nation's imagery requirements, even though it invariably identified more requirements than CORONA could satisfy. Broad intelligence community representations gave each agency a forum for expressing — and debating — the priority of its requirements. Final appeals could be made, of course, to the USIB, but this option was rarely exercised.

During CORONA's early missions, COMOR passed its approved requirements to the collection system operator (the NRO) through the CIA Development Project Staff's Operation Center (where two Air Force detailees, Majors Arthur Dulac and John Schadegg, pioneered the work). In 1963, this operational task was transferred to the newly formed NRO Satellite Operations Center (SOC) in the basement of the Pentagon. An NRO observer attended each COMOR meeting to assure that each new requirement was fully understood and to advise the USIB committee of CORONA's capabilities and limitations.

There was one major limitation. The CORONA system never carried an on-board computer through which targeting requirements might have been changed or modified in real-time. Rather, camera on-off commands were initiated by means of a paper (later Mylar) tape containing punched holes corresponding to preselected ground-latitudes for a specific orbital revolution. Turn-off, turn-on control was done by a clock-timer that could adjust the tape to actual orbital position. At the beginning of CORONA operations, targeting decisions were quite limited, consisting essentially of an command turning the cameras on when the satellite crossed the Soviet Union's northern border and turning them off when it exited the southern border. This limited capability was sufficient for the early CORONA missions, since they were of short durations. As the program matured, its targeting capability had to be augmented; by the end of the program, CORONA's dual cameras could be operated independently and selections could be made from a number of pre-cut programs, making it possible to adjust to changes in weather forecasts, vehicle health, and emergency intelligence needs.

A COMIREX subcommittee—initially called the Photo Working Group (PWG) and later the Imagery Collection Requirements Subcommittee (ICRS)—was responsible for correlating approved requirements and formally passing them to the NRO, where they were converted into targeting commands, on a mission-by-mission basis.

It must be kept in mind that CORONA was developed as a *search* system; its basic role was to detect new activities of national interest in denied areas. During the early years, when it was the only US reconnaissance vehicle over the USSR, it was, of necessity, also a surveillance system, providing repetitive coverage of specified targets. To help manage CORONA operations in the search mode, COMOR divided the Soviet Union into areas of greater or lesser probability of "new" activity; initially, these categories were either "built-up" or "undeveloped." There was a continuing basic requirement to obtain clear imagery of "built-up" targets at least once each six months; "undeveloped" targets were to be covered at least once per year. As CORONA matured into an increasingly sophisticated system, the entire world was divided into seven categories, with collection frequency ranging from three months to three years.

In order to assist the NRO in collection management, COMIREX used a requirement priority structure which had ten increments, 0 to 9, to guide on-orbit choices. Eventually, the NRO responded to the choice-problem by developing a mission-simulation capability that permitted the COMIREX to review predicted mission results—and adjust priorities—before the mission was actually flown.

Overhead Reconnaissance Product Security

Very early in its overhead reconnaissance operations, the CIA set up a special security system to protect the information collected. The purpose of the system was not only to protect the privacy of the product, but also to shelter, if possible, knowledge of the collection source or method. The original system was named TALENT; it covered aircraft collectors and collections. Later, spacecraft collections were subsumed into the TALENT system by another security system called TALENT-KEYHOLE (TK). Access to TK-protected information demanded a special security clearance and authenticated need-to-know, and was typically reserved to exploiters of the finished intelligence product.

Photo-interpreters could be assisted in their analyses by knowing the physical characteristics and performance capabilities of the reconnaissance satellite itself, as well as the operational parameters of each mission. To assist them in this regard, a special booklet was prepared on the CORONA system, as well as for subsequent systems; in CORONA's case it was called the "KH-4 System Manual" (KH standing for KEYHOLE) and was security-controlled in the TK system. In addition, operational data unique to each mission were provided to the interpreter, usually covering such matters as vehicle attitude and altitude, solar elevation, and so forth. Most intelligence community members were briefed at the TK level only, rather than at the more comprehensive BYEMAN level; consequently, reference to satellite reconnaissance systems was usually made by their TK designators. Thus, CORONA, a BYEMAN program, was known as KH-4 in intelligence circles.

CORONA Intelligence Achievements

A new era in overhead reconnaissance was opened by CORONA's capability to photograph millions of square miles of denied area during a single mission. CORONA's predecessor, the U-2 aircraft, had made a total of 24 deep-penetration overflights during a four-year period but had covered only one million square miles of the Soviet Union, a target that comprised more than 10 million square miles. When the U-2 missions came to an abrupt end on 1 May 1960, there were vast reaches of the USSR which had never been seen by US reconnaissance sensors; it was providential that, a little more than three months after the Gary Francis Powers episode, CORONA mission 9009 demonstrated a new observational mode, providing authoritative answers to the question: "Is there a missile gap?"

CORONA's initial major accomplishment was imaging *all* Soviet medium-range, intermediate-range, and intercontinental ballistic missile launching complexes. CORONA also identified the Plesetsk Missile Test Range, north of Moscow. Repetitive coverage of centers like Plesetsk provided information as to what missiles were being developed, tested, and/or deployed. Also, the unequivocal fact of observation gave the United States freedom from concern over many areas and locations which had been suspect in the past.

Severodvinsk, the main Soviet construction site for ballistic-missile-carrying submarines was first seen by CORONA. Now it was possible to monitor the launching of each new class of submarine and follow it through deployment to operational bases. Similarly, one could observe Soviet construction and deployment of the ocean-going surface fleet. Coverage of aircraft factories and airbases provided an inventory of bomber and fighter forces. Great strides were also made in compiling an improved Soviet ground order of battle.

It was CORONA imagery which uncovered Soviet antiballistic missile activity. Construction of the GALOSH sites around Moscow and the GRIFFON site near Leningrad, together with construction of sites around Tallinn for the Soviet surface-to-air missile known as the SA-5, were first observed in CORONA imagery. HEN HOUSE, DOG HOUSE, and the Soviet Union's first phased-array radars—all associated with the Soviet ABM program—were also identified in CORONA imagery.

CORONA "take" was used to locate Soviet SA-1 and SA-2 installations; later its imagery was used to find SA-3 and SA-5 batteries. The precise location of these defenses provided Strategic Air Command planners with the information needed to determine good entry and egress routes for US strategic bombers.

In the period after 1963, when the high-resolution GAMBIT system became operational, the CORONA imagery was used for pioneer work to detect new installations or activities which could be targeted for closer observation by the GAMBIT vehicle.

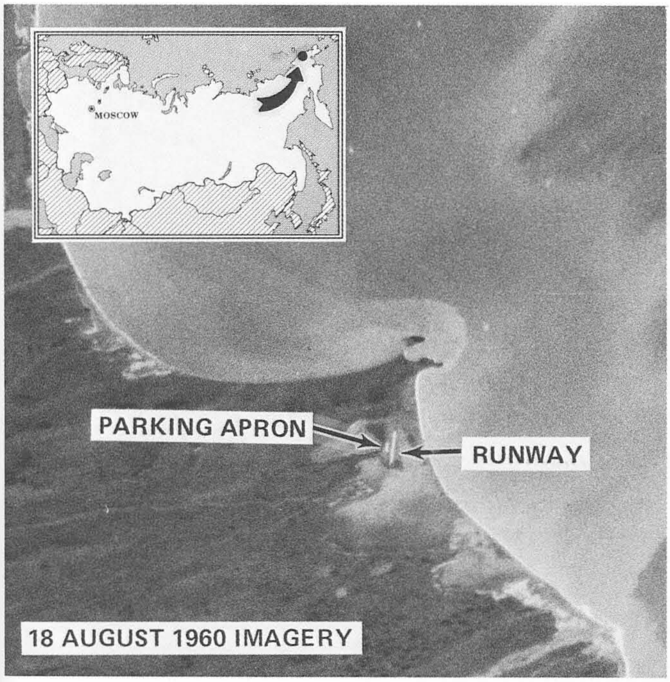
CORONA imagery was also adapted extensively to serve the needs of the Army Map Service and its successor, the Defense Mapping Agency (DMA). Enhanced by improvements in system attitude control and ephemeris data plus the addition of a stellar-index camera, CORONA eventually became almost the sole source of DMA's military mapping data.

Appendix B

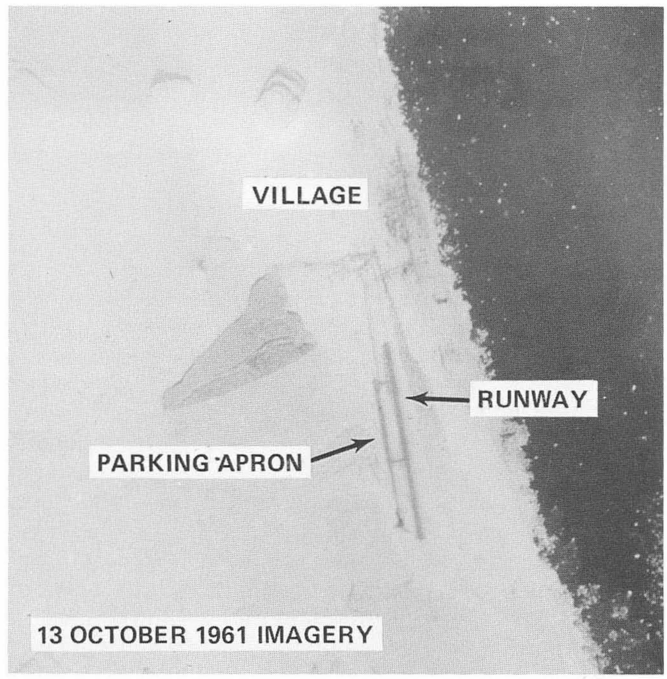
Representative CORONA Imagery

The following examples of CORONA imagery represent some of the more significant and dramatic contributions made by the CORONA system to the national intelligence production process.

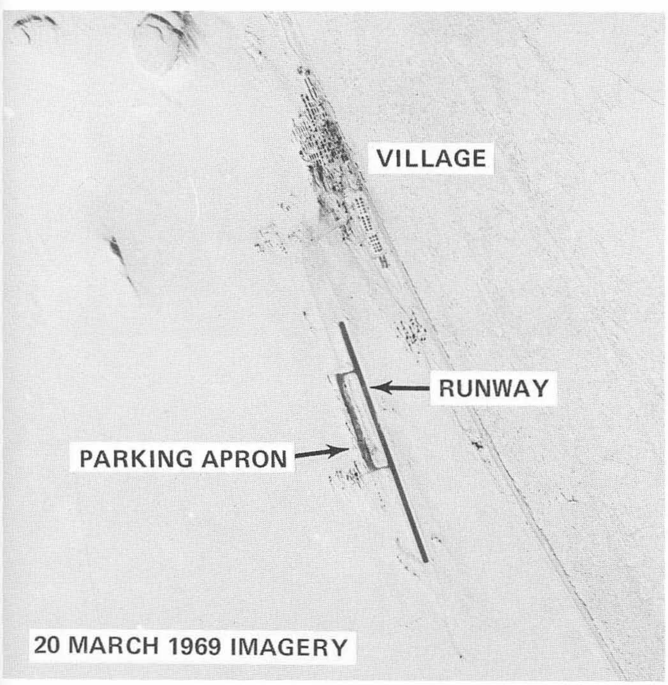
APPENDIX B-1
Mys Shmidta



18 AUGUST 1960 IMAGERY



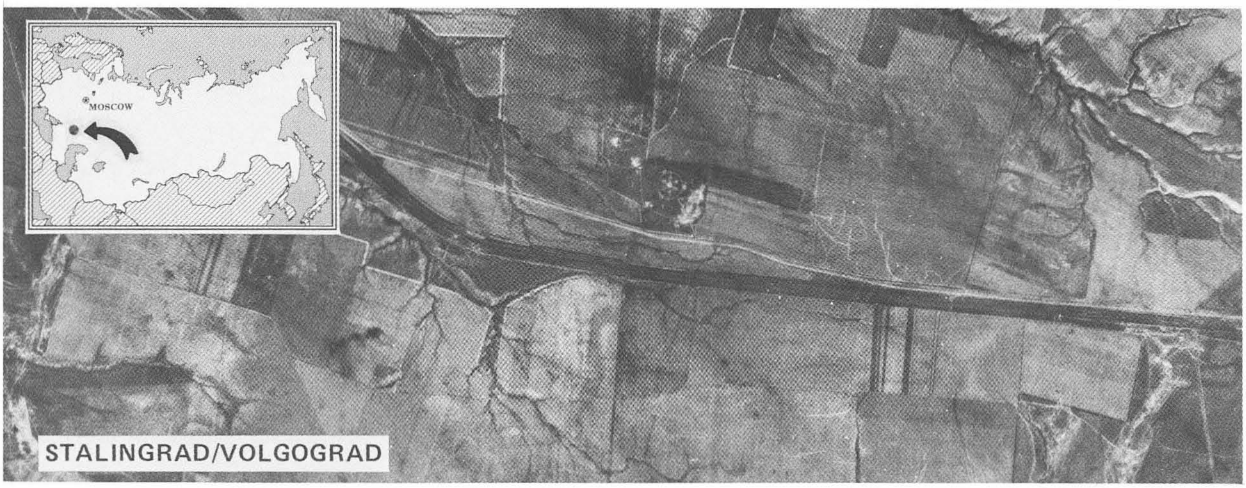
13 OCTOBER 1961 IMAGERY



20 MARCH 1969 IMAGERY

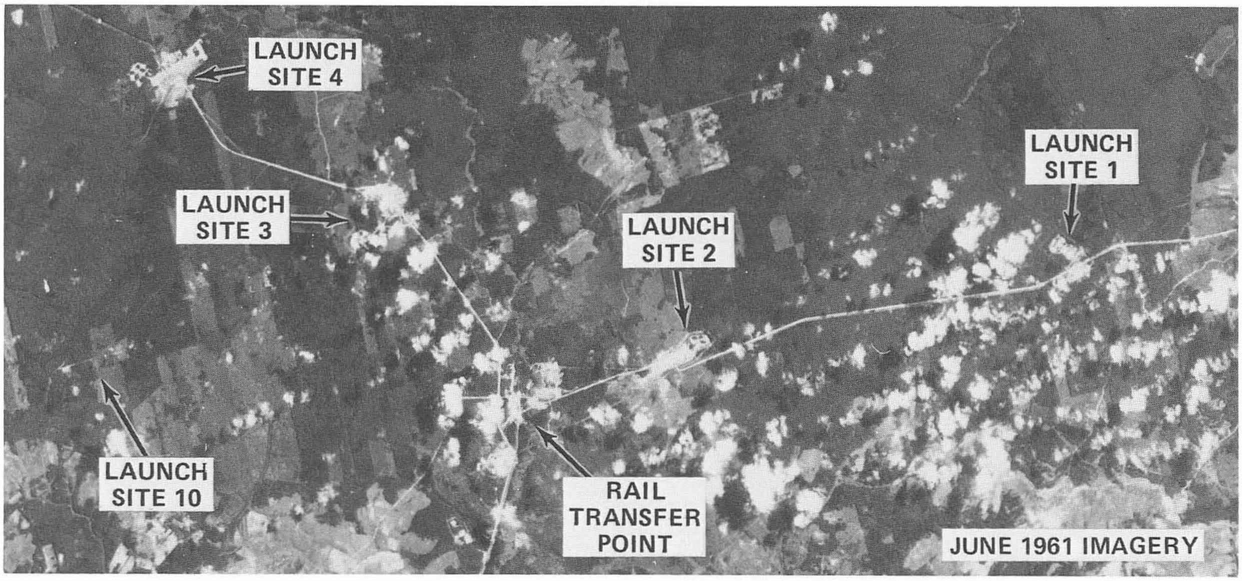
A Soviet bomber base at Mys Shmidta, on the extreme northeast coast of the Soviet Far East — only 400 miles from Nome, Alaska — was the first image acquired by the first successful CORONA satellite, mission 9009, on 18 August 1960 using the KH-1 camera. Owing to Mys Shmidta's close proximity to U.S. territory, this bomber base became a frequent target for CORONA cameras. Subsequent photos by the KH-3 camera on 13 October 1961 and the KH-4A camera on 20 March 1969 illustrate the dramatic improvement in the quality and resolution of CORONA imagery.

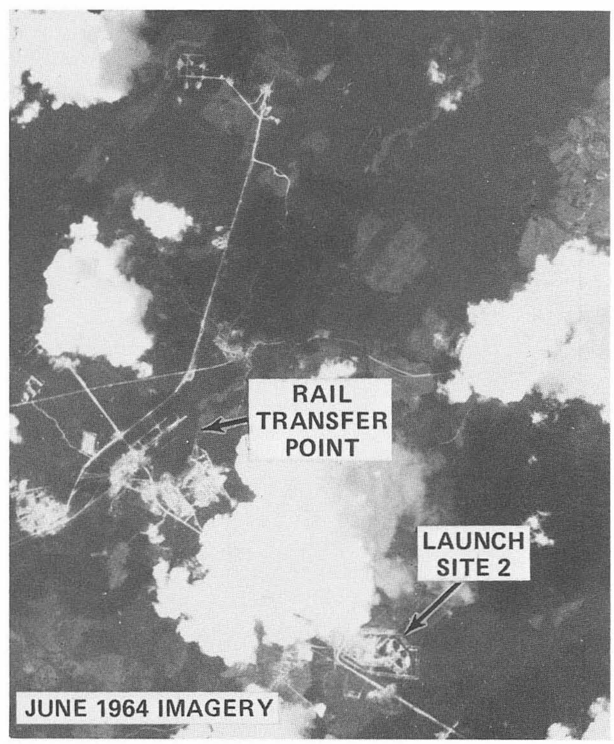
APPENDIX B-2
Stalingrad (Volgograd), Kapustin Yar



Mission 9009's KH-1 camera, on its eighth pass over the Soviet Union, obtained imagery of several surface-to-air missile sites. A newly deployed SA-2 GUIDELINE launching site was photographed east of Stalingrad (now called Volgograd). On the very next frame, mission 9009 filmed the defensive-missile launching area at the Kapustin Yar Missile Test Complex, 60 miles east-southeast of Stalingrad. This imagery also revealed test and training facilities for the SA-1 system.

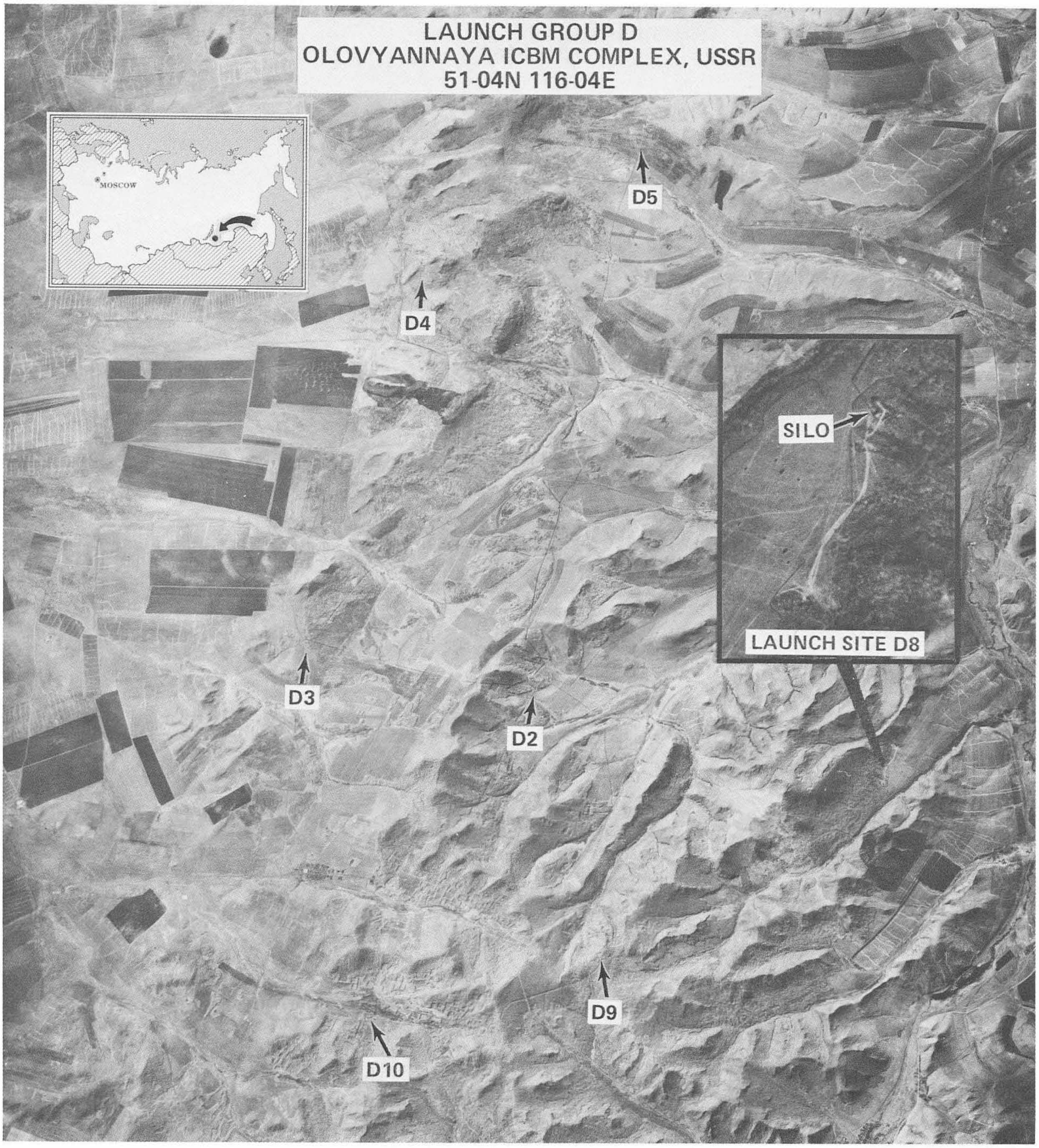
APPENDIX B-3
Yurya





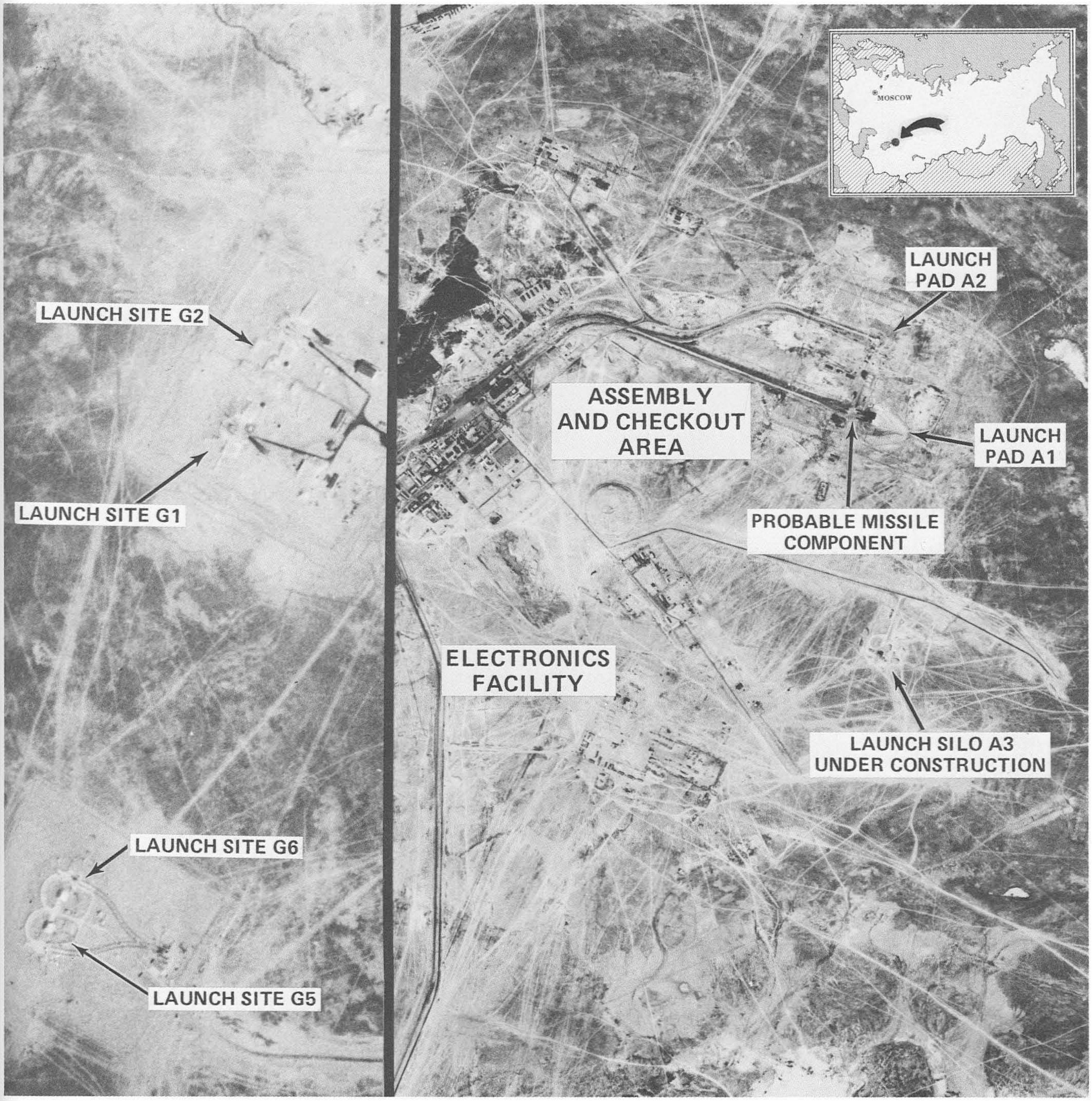
The first deployed Soviet ICBM launching complex identified on overhead photography — either airborne or satellite — was at Yurya, 500 miles east of Moscow. This SS-7 site was first seen in imagery acquired by the KH-2 camera aboard CORONA mission 9017, launched in June 1961. One year later, Yurya was imaged by the KH-4 Mural camera aboard CORONA mission 9038, launched in June 1964.

APPENDIX B-4
Olovyannaya



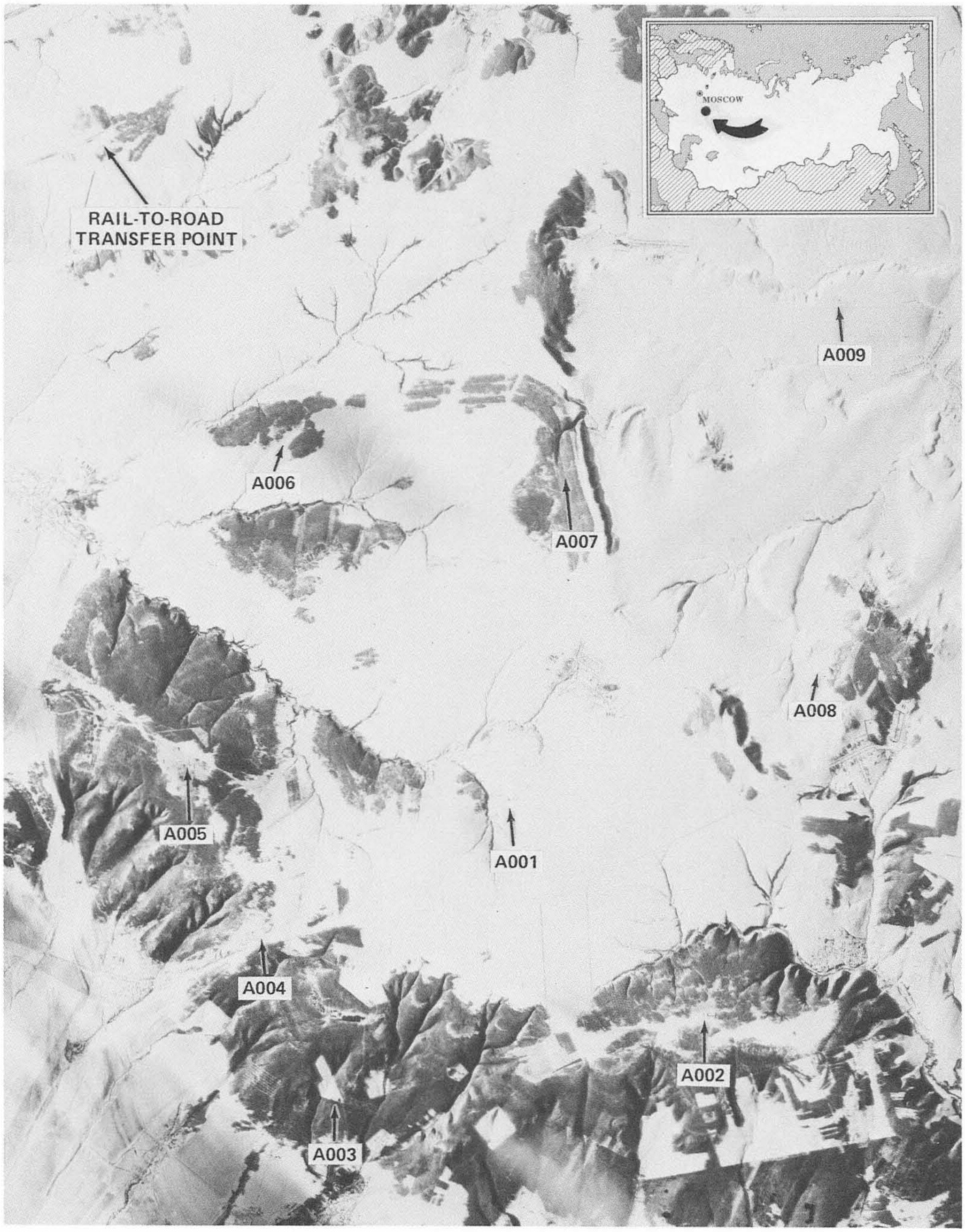
In the mid-1960s, the Soviet Union began to deploy a new ICBM, the SS-11, in hardened silos which were often discovered in remote and desolate areas. One of these SS-11 complexes, located in Olovyannaya, just north of Mongolia, was found in KH-4A imagery, obtained by CORONA mission 1012-1 in October 1964.

APPENDIX B-5
Tyuratam



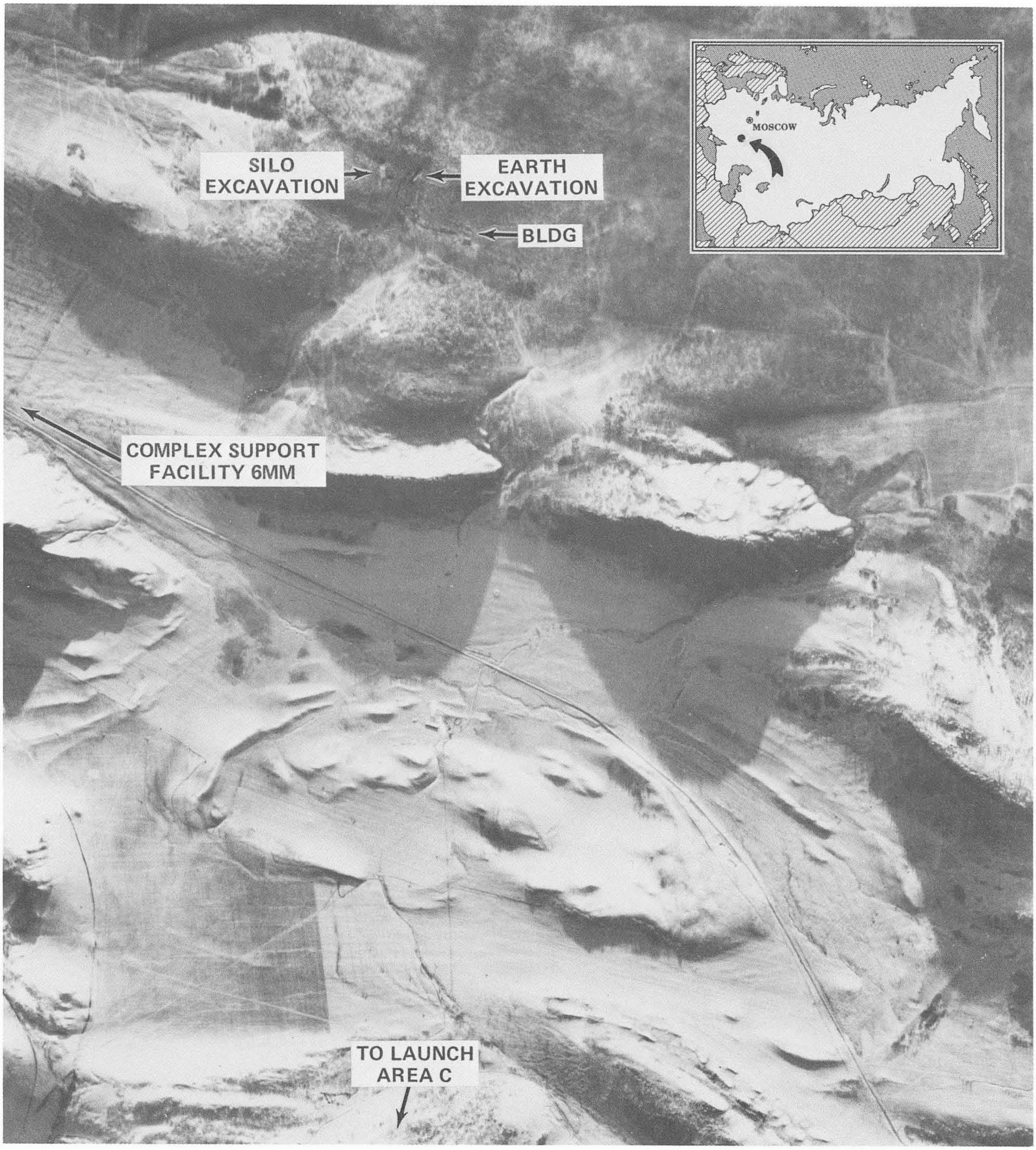
The Tyuratam Missile Test Center in Soviet Central Asia has been the principal Soviet R&D facility for both space-launch vehicles and ICBM development. Its Launch Complex A, the original deep-space launching facility, began operation in 1957. As each new missile system was developed, a concomitant new launch complex was seen in CORONA imagery of Tyuratam. These photos, obtained by the KH-3 camera in August 1964, show the original space-launch facility and areas at Complex G for testing the SS-10 and SS-11 ICBMs.

APPENDIX B-6
Tatishchevo



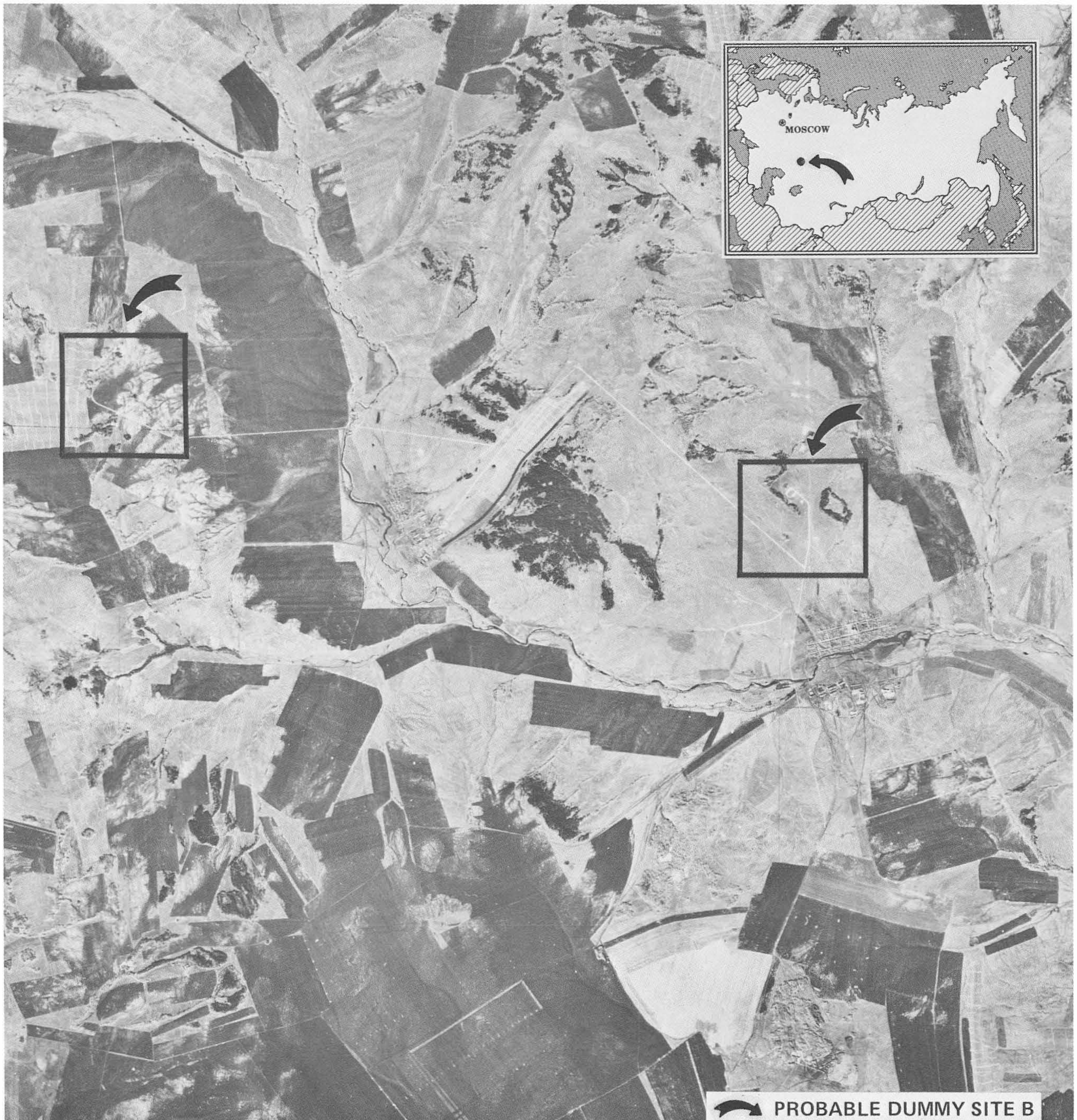
In addition to monitoring ICBM development, CORONA cameras also located deployed Soviet missiles. The SS-11 ICBM Complex at Tatishchevo is typical of such sites discovered on KH-4A imagery in December 1964. Located in a remote and desolate area, it consists of nine clusters of silos.

APPENDIX B-7
Uzhur



An SS-9 ICBM Complex was discovered under construction near Uzhur, southwest of Moscow, in KH-4A imagery obtained in November 1964.

APPENDIX B-8
Kartaly



Improvements to CORONA cameras made it possible by November 1967 to discover in KH-4A imagery probable dummy Type-IIIC single silos at Kartaly ICBM Complex southeast of Moscow.

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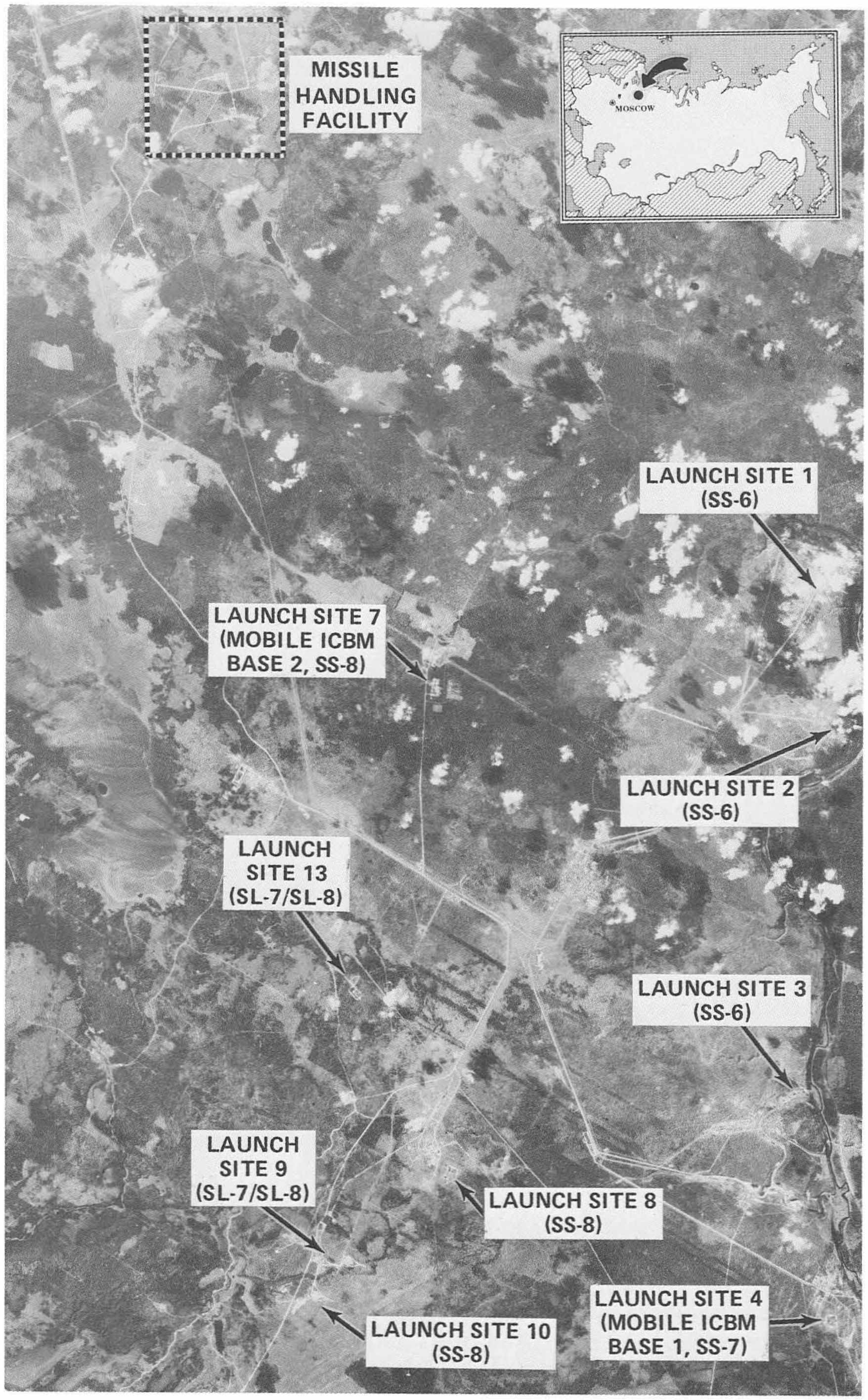
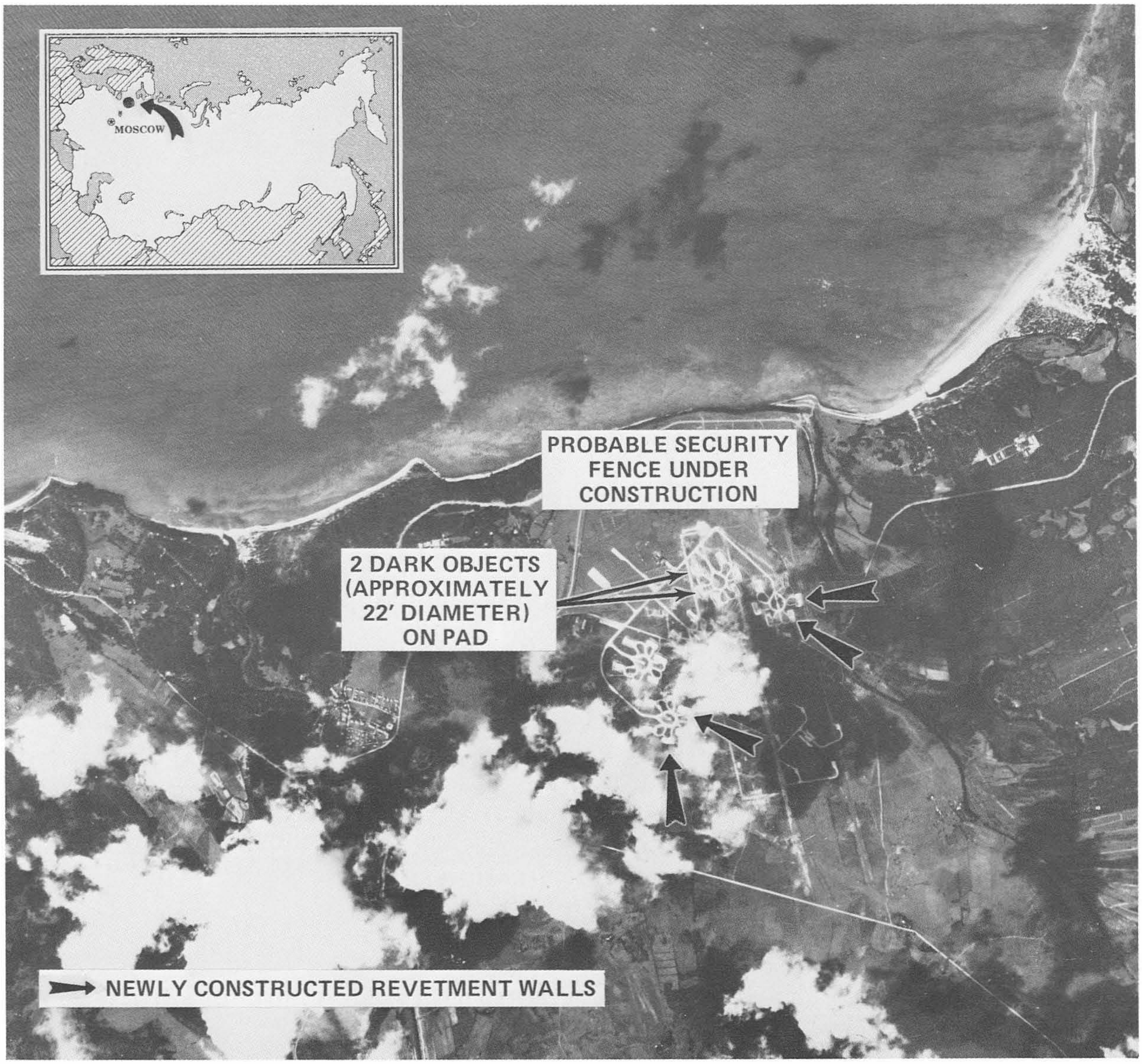
APPENDIX B-9
Plesetsk



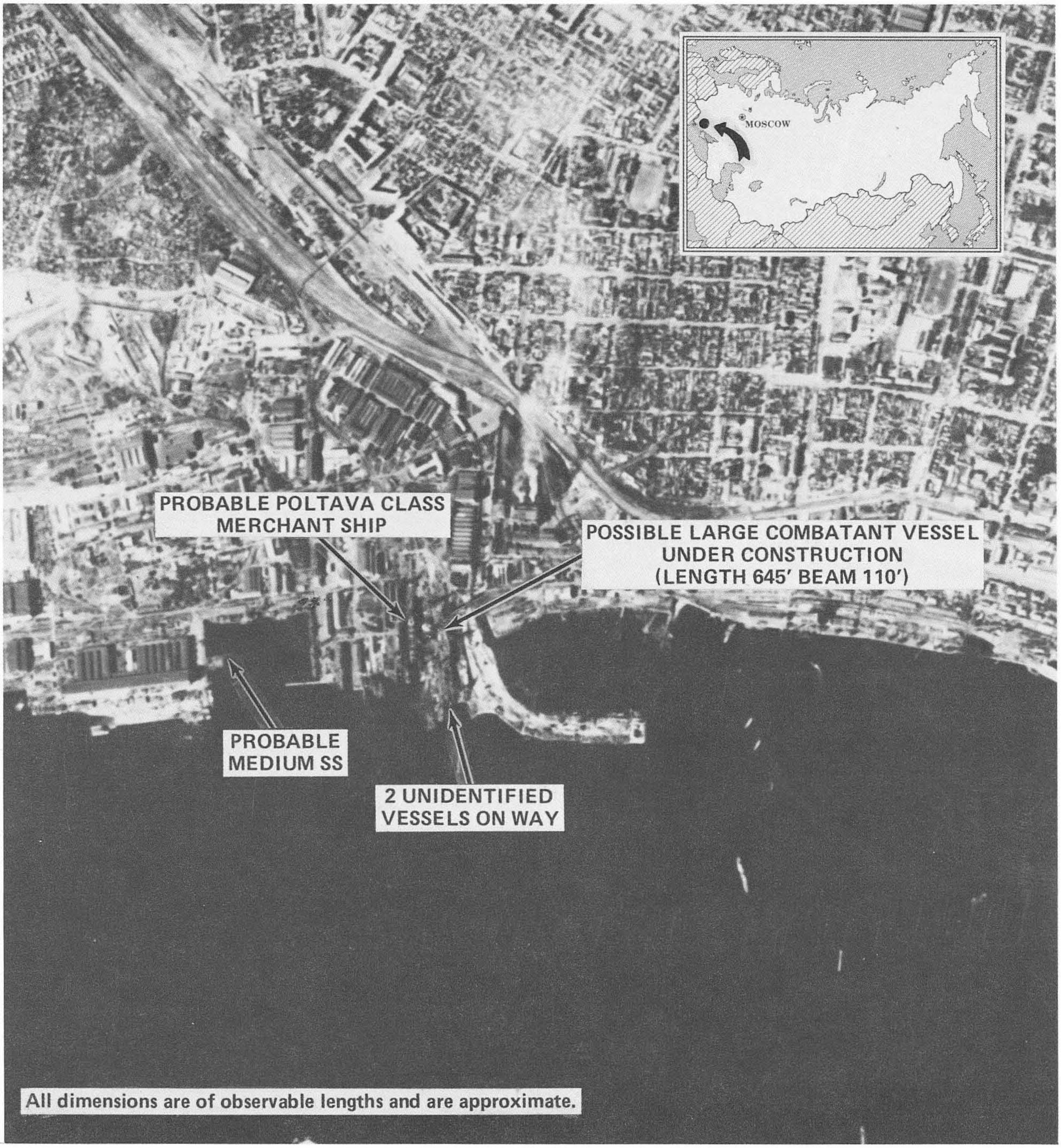
Another frequent target of CORONA cameras was the Plesetsk Missile and Space Test Range north of Moscow. This facility, photographed here by the KH-4A camera in October 1964, was involved in a wide range of activities from testing mobile ICBMs to launching military satellites.

APPENDIX B-10
Tallinn



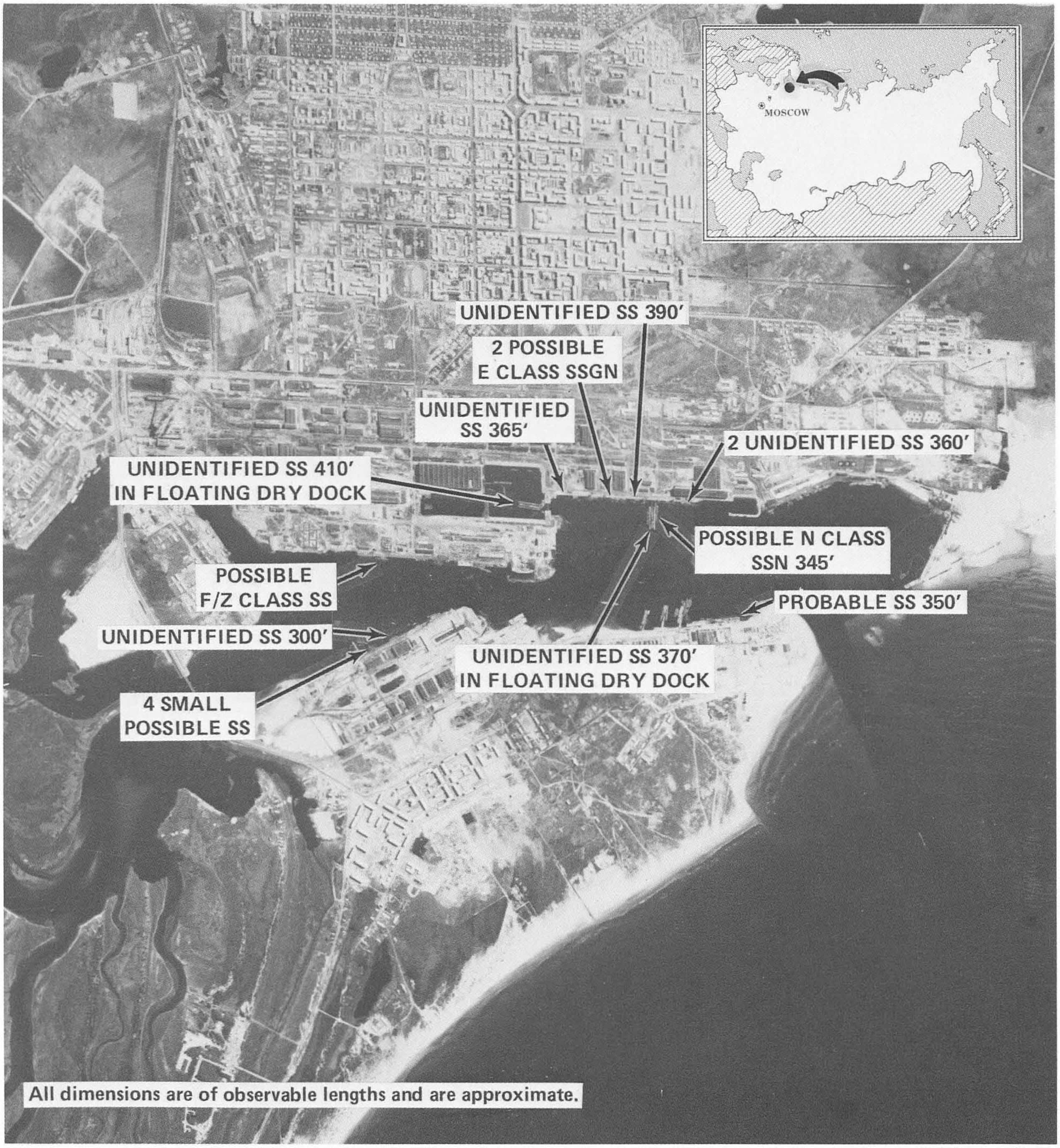
Although CORONA cameras were capable of searching wide areas of the Soviet Union for defense-related facilities, these same cameras were not always able to obtain imagery with sufficient scale to answer all questions asked by weapons analysts. A case in point was the surface-to-air missile installation near Tallinn in Soviet Estonia. Designated the SA-5, this system was believed by the Air Force to be an anti-ballistic missile (ABM) weapon. CIA analysts, however, believed the SA-5 was designed to interdict B-52 and B-58 bombers attacking from high altitudes. This KH-4A imagery, obtained in August 1964, was unable to resolve the missiles and their guidance antennas in sufficient detail to determine their purpose. High-resolution imagery from another satellite system eventually made it possible to determine that the SA-5 was targeted against high-altitude bombers and not ICBMs.

APPENDIX B-11
Nikolayev



CORONA imagery was also used to obtain naval order of battle information. Shipyards near the Black Sea port of Nikolayev were frequent targets. This KH-4A imagery, obtained in September 1964, shows several vessels under construction at Nikolayev's Nosenko Shipyard 444.

APPENDIX B-12
Severodvinsk



Another frequent target of the CORONA cameras was the Severodvinsk Naval Base and Shipyard 402 in the far north on the White Sea. This facility, the major producer of ballistic-missile firing submarines, was imaged by a KH-4A camera in August 1964.

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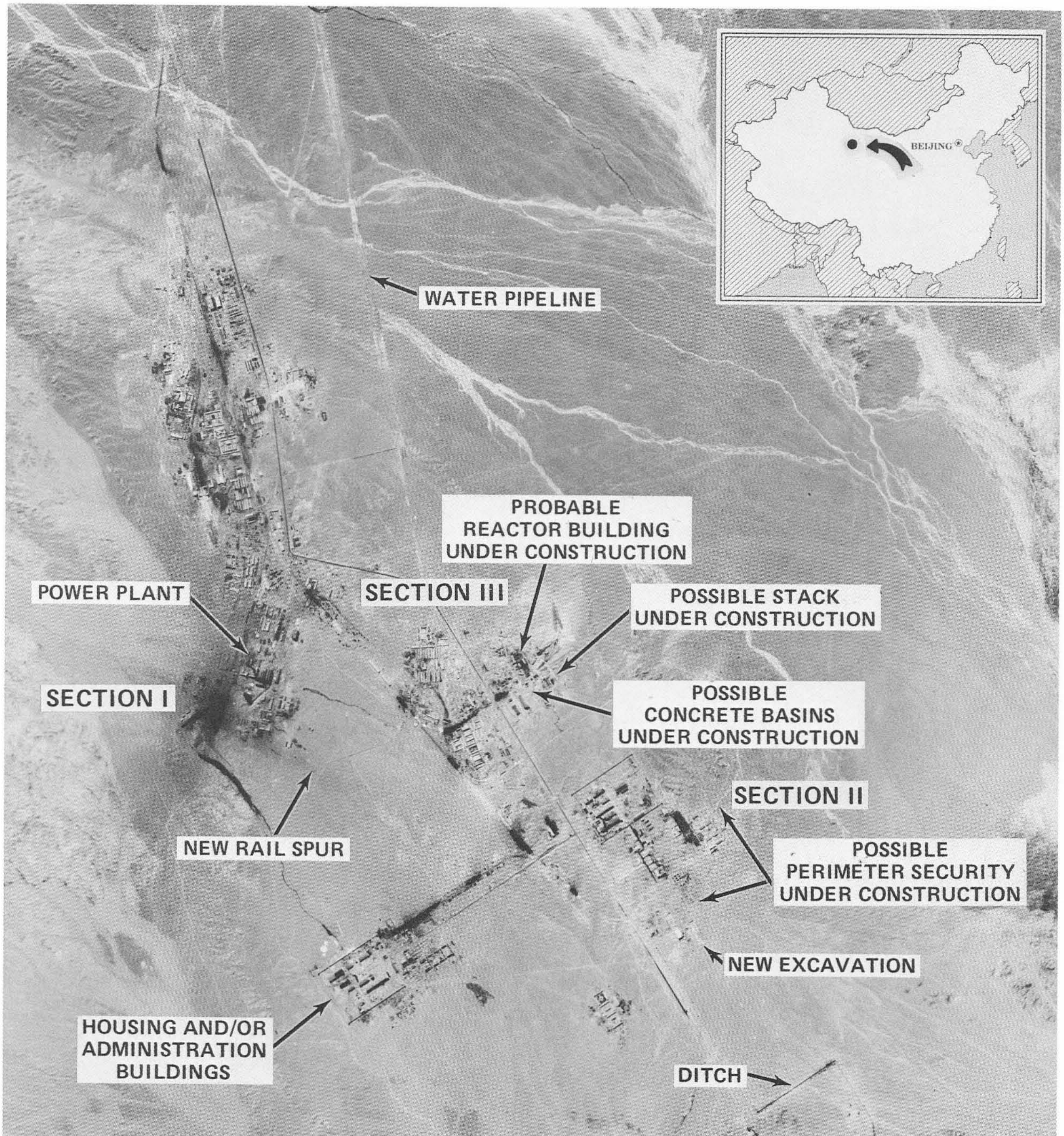
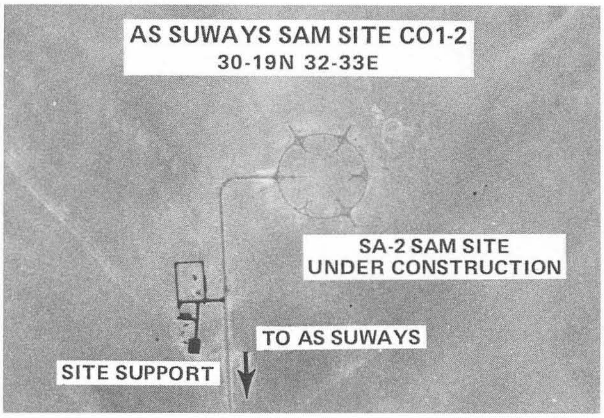
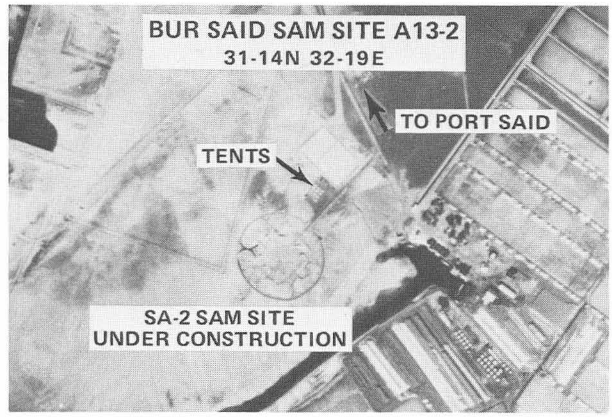
APPENDIX B-13
Yumenzhan

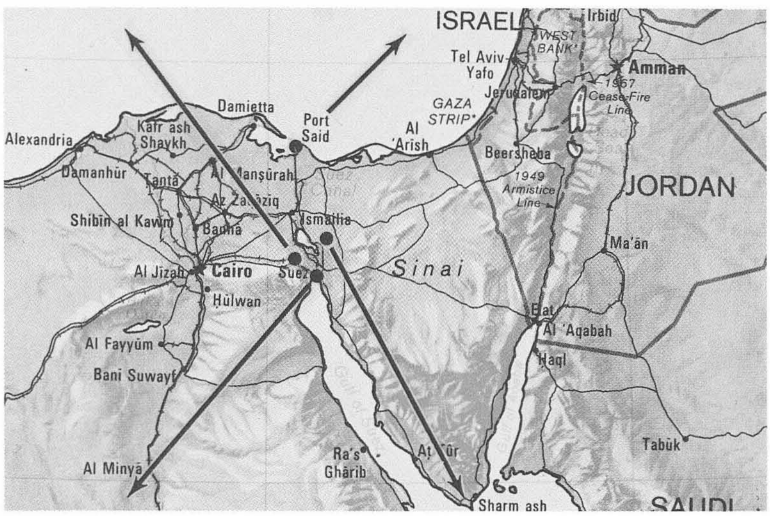


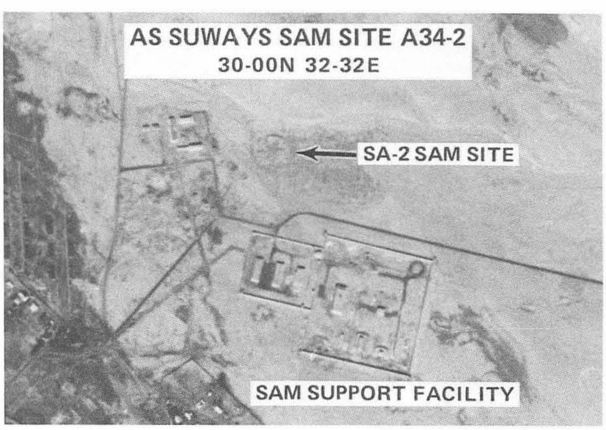
Satellite photography did much to prove that the Soviet Union was aiding the People's Republic of China in its nuclear program. This KH-4A photo, taken in August 1964, shows the chemical and plutonium facilities at Yumenzhan in north-central China, which was built with Soviet assistance. Many of these buildings resemble those at the Soviet nuclear facility near Tomsk.

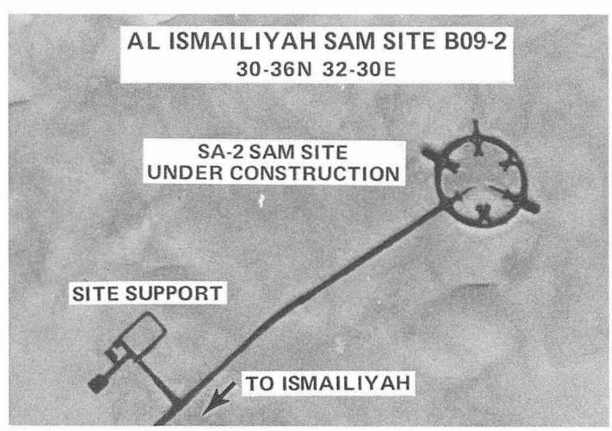
APPENDIX B-14
Suez Canal





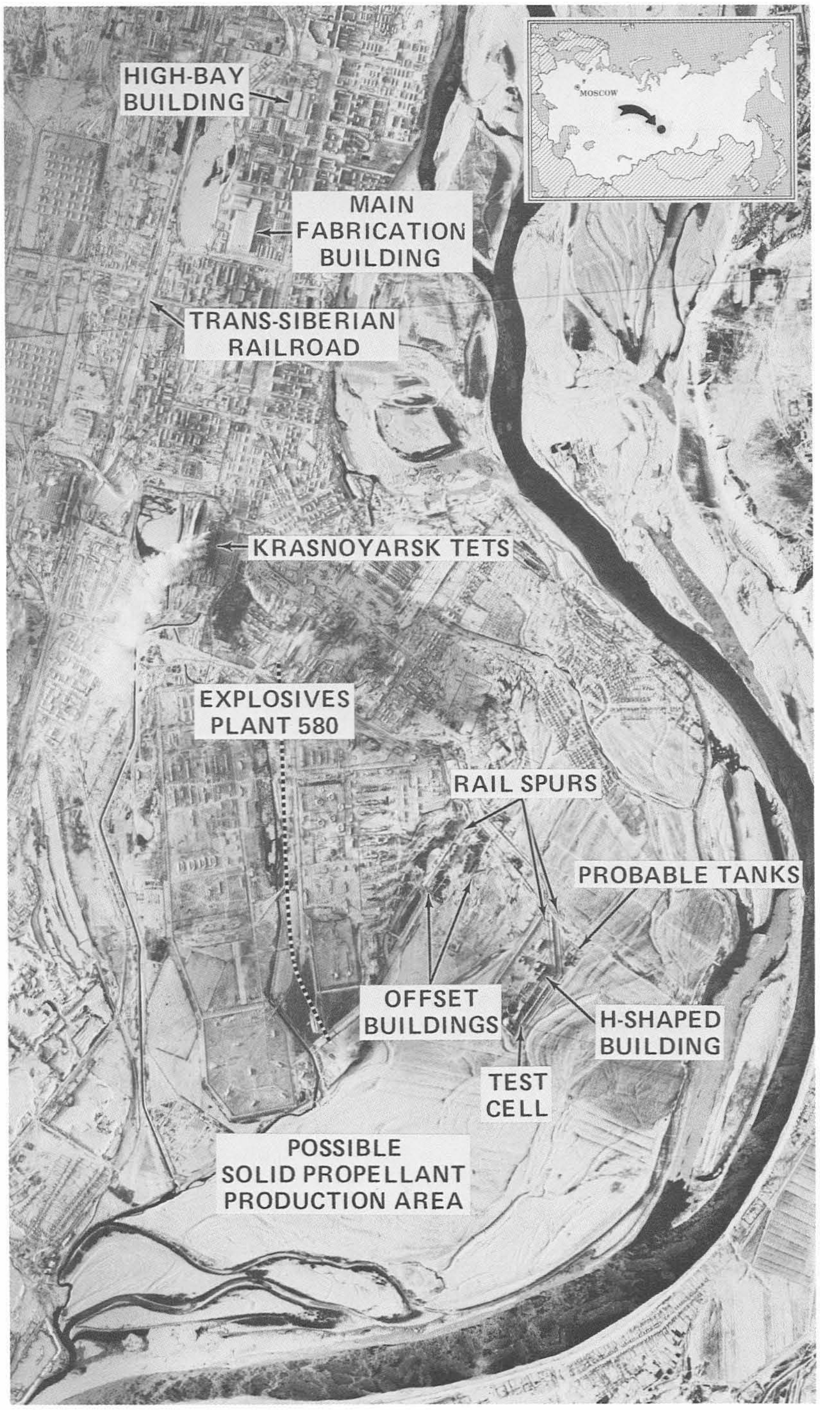






While CORONA's primary targets were located in the Soviet Union, People's China, and East Europe, this satellite system was used to acquire imagery of Third World areas as well. These photos, acquired by the KH-4A camera in December 1964, revealed the presence of Soviet-manufactured SA-2 GUIDELINE missiles in Egypt protecting the Suez Canal.

APPENDIX B-15
Krasnoyarsk



The Krasnoyarsk facility, Plant 580, for testing solid-propellant air-to-air missiles was discovered in KH-4A imagery obtained in November 1964. The same photograph showed the main fabrication building of the Voroshilov Arms Plant which produced submarine-launched ballistic missiles. Both facilities were located in close proximity to the TETS powerplant.

References

1. RAND Rpt, R-262, 1 Mar 54.

2. Hq, Air Research and Development Command General Operational Requirement No. 80, 27 Nov 54.

3. Ltr, Maj Gen A. Boyd, D/Cmdr Wpn Sys, ARDC to CMDR, WDD, 7 Nov 55; Dev Plan, WS-117L, 2 Apr 56; Dev-Dir No. 85, Hq USAF, 3 Aug 56; ARDC Sys Dev Dir, WS-117L, 17 Aug 56.

4. Ltr Contract AF04(647)-97, 29 Oct 56; ltr, Lt Gen D. L. Putt, DCS/D, USAF to Cmdr ARDC, 10 Dec 56, subj: Requirements for Additional FY 1957 Funds for WS-117L Visual and Ferret Systems, 19 Sep 58.

5. Memo, Col F.C.E. Oder Dir/WS-117L Prog, to Maj Gen B. A. Schriever, Cmdr WDD, 1 Aug 57, no subj; WS-117L Dev Plan, 16 Jul 57; Ltr, Col H. F. Boone, D/Asst for GM, ARDC, to DCS/D USAF, 13 Jul 57, subj: Program Planning Guidance for WS-117L, and ltr, Lt Gen D. L. Putt, DCS/D USAF to Cmdr ARDC, 3 Sep 57, same subj.

6. CORONA Chronology, Apr 59; ltr, J. F. Cassidy, Staff Dir, President's Board of Consultants on Foreign Intelligence Activities, to Maj Gen B. A. Schriever, Cmdr WDD, 20 May 57, no subj.

7. Memo, Col F.C.E. Oder, Dir/WS-117L Prog, to Maj Gen B. A. Schriever, Cmdr WDD, 27 Aug 57.

8. Ltr, Maj Gen B. A. Schriever, Cmdr AFBMD, to Lt Gen S. E. Anderson, Cmdr ARDC, 10 Sep 57, no subj.

9. Ltr, Col A. B. Gibbs, USAF Liaison Officer, NRL Vanguard Project, to Maj Gen B. A. Schriever, Cmd AFBMD, 9 Sep 57, no subj.

10. Ltr, Lt. Gen D. L. Putt, DCS/D USAF, to Lt. Gen S. E. Anderson, Cmdr ARDC, 17 Oct 57, no subj.

11. Memo, Brig Gen H. A. Boushey, D/Dir R&D, to DCS/D USAF, 13 Nov 57, subj: Information for Senate Investigating Committee; C/S USAF Policy Book, 7 Feb 58.

12. *Op Cit,* ref 10.

13. Rpt of the Edward Teller Ad Hoc Committee, 28 Oct 57.

14. Memo, R. E. Horner, Asst Sec AF (R&D), to Sec Def, 12 Nov 57, subj: Outer Space Vehicles.

15. RAND Rpt RM-2012, 12 Nov 57, *A Family of Reconnaissance Satellites;* ltr Lt. Col F.C.E. Oder, Asst for WS-117L, WDD to R-W Corp, 14 Dec 56, subj: Recoverable Payload Package Study.

16. Brochures: "Pioneer Strategic Reconnaissance Satellite for ICBM and IRBM with Recoverable System," 27 Nov 57 and 4 Jan 58; ltr, H. W. Page, Gen Mgr, GE Missiles and Space Veh Dept, to Brig Gen O. J. Ritland, V/Cmdr BMD, 15 Apr 59.

17. LMSD Doc 2832, WS-117L Development Plan for Program Acceleration, 6 Jan 58; ltr, L. E. Root, V/Pres, LAC to Cmdr BMC, 26 Nov 57, no subj; ltr, Maj Gen B. A. Schriever, Cmdr BMD, to L. E. Root, LAC, 23 Dec 57, no subj.

18. Memo, Col F.C.E. Oder, Dir/WS-117L Prog, to Maj Gen B.A. Schriever, Cmdr BMD, 7 Dec 57, no subj.

19. Memo, L. R. Houston, Gen Counsel CIA, to DCI, 3 Jun 63, subj: Basic Authority for CIA Conduct of Overflight Reconnaissance Operations, BYE-4250-63, S.

20. Memo, R. M. Bissell, 19 Nov 57, subj; Proposed Advanced Reconnaissance System.

21. CORONA Cover Plan, 8 Dec 58, COR-0160.

22. Memo, Col F.C.E. Oder, Dir/WS-117L Prog, to Maj Gen B.A. Schriever, Cmdr BMD, 18 Feb 58; subj: Preliminary Evaluation of Itek Proposal; TWX AFCVC 57197, USAF to BMD, 3 Mar 58.

23. Memo, Col F.C.E. Oder, Dir/WS-117L Prog, for Record, 12 Mar 58, subj: Record of Conference.

24. Memo, Col F.C.E. Oder, Dir/WS-117L Prog, for Record, 12 Mar 58.

25. Memo, Oder for Record, 25 Mar 58, subj: Report of Meeting, 17 Mar 58; Memo, Oder for Record, no subj, in Schriever's file (deals with 18 Mar 58 mtg at Cambridge); draft memo, Oder to Maj Gen B.A. Schriever, Cmdr AFBMD, 28 Mar 58, subj: Back Up Camera Pod Development for Project CORONA.

26. Project CORONA Outline, 15 Apr 58, COR-0013, TS, with covering memo from R. M. Bissell, Jr, Spec Asst to the Director,CIA, to Brig Gen A. J. Goodpaster, the White House, COR-0014.

27. Work Statement, Development of a Satellite Reconnaissance and Recovery System (CORONA) by Lockheed Missiles Systems Division, 25 Apr 58, COR-0016.

28. Greer, Kenneth, "CORONA: The First Photo-Satellite," *Studies in Intelligence,* Vol. 17, No. 1-S, Spring 1973, p. 6.

29. Ltr, F. W. O'Green, Tech Dir, LMSD to LMSD pers, 31 Jul 58, subj: Advanced Engineering Tests.

30. Memo, R. M. Bissell, CIA, for Brig Gen A. J. Goodpaster, Staff Secretary to the Pres, 9 Aug 58, w/att.

31. TWX AFOOP-OC-R53942, USAF to BMD, 10 Jul 58; memo, Lt Col L. E. Vandeveer, BMD Ops Ofc, for Record, 21 Jul 58, subj: Report of Meeting with TAC and ADC to Establish a C-119 Squadron; ARDC GO38, 22 Jul 58.

32. Memo, Col W. A. Sheppard, for Record, 17 Jun 58, subj: Lockheed-General Electric Relations.

33. TWX AFCGM52800, USAF to BMD, 2 Jul 58.

34. Msg 2956, CIA (R. M. Bissell) to BMD (Brig Gen O. J. Ritland, V/Cmdr), 2 Oct 58; Msg 2979, CIA (Bissell) to BMD (Col W. A. Sheppard), 2 Oct 58; Msg 0096, BMD to CIA (Bissell), 7 Oct 58.

35. Memo, R. W. Johnson, Dir/ARPA, to Cmdr BMD, 10 Sep 58, subj: Redefinition of WS-117L; memo, Col F.C.E. Oder, Dir/WS-117L Prog, to Col W. A. Sheppard, 30 Sep 58, subj: Comments on COR-0160, 25 Sep 58; CORONA Cover Plan, 8 Dec 58.

36. Memo Rpt, R. B. Cesaro, C. R. Irvin, L. L. Lind, R. C. Truax, ARPA Staff to Dir, D/Dir, Ch Sci, ARPA, 1 Dec 58, subj: Reorientation of 117L Program; msg 0529, Col W. A. Sheppard, BMD,

to CIA, 22 May 59; memo R. M. Bissell, CIA, for Maj Gen J. E. Smart, Asst VCS USAF, 25 Nov 58, subj: Distribution of Responsibilities for CORONA.

37. Memo, Col. W. A. Sheppard to Maj Gen B. A. Schriever, Cmdr BMD, 17 Nov 58, subj: Status of Scientific Advisory Committee for Reconnaissance Satellites; memo, R. M. Bissell, CIA, to Maj Gen A. J. Goodpaster, Staff Secretary to the Pres, 5 Nov 58, subj: Project CORONA.

38. Memo, R. W. Johnson, Dir/ARPA, to SAFUS, 4 Dec 58, subj: WS-117L Program, ARPA.

39. Memo, A. W. Dulles, DCI, 4 Dec 58, for Dep Sec Def; Spcl Asst to the Pres for Sci and Tech, subj: Proposed Curtailment of Project CORONA; memo, R. W. Johnson, Dir/ARPA, to SAFUS, 17 Dec 58, subj: Reorientation of Sentry Program.

40. CORONA Cover Plan, *op.cit.*

41. *Ibid.*

42. Memo, Lt Gen R. C. Wilson, DCS/D USAF, to Maj Gen J. Ferguson, et al (DCS/D), 2 Feb 59, subj: AFBMD Presentation to Mr. MacIntyre.

43. Memo, Col W. A. Sheppard to Maj Gen B. A. Schriever, 20 Jan 59, subj: CORONA Prg Rpt; Ibid; msg 0327 Sheppard (BMD) to Bissell (CIA), 3 Feb 59; msg 0328, CIA to BMD (Sheppard), 4 Feb 59; msg 0340, BMD (Sheppard) to CIA (Bissell), 11 Feb 59; memo, Lt Gen R. C. Wilson, DCS/D USAF, to J. V. Charyk, SAFUS, 29 Feb 60, subj: Satellite Reconnaissance; msg 6717, CIA to BMD (Sheppard), 6 Mar 59; msg 0446, BMD (Sheppard) to CIA (Bissell), 3 Apr 59; TWX AFDAT59353, USAF to BMD, 27 Apr 59; Amend No. 4 to ARPA Order 48-59, 20 May 59.

44. Msg 0417, BMD (Sheppard) to CIA, 24 Mar 59; memo, Col W. A. Sheppard to Maj W. F. Weaver, 14 Apr 59, subject: Root-Schriever, Schriever-Root Exchange of Letters; msg 0500, BMD to CIA, 5 May 59; ltr, L. E. Root, VP and Gen Mgr LMSD, to Maj Gen B. A. Schriever, Cmdr BMD, 7 Apr 59, no subj (cys to several LMSD depts); ltr, Brig Gen O. J. Ritland, Cmdr, BMD to L. E. Root, LMSD, 6 May 59, no subj (multiple coord within BMD).

45. Mosely, Leonard; *A Biography of Eleanor, Allen, and John Foster Dulles and Their Family Network,* Dial Press, 1978, p. 432.

46. TWX WDZ-8-15-E, BMD to USAF, 28 Aug 59; msg 2389 CIA to BMD, 14 Sep 59; msg 0856, BMD (Col P. E. Worthman) to CIA, 15 Sep 59, quoting BMD TWX to ARPA, 15 Sep 59; msg 9505 BMD (Sheppard) to CIA (Bissell), 29 Sep 59.

47. Memo, Col F.C.E. Oder, Asst D/Cmdr Space Sys, BSD to WS-117L Prog Ofc, approx 5 Sep 59, subj: LMSD Discoverer Recovery Report; ltr, R. Smelt, LMSD, to Cmdr BMD, 21 Sep 59, subj: Modifications Incorporated in Discoverer VII; memo, Maj F. S. Buzard, Disc Prog Ofc, for Record, 4 Sep 59, subj: Report on Meeting of 3 September; memo, Maj W. F. Weaver, Jr. Disc Prog Ofc, for Record, 10 Sep 59, subj: 8 Sep 59 Meeting.

48. TWX, RDRRB 27-11-31-E, ARDC to USAF, 1 Dec 59 in USAF Hist Div files; Chart, CORONA Summary, 15 Jan 62.

49. Msg 1111, BMD (Col Worthman) to CIA, 19 Feb 60; Chart, CORONA Summary, 15 Jan 62.

50. Msg 1113, BMD (Col Worthman) to CIA [redacted] 19 Feb 60; msgs 1150 and 1152, BMD (Worthman) to CIA [redacted] 9 Mar 60; msg 8058 [redacted] to BMD (Worthman), 7 Mar 60.

51. Ltr, Gen C. E. LeMay, VCS USAF, to Pres, LAC, 25 Apr 60, no subject, USAF Hist Files; memo, Lt Col R. J. Ford, CORONA Prog Ofc, for Record, 2 May 56, subj: Program Review, 1 May 60; Chart: CORONA Summary, 15 Jan 62.

52. Msg 1722, CIA (R. M. Bissell) to BMD (Maj Gen O. J. Ritland, Cmdr), 1 Jul 60; Chart: CORONA Program Summary, 15 Jan 62.

53. Interviews, Maj Gen Greer and Col J. W. Ruebel, SAFSP, 12 Dec 62; Lt. Col R. J. Ford, 21 Jan 63, all by R. L. Perry.

54. Msg 1352, BSD (Ford) to CIA, 12 Aug 60.

55. Perry, Robert, *A History of Satellite Reconnaissance,* Revised Oct 73, Volume I, p. 99.

56. CIA Working Paper 0347A, Chapter VI, Project CORONA, the Beginning, p. VI-15.

57. Msg 2804, CIA (R. M. Bissell) to BMD (Maj Gen O. J. Ritland, Cmdr), 17 Aug 60; memo, Col P. Worthman, for Record, 23 Aug 60, subj: Quality of "Take"; memo, Worthman for Record 24 Aug 60, subj: Quality of "Take" and Bangmeter.

58. *Yearbook of the United Nations, 1959,* Political and Security Questions, Documentary References, pp. 28-29.

59. UN Registration of Space Vehicles: Chronology of Events, CIA DD/S&T Retired File, "Outer Space, Mar-Jul 1962," Job 66-R-638.

60. NYUSDEL Telegram 3556 to Department of State, 26 Apr 62, subj: Outer Space.

61. Memo, Herbert Scoville to DCI, 27 Apr 62, subj: Herb Stevenson's Telegram.

62. Memo, Roswell Gilpatric, D/Sec Def, to Gen Maxwell Taylor, 10 Apr 62, subj: "Interaction of U.S. Action in the U.N. with U.S. Satellite Reconnaissance Activities."

63. Memo, Herbert Scoville to DCI, 29 Jun 62, subj: Report of NSAM 156 Working Group, DD/R-295-62.

64. Memo, James R. Killian, Chairman, PFIAB, to President Kennedy, 16 May 62.

65. Memo, John McCone, DCI, to DDCI, 22 May 62, subj: "U.S. Position in U.N. Outer Space Committee," ER-62-3520.

66. Marshall S. Carter, Lt Gen, U.S.A., DDCI, Memo to DD/R, 29 May 62, "Formulation of Policies on Outer Space."

67. National Security Council Action 2454, "U.S. Policy on Outer Space, Including Satellite Activity," 10 Jul 62.

68. Letter "Agreement on Management of the NRP," signed by Lt Gen Cabell, Acting Director, CIA and Roswell Gilpatrick, D Sec Def, 6 Sep 61.

69. Interview, AF Secretary Eugene Zuckert, 25 Jul 64, by Lawrence McQuade, Tape in Kennedy Library, Boston, Massachusetts.

70. Interview, Maj Gen R. E. Greer by Perry, 9 Dec 63, cited in *A History of Satellite Reconnaissance,* Vol IIA, Oct 1973.

71. "Agreement between Secretary of Defense and the DCI on Responsibilities of the NRO," 2 May 62, BYE-11601-62.

72. Memo for NRO Program Directors, J. V. Charyk, 23 Jul 62, subj: Organization and Functions of the NRO, BYE-1733-62.

73. "Status of CORONA," 17 Apr 60, DoD Unnumbered Document in OSA retired files.

74. Memo for Record, Col. P. Worthman, subj: Stereo C-Triple-Prime, 24 Feb 61. Draft memo, J. Charyk, U/Sec AF to SOD, no subject, Mar 61, NRO Staff files.

75. Msgs 9468 and 9559, CIA to Lt Col Battle, CORONA Office, 30 Mar and 6 Apr 61; msgs 8691 and 9240, CIA to LMSD, 13 Mar and 26 Mar 61, SAFSP files.

76. Memo, J. Charyk, U/Sec AF, and R. M. Bissell, D/Dir CIA to Dir DIA, 7 Feb 62, subj: Exploitation.

77. Memo, J. Charyk, U/Sec AF to Dir DIA, 14 Feb 62, subj: MURAL.

78. Memo, J. Charyk to Chm, FIAB, 15 Jun 62.

79. Ltr, [redacted] CIA, to Col Battle, CORONA Office, 13 Jul 62, no subj, SAFSS files.

80. NRP Report to FIAB, 1962. See rpts for 27 Sep and 7 Dec.

81. Memo, Lt Col Howard, DNRO Staff, to Col. L. Battle, SAFSS, 18 Sep 62, no subj, SAFSS files.

82. CIA Working Paper, "CORONA History," Chapter VII, 22 Oct 84.

83. Memo, R. M. Bissell to Maj Gen R. Smart, Dep V/C Staff, USAF, subj: "Distribution of Responsibilities for CORONA," 25 Nov 58, SAFSS files.

84. Memo, J. A. Cunningham, Dep Asst Dir (Special Activities) to Exec Dir, CIA, subj: "Basic Authorities and Agreements Which CIA Holds With USAF/NRO; Recommended Modifications and Suggestions Regarding the NRO Organization," 24 Jan 63, CIA files, "CORONA 2, History and Background."

85 DoD-CIA Agreement, "Management of the National Reconnaissance Program" signed by Roswell Gilpatric, D/Sec Def and John McCone, Director, CIA, 13 Mar 1963

86. CIA Working Paper, "CORONA History," Chapter VII, 22 Oct 84.

87. Memo, J. A. McCone, DCI to DNRO, 9 Apr 63, subj: "Special Procedures for Satellite Reconnaissance Missions," DNRO files.

88. Msg, [redacted] 0832 McMillan, DNRO, to Maj Gen R. L. Greer, Dir SP, 19 Apr 63, SAFSP files.

89. Msg, [redacted] 2296, Dir/SP to CIA, SAFSP, 13 Feb 64, in SAFSS files.

90. Agreement for Reorganization of National Reconnaissance Program, 13 Aug 1965, BYE-5678-65.

91. Study, A. Wheelon, DDS/T, for DCI, "A Summary of the NRP," 13 May 1965, BYE-0204-65, CIA files.

92. History, Office of Special Projects, CIA, 1965-70, Jun 1973, BYE-6400-72, p. 130.

93. *Ibid*, p. 14.

94. Memo, A. H. Flax, DNRO, to NRP Executive Committee, 22 Apr 66, subj: CORONA Management.

95. Memo, A. H. Flax, DNRO, to Dir Recon, CIA, and Dir Spec Proj, SAF, 22 Jun 66, subj: CORONA Management Plan and Organizational Responsibilities.

96. "The CORONA Improvement (J-3) Program Development History," 27 Oct 67, COR-6148-67.

97. "A Century of CORONA," 1960-68, BYE 7752-68, to DD/Sat Ops, NRO, from J. Crowley (Note: from OSP correspondence file: History 64-69).

98. "Report of the HEXAGON Review Committee" (Chm F. R. Naka), 20 Jun 69; 2nd report, 4 Nov 69, 3rd report, 22 Jan 70, DNRO and Ex Com files.

99. Memo, A. H. Flax, DNRO, to Dep Sec Def, 26 Jun 67, subj: "FY 1968 Obligations and Expenditure Indications for the NRP" (Source: NRP Ex Com files).

100. NRP Ex Com Minutes, mtg 20 Aug 68.

101. NRP Ex Com Minutes, mtg 18 Nov 68.

102. NRP Ex Com Minutes, mtg Jun 69.

103. Final Report, CORONA Photographic Experiments Committee, Jun 1969, BYE-7180-69.

104. Ltr, H. E. Newell, Assoc Admin, NASA, to J. L. McLucas, U/Sec AF (DNRO), 2 Mar 70; McLucas to Newell, 26 Mar 70. (Source: DNRO files.)

105. Ltr. R. S. Cline, Dir/Intelligence and Resources, Dept of State, to R. Helms, Dir CIA, 4 Sep 70. (Source: DNRO files.)

106. Memo, Lt Gen D. V. Bennett, Dir. DIA to Dep Sec Def, subj: Continuity of Satellite Coverage. (Source: DNRO files.)

107. Ltr, R. Helms, Dir CIA to D. Packard, Dep Sec Def, 17 Nov 70. (Source: DNRO files.)

108. Memo, J. Martin, President's OST to Dr. E. E. David, Presidential Science Adviser, 3 Feb 71, subj: CORONA Re-order Insurance Costs.

109. Robert Perry, *A History of Satellite Reconnaissance,* Vol I, p. 218, TS. (Source: SAFSP files.)

110. "Report to the 40 Committee, 1 Jul 71 - 30 Jun 72," BYE 13190172. (Source: DNRO files.)

111. *Op cit,* ref 105, p. 217.

112. *Op cit,* ref 106.

113. *Ibid.*

114. *Ibid.*

115. *Op cit,* ref 105.

116. Kenneth Greer, "CORONA Program History," Vol I, Directorate of Science and Technology, CIA, 1976.

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