2

Developing the U-2

THE ESTABLISHMENT OF THE U-2 PROJECT

On 26 November 1954, the day after Thanksgiving, Allen Dulles called his special assistant, Richard Bissell, into his office to tell him that President Eisenhower had just approved a very secret program and that Dulles wanted Bissell to take charge of it. Saying it was too secret for him to explain, Dulles gave Bissell a packet of documents and told him he could keep it for several days to acquaint himself with the project. Bissell had long known of the proposal to build a high-altitude reconnaissance aircraft, but only in the most general terms. Now he learned in detail about the project that proposed sending aircraft over the Soviet Union.

Late on the morning of 2 December 1954, Dulles told Bissell to go to the Pentagon on the following day to represent the Agency at an organizational meeting for the U-2[1] project. Before leaving, Bissell asked Dulles which agency was to run the project. The DCI replied that nothing had been clearly decided. Bissell then asked who was going to pay for the project. Dulles answered: "That wasn't even mentioned. You'll have to work that out." [2]

Bissell was accompanied by Herbert I. Miller, chief of the Office of Scientific Intelligence's Nuclear Energy Division, who soon became the executive officer of the overflight project. When Bissell and Miller arrived at the Pentagon on the afternoon of 3 December, they

[1] Although the Lockheed CL-282 was not designated as the U-2 until July 1955, this study will use the more widely known designator to avoid confusion.

[2] Bissell interview (S); *OSA History*, chap. 3, p. 1 (TS Codeword).

James A. Cunningham, Jr.

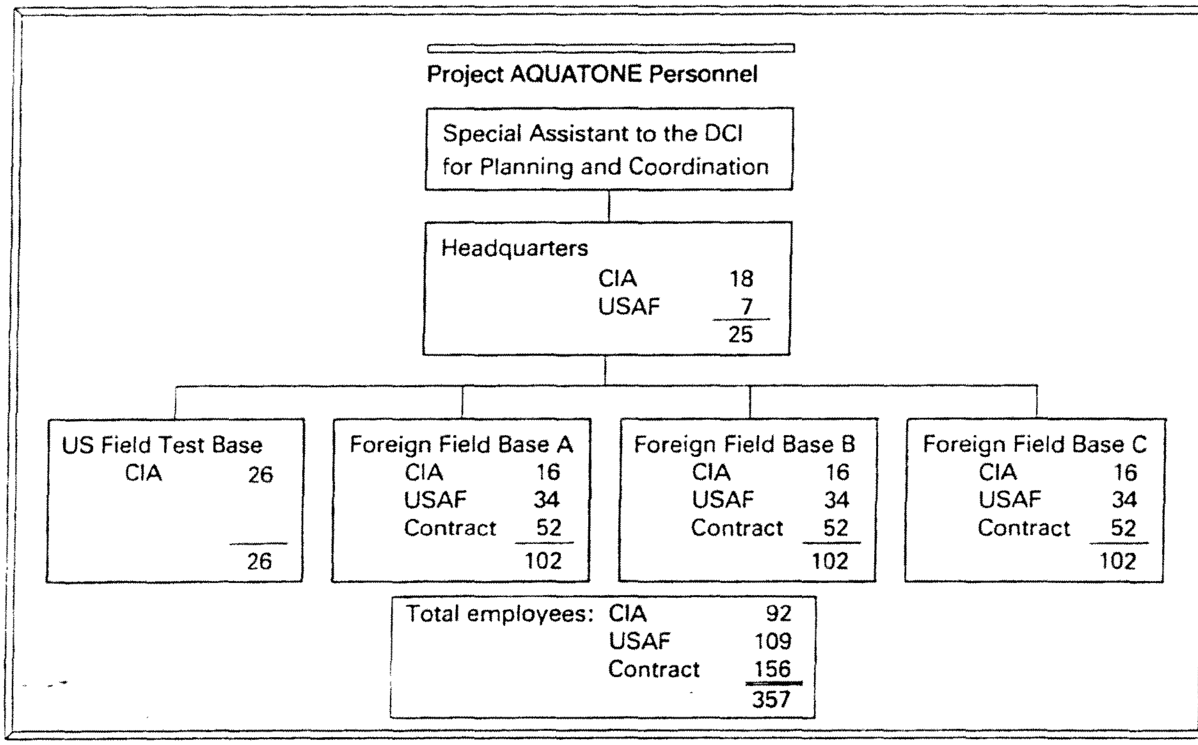
sat down with a group of key Air Force officials that included Trevor Gardner and Lt. Gen. Donald L. Putt. The participants spent very little time delineating Air Force and Agency responsibilities in the project, taking for granted that the CIA would handle the security matters. Much of the discussion centered on methods for diverting Air Force materiel to the program, particularly the Pratt & Whitney J57 engines, because a separate contract for the engines might jeopardize the project's security. The Air Force promised to turn over a number of J57 engines, which were then being produced for B-52s, KC-135s, F-100s, and RB-57s. Eventually Bissell asked who was going to pay for the airframes to be built by Lockheed. His query was greeted with silence. Everyone present had their eyes on him because they all expected the Agency to come up with the funds. Bissell rose from his chair, said he would see what he could do, and the meeting adjourned.[3]

After the meeting, Bissell told Dulles that the CIA would have to use money from the Contingency Reserve Fund to get the project going. The DCI used this fund to pay for covert activities, following approval by the President and the Director of the Budget. Dulles told Bissell to draft a memorandum for the President on funding the overflight program and to start putting together a staff for Project AQUATONE, the project's new codename.

At first the new "Project Staff" (renamed the Development Projects Staff in April 1958) consisted of Bissell, Miller, and the small existing staff in Bissell's Office of the Special Assistant to the DCI. During the months that followed the establishment of the project, its administrative workload increased rapidly, and in May 1955 the project staff added an administrative officer, James A. Cunningham, Jr., a former Marine Corps pilot then working in the Directorate of Support. Cunningham stayed with the U-2 project for the next 10 years. Two other key project officials who began their duties early in 1955 were [redacted] the finance officer, and [redacted] the contracting officer.[4]

[3] *OSA History*, chap. 3, p. 2 (TS Codeword); Bissell interview, 8 November 1984 (S); Beschloss, *Mayday*, p. 89.

[4] *OSA History*, chap. 3, pp. 6-7, chap. 4, pp. 1-2, chap. 5, pp. 27-29 (TS Codeword); *Chronology of the Office of Special Activities, 1954-1968*, (CIA: DS&T, 1969), p. 2-4 (TS Codeword) (hereafter cited as *OSA Chronology*).



During the first half of 1955, the project staff grew slowly; many of the individuals working on overhead reconnaissance remained on the rolls of other Agency components. To achieve maximum security, Bissell made the project staff self-sufficient. Project AQUATONE had its own contract management, administrative, financial, logistic, communications, and security personnel, and, thus, did not need to turn to the Agency directorates for assistance. Funding for Project AQUATONE was also kept separate from other Agency components; its personnel and operating costs were not paid out of regular Agency accounts. As approving officer for the project, Richard Bissell could obligate funds in amounts up to $100,000; larger sums required the DCI's approval.[5]

At the end of April 1955, Bissell's staff developed, and the Deputy Director for Support approved, the first table of organization for Project AQUATONE. Once operational, the project would have a

[5] *OSA History*, chap. 3, pp. 5-7 (TS Codeword).

The Matomic Building

total of 357 personnel divided among project headquarters, a US testing facility, and three foreign field bases. CIA employees represented only one-fourth (92) of the total. The Air Force personnel commitment was larger, with 109 positions on the 1955 table of organization (this total does not include many other Air Force personnel, such as SAC meteorologists, who supported the U-2 project in addition to their other duties). The largest Project AQUATONE category was contract employees, with 156 positions in 1955. This category included maintenance and support personnel from Lockheed (five per aircraft), the pilots, and support personnel from other contractors for items such as photographic equipment.[6]

The first project headquarters was in CIA's Administration (East) Building at 2430 E Street, NW. Continued growth caused the AQUATONE staff to move several times during its first two years. On 1 May 1955, the project staff moved to the third floor of a small red brick building (the Briggs School) at 2210 E Street, NW. Then on 3 October, the staff moved to Wings A and C of Quarters Eye, a World War II "temporary" building on Ohio Drive, NW, in the West Potomac Park area of Washington. On 25 February 1956, the project staff moved again, this time to the fifth floor of the Matomic Building

[6] Project AQUATONE Table of Organization, 28 April 1955 in *OSA History*, chap. 3, annex 15 (TS Codeword).

at 1717 H Street, NW. Here the staff remained for the next six years until it moved into the new CIA Headquarters building at Langley in March 1962. The final move came in January 1968, when the project staff (by that time known as the Office of Special Activities) moved to the [redacted]

Bissell reported directly to the DCI, although in reality the DDCI, Gen. Charles Pearre Cabell, was much more closely involved in the day-to-day affairs of the overhead reconnaissance project. Cabell's extensive background in Air Force intelligence, particularly in overhead reconnaissance, made him ideally qualified to oversee the U-2 project. Cabell frequently attended White House meetings on the U-2 for the DCI.

DDCI Charles Pearre Cabell

FUNDING ARRANGEMENTS FOR PROJECT AQUATONE

Although Allen Dulles had approved the concept of covert funding for the reconnaissance project, many financial details remained to be settled, including the contract with Lockheed. Nevertheless, work on the U-2 began as soon as the project was authorized. Between 29 November and 3 December 1954, Kelly Johnson pulled together a team of 25 engineers, which was not easy because he had to take them off other Lockheed projects without being able to explain why to their former supervisors. The engineers immediately began to work 45 hours a week on the project. The project staff gradually expanded to a total of 81 personnel, and the workweek soon increased to 65 hours.[8]

Kelly Johnson's willingness to begin work on the aircraft without a contract illustrates one of the most important aspects of this program: the use of unvouchered funds for covert procurement. Lockheed was well acquainted with the covert procurement process, having previously modified several aircraft for covert use by the CIA.

Covert funding for sensitive projects simplifies both procurement and security procedures because the funds are not attributable to the Federal Government and there is no public accountability for their

[7] *OSA History*, chap. 18, pp. 7-8 (TS Codeword); *OSA Chronology*, pp. 4, 7, 10, 45 (TS Codeword).

[8] Johnson, "Log for Project X," 29 November–3 December 1954 (U).

use. Public Law 110, approved by the 81st Congress on 20 June 1949, designates the Director of Central Intelligence as the only government employee who can obligate Federal money without the use of vouchers. By using unvouchered funds, it is possible to eliminate competitive bidding and thereby limit the number of parties who know about a given project. The use of unvouchered funds also speeds up the Federal procurement cycle. A general contractor such as Lockheed can purchase much, if not all, of the supplies needed for a project without resorting at each step to the mandated procurement procedures involving public, competitive bidding. [redacted]

In mid-December 1954, President Eisenhower authorized DCI Dulles to use $35 million from the Agency's Contingency Reserve Fund to finance the U-2 project. Then on 22 December 1954, the Agency signed a letter contract with Lockheed, using the codename Project OARFISH. The Agency had proposed to give Lockheed "performance specifications" rather than the standard Air Force "technical specifications," which were more rigid and demanding, and Kelly Johnson agreed that such a move would save a lot of money. Lockheed's original proposal to the Air Force in May 1954 had been $28 million for 20 U-2s equipped with GE J73 engines. During negotiations with CIA General Counsel Lawrence R. Houston, Lockheed changed its proposal to $26 million for 20 airframes plus a two-seat trainer model and spares; the Air Force was to furnish the engines. Houston insisted that the Agency could only budget $22.5 million for the airframes because it needed the balance of the available $35 million for cameras and life-support gear. The two sides finally agreed on a fixed-price contract with a provision for a review three-fourths of the way through to determine if the costs were going to exceed the $22.5 million figure. The formal contract, No. SP-1913, was signed on 2 March 1955 and called for the delivery of the first U-2 in July 1955 and the last in November 1956. Meanwhile, to keep work moving at Lockheed, Richard Bissell wrote a check for $1,256,000 [redacted] and mailed it to Kelly Johnson's home on 21 February 1955.[9]

[9] John S. Warner, Office of the General Counsel, interview by Donald E. Welzenbach, Washington, DC, tape recording, 5 Aug 1983 (S); *OSA History*, chap. 5, pp. 1-2 and annex 42 (TS Codeword); Johnson, "Log for Project X," 21 February 1955.

As it turned out, no review of the contract was necessary at the three-fourths point. Lockheed delivered the aircraft not only on time but under budget. During the final contract negotiations in the spring of 1958, Lockheed and the US Government agreed on a price for the original 20 aircraft of $17,025,542 plus a profit of $1,952,055 for a total of $18,977,597—less than $1 million for each aircraft. Because its design was based on Lockheed's F-104, the U-2 was relatively inexpensive even though only a small number of aircraft had been ordered. Only the wings and tail were unique; Lockheed manufactured the other portions of the aircraft using the F-104's jigs and dies.

MAJOR DESIGN FEATURES OF THE U-2

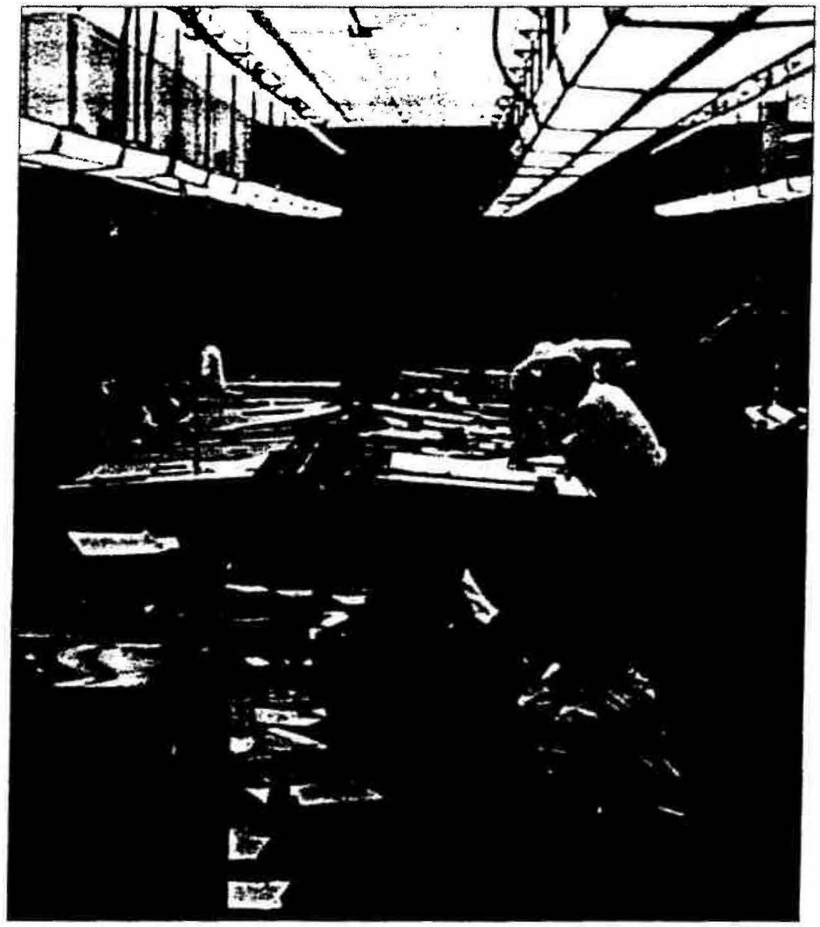
Aware of the great need for secrecy in the new project, Kelly Johnson placed it in Lockheed's Advanced Development facility at Burbank, California, known as the Skunk Works.[10] Lockheed had established this highly secure area in 1945 to develop the nation's first jet aircraft, the P-80 Shooting Star. The small Skunk Works staff began making the detailed drawings for the U-2, which was nicknamed the "Angel" because it was to fly so high.

Kelly Johnson's approach to prototype development was to have his engineers and draftsmen located not more than 50 feet from the aircraft assembly line. Difficulties in construction were immediately brought to the attention of the engineers, who gathered the mechanics around the drafting tables to discuss ways to overcome the difficulties. As a result, engineers were generally able to fix problems in the design in a matter of hours, not days or weeks. There was no emphasis placed on producing neatly typed memorandums; engineers simply made pencil notations on the engineering drawings in order to keep the project moving quickly.[11]

A little more than a week after he had been authorized to begin the project, Kelly Johnson wrote a 23-page report detailing his most recent ideas on the U-2 proposal. The aircraft, he explained, would be designed to meet load factors of only 2.5 g's, which was the limit for transport aircraft rather than combat planes. The U-2 would have a

[10] The Lockheed "Skunk Works" was named after the Kickapoo Joy Juice factory known as the "Skonk Works" in Al Capp's comic strip *Li'l Abner*.

[11] Ben A. Rich (current head of the "Skunk Works"), interview by Donald E. Welzenbach and Gregory W. Pedlow, Burbank, California, 26 August 1988.



Skunk Works Design Staff

speed of Mach 0.8 or 460 knots at altitude. Its initial maximum altitude would be 70,600 feet and the ultimate maximum altitude would be 73,100 feet. According to these early December 1954 specifications, the new plane would take off at 90 knots, land at 76 knots, and be able to glide 244 nautical miles from an altitude of 70,000 feet. After discussing the reconnaissance bay with James Baker, Johnson had worked out various equipment combinations that would not exceed the weight limit of 450 pounds. Johnson ended his report by promising the first test flight by 2 August 1955 and the completion of four aircraft by 1 December 1955.[12]

[12] Kelly Johnson, "A High-Altitude Reconnaissance Aircraft," 9 December 1954, Lockheed Contract Files, OSA Records (S).

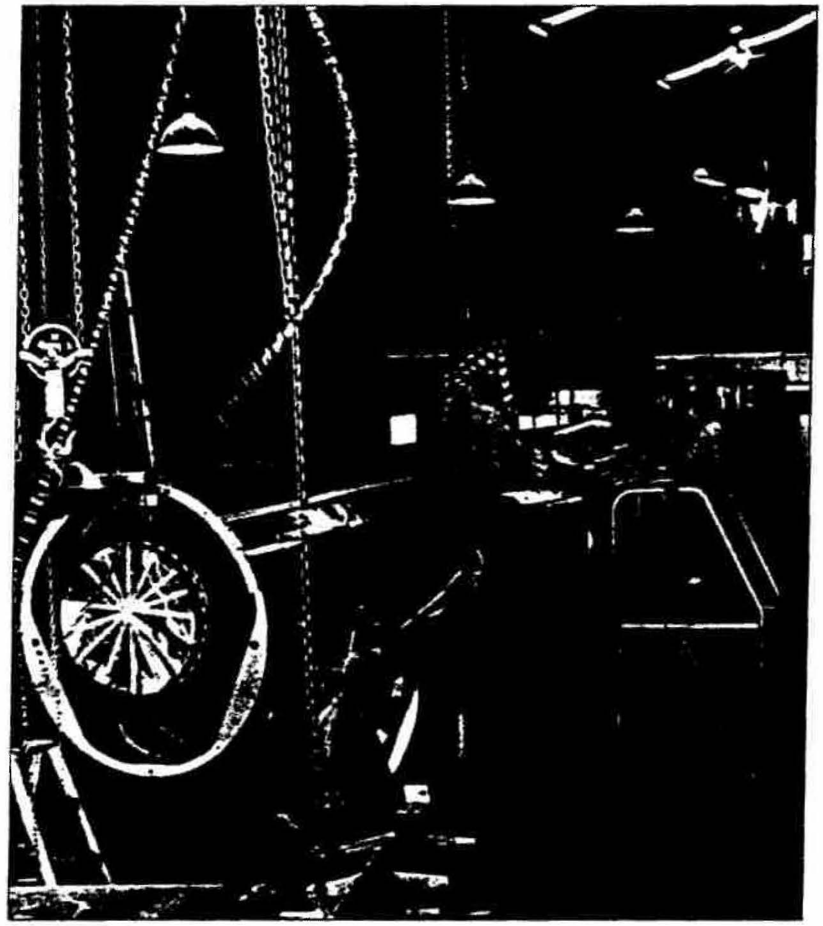
In designing the U-2 aircraft, Kelly Johnson was confronted with two major problems—fuel capacity and weight. To achieve intercontinental range, the aircraft had to carry a large supply of fuel, yet, it also had to be light enough to attain the ultrahigh altitudes needed to be safe from interception. Although the final product resembled a typical jet aircraft, its construction was unlike any other US military aircraft. One unusual design feature was the tail assembly, which—to save weight—was attached to the main body with just three tension bolts. This feature had been adapted from sailplane designs.

The wings were also unique. Unlike conventional aircraft, whose main wing spar passes through the fuselage to give the wings continuity and strength, the U-2 had two separate wing panels, which were attached to the fuselage sides with tension bolts (again, just as in sailplanes). Because the wing spar did not pass through the fuselage, Johnson was able to locate the camera behind the pilot and ahead of the engine, thereby improving the aircraft's center of gravity and reducing its weight.

The wings were the most challenging design feature of the entire airplane. Their combination of high-aspect ratio and low-drag ratio (in other words, the wings were long, narrow, and thin) made them unique in jet aircraft design. The wings were actually integral fuel tanks that carried almost all of the U-2's fuel supply.

The fragility of the wings and tail section, which were only bolted to the fuselage, forced Kelly Johnson to look for a way to protect the aircraft from gusts of wind at altitudes below 35,000 feet, which otherwise might cause the aircraft to disintegrate. Johnson again borrowed from sailplane designs to devise a "gust control" mechanism that set the ailerons and horizontal stabilizers into a position that kept the aircraft in a slightly nose-up attitude, thereby avoiding sudden stresses caused by wind gusts. Nevertheless, the U-2 remained a very fragile aircraft that required great skill and concentration from its pilots.

The final major design feature was the lightweight, bicycle-type landing gear. The entire structure—a single oleostrut with two lightweight wheels toward the front of the aircraft and two small, solid-mount wheels under the tail—weighed only 208 pounds yet could withstand the force of touchdown for this 7-ton aircraft. Because both sets of wheels were located underneath the fuselage, the U-2 was also equipped with detachable pogos (long, curved sticks with two small wheels on them) on each wing to keep the wings level during takeoff. The pilot would drop the pogos immediately after takeoff so



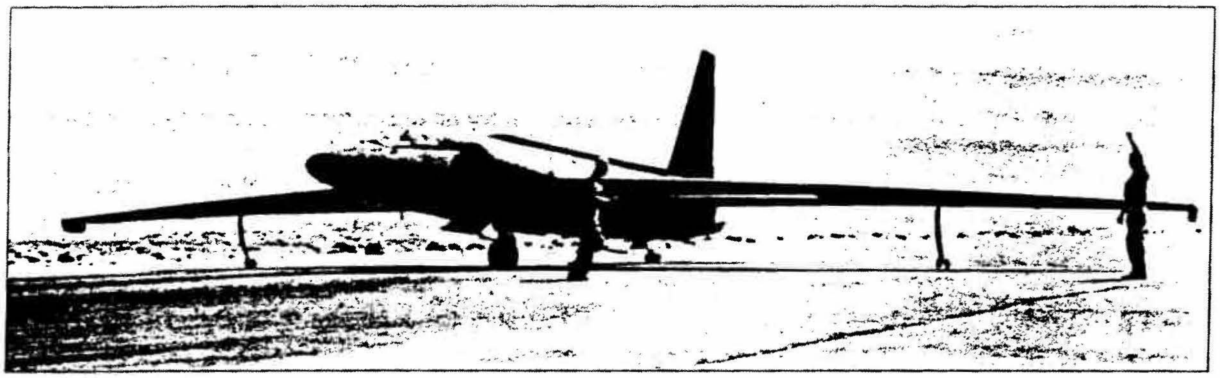
U-2 at testing site before attachment of wings and tail assembly

that they could be recovered and reused. The aircraft landed on its front and back landing gear and then gradually tilted over onto one of the wingtips, which were equipped with landing skids.[13]

THE DEVELOPMENT OF THE CAMERA SYSTEM

By December 1954, Kelly Johnson was at work on drawings for the U-2's airframe and Pratt & Whitney was already building the J57 jet

[13] For the design features of the U-2 in early 1955, see R. F. Boehme, *Summary Report: Reconnaissance Aircraft*, Lockheed Aircraft Corporation Report 10420, 28 January 1955, pp. 7-9, OSA Records, job 74-B-645, box 1 (S).



U-2 landing gear and pogos

engine, but no firm plans existed for the all-important cameras. Existing cameras were too bulky and lacked sufficient resolution to be used in high-altitude reconnaissance.

The workhorses of World War II aerial photography had been the Fairchild K-19 and K-21 framing cameras with lenses of varying focal lengths from 24 to 40 inches. Late in the war, the trimetrogon K-17 mapping-camera system came into use. This system consisted of three separate cameras which made three photographs simultaneously: a vertical, an oblique to the left, and an oblique to the right. The major shortcomings of the trimetrogon system were the large amount of film required and the system's lack of sharp definition on the obliques.

The standard aerial cameras available in the early 1950s could achieve resolutions of about 20 to 25 feet (7 to 8 meters) on a side when used at an altitude of 33,000 feet (10,000 meters), or about 25 lines per millimeter in current terms of reference. Such resolution was considered adequate because aerial photography was then used primarily to choose targets for strategic bombing, to assess bomb damage after air raids, and to make maps and charts. Unfortunately, a camera with a resolution of only 20 to 25 feet at a height of 33,000 feet was too crude to be used at twice that altitude. Indeed, for intelligence purposes a resolution of less than 10 feet was necessary to discern smaller targets in greater detail. This meant that any camera carried to altitudes above 68, 000 feet had to be almost four times as good as existing aerial cameras in order to achieve a resolution of less than 10 feet. As a result, some scientists doubted that useful photography could be obtained from altitudes higher than 40,000 feet.[14]

[14] Baker interview (S).

James G. Baker

The first success in designing very-high-acuity lenses came in the mid-1940s, when James G. Baker of Harvard and Richard S. Perkin of the Perkin-Elmer (P-E) Company of Norwalk, Connecticut, collaborated on a design for an experimental camera for the Army Air Force. They developed a 48-inch focal-length scanning camera that was mounted in a modified B-36 bomber. When tested over Fort Worth, Texas, at 34,000 feet, the new camera produced photographs in which two golf balls on a putting green could be distinguished (in reality, however, the "golf balls" were 3 inches in diameter). These photographs demonstrated the high acuity of Baker's lens, but the camera weighed more than a ton and was much too large to be carried aloft in an aircraft as small as the U-2.

Realizing that size and weight were the major restraining factors in developing a camera for the U-2, James Baker began working on a radically new system in October 1954, even before the CIA adopted the Lockheed proposal. Baker quickly recognized, however, that he would need almost a year to produce a working model of such a complex camera. Since Kelly Johnson had promised to have a U-2 in the air within eight months, Baker needed to find an existing camera that could be used until the new camera was ready. After consulting with his friend and colleague Richard Perkin, Baker decided to adapt for the U-2 an Air Force camera known as the K-38, a 24-inch aerial framing camera built by the Hycon Manufacturing Company of Pasadena, California.

Perkin suggested modifying several standard K-38 cameras in order to reduce their weight to the U-2's 450-pound payload limit. At the same time, Baker would make critical adjustments to existing K-38 lenses to improve their acuity. Baker was able to do this in a few weeks, so several modified K-38s, now known as A-1 cameras, were ready when the first "Angel" aircraft took to the air in mid-1955.[15]

CIA awarded Hycon a contract for the modified K-38 cameras, and Hycon, in turn, subcontracted to Perkin-Elmer to provide new lenses and to make other modifications to the cameras in order to make them less bulky. In its turn, Perkin-Elmer subcontracted to Baker to rework the existing K-38 lenses and later design an improved lens system. To keep his lens-designing efforts separate from

[15] *Ibid.*

A-1 camera

his research associate duties at Harvard and his service on government advisory bodies, Baker established a small firm known as Spica, Incorporated, on 31 January 1955.

The A-1 camera system consisted of two 24-inch K-38 framing cameras. One was mounted vertically and photographed a 17.2° swath beneath the aircraft onto a roll of 9.5-inch film. The second K-38 was placed in a rocking mount so that it alternately photographed the left oblique and right oblique out to 36.5° onto separate rolls of 9.5-inch film. The film supplies unwound in opposite directions in order to minimize their effect on the balance of the aircraft. Both cameras used standard Air Force 24-inch focal-length lenses adjusted for maximum acuity by Baker. The development of the special rocking mount by Perkin-Elmer's Dr. Roderic M. Scott was a major factor in reducing the size and weight of the A-1 system, because the mount provided broad transverse coverage with a single lens, ending the need for two separate cameras.[16]

[16] *OSA History*, chap. 1, annex 3, pp. 1-3 (TS Codeword).

A-2 camera

U-2s equipped with the A-1 camera system also carried a Perkin-Elmer tracking camera using 2.75-inch film and a 3-inch lens. This device made continuous horizon-to-horizon photographs of the terrain passing beneath the aircraft. Because the A-1 system was new, it also included a backup camera system, a K-17 6-inch three-camera trimetrogon unit using 9-inch film.

While the A-1 system was still being developed, James Baker was already working on the next generation of lenses for high-altitude reconnaissance. Baker was a pioneer in using computers to synthesize optical systems. His software algorithms made it possible to model lens designs and determine in advance the effects that variations in lens curvatures, glass compounds, and lens spacings would have on rays of light passing through a lens. These "ray-tracing" programs required extensive computations, and, for this he turned to the most modern computer available, an IBM CPC (card-programmed calculator) installation at nearby Boston University.[17]

[17] Ibid., chap. 1, pp. 7-8 (TS Codeword).

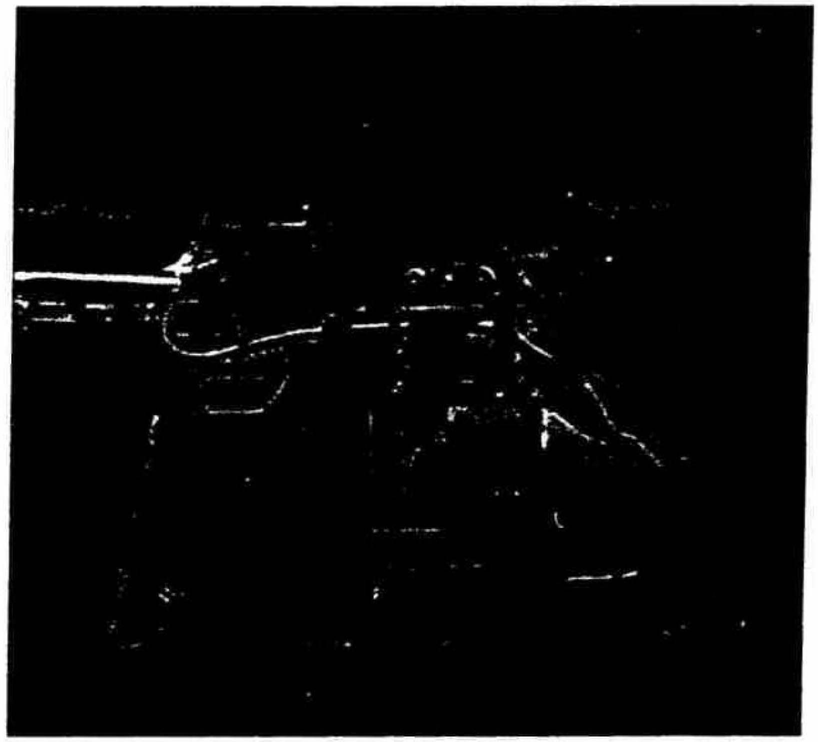
Baker's new lenses were used in a camera system known as the A-2, which returned to a trimetrogon arrangement because of problems with the A-1 system's rocking mount. The A-2 consisted of three separate K-38 framing cameras and 9.5-inch film magazines. One K-38 filmed the right oblique, another the vertical, and a third the left oblique. The A-2 system also included a 3-inch tracking camera. All A-2 cameras were equipped with the new 24-inch f/8.0 Baker-designed lenses. These were the first relatively large photographic objective lenses to employ several aspheric surfaces. James Baker personally ground these surfaces and made the final bench tests on each lens before releasing it to the Agency. These lenses were able to resolve 60 lines per millimeter, a 240-percent improvement over existing lenses.[18]

Once Baker and Scott had redesigned the 24-inch lens for the K-38 devices, they turned their attention to Baker's new camera design, known as the B model. It was a totally new concept, a high-resolution panoramic-type framing camera with a much longer 36-inch f/10.0 aspheric lens. The B camera was a very complex device that used a single lens to obtain photography from one horizon to the other, thereby reducing weight by having two fewer lenses and shutter assemblies than the standard trimetrogon configuration. Because its lens was longer than those used in the A cameras, the B camera achieved even higher resolution—100 lines per millimeter.

The B camera used an 18- by 18-inch format, which was achieved by focusing the image onto two counterrotating but overlapping 9. 5-inch wide strips of film. Baker designed this camera so that one film supply was located forward, the other aft. Thus, as the film supplies unwound, they counterbalanced each other and did not disturb the aircraft's center of gravity.

The B camera had two modes of operation. In mode I, the camera used a single lens to make seven unique exposures from 73.5° on the far right and far left obliques to vertical photos beneath the aircraft, effectively covering from horizon to horizon. Mode II narrowed the lateral coverage to 21.5° on either side of vertical. This increased the available number of exposures and almost doubled the camera's

[18] "Basic Configuration and Camera Data," 24 January 1956, OSA Records (TS Codeword); *OSA History*, chap. 5, annex 44 (TS Codeword).



B camera

operating time. Three of the seven B-camera frames provided stereo coverage. The complex B cameras were engineered by Hycon's chief designer, William McFadden.[19]

James Baker's idea for the ultimate high-altitude camera was the C model that would have a 240-inch focal length. In December 1954, he made preliminary designs for folding the optical path using three mirrors, a prism, and an f/20.0 lens system. Before working out the details of this design, however, Baker flew to California in early January 1955 to consult with Kelly Johnson about the weight and space limitations of the U-2's payload compartment. Despite every effort to reduce the physical dimensions of the C camera, Baker needed an additional six inches of payload space to accommodate the bigger lens. When he broached this subject to Johnson, the latter replied, "Six more inches? I'd sell my grandmother for six more inches!"[20]

[19] Ibid.; Baker interview (S).

[20] Baker interview (S).

Realizing that the 240-inch lens was both too large and too heavy for the camera bay, Baker scaled the lens down to a 200-inch f/16. 0 system. This was still too big. Further reductions followed, resulting by July 1955 in a 120-inch f/10.9 lens that met both the weight and space limitations. Later in the year, Baker decided to make the mirrors for the system out of a new, lightweight foamed silica material developed by Pittsburgh-Corning Glass Company. This reduced the weight significantly, and he was able to scale up the lens to a 180-inch f/13.85 reflective system for a 13- by 13-inch format. In the past, the calculations for such a complex camera lens would have taken years to complete, but thanks to Baker's ray-tracing computer program, he was able to accomplish the task in just 16 days.

When a C camera built by Hycon was flight-tested on 31 January 1957, project engineers discovered that its 180-inch focal length, which was five times longer than that of the B camera, made the camera very sensitive to aircraft vibration and led to great difficulty in aiming the C camera from altitudes above 68,000 feet. The engineers, therefore, decided to shelve the camera. More than five years later, a redesigned C camera was employed during the Cuban Missile Crisis in October 1962, but the results were not very satisfactory.

The failure of the C camera design was not a serious setback to the high-altitude reconnaissance program, because the B camera proved highly successful. Once initial difficulties with the film-transport system were overcome, the B camera became the workhorse of high-altitude photography. An improved version known as the B-2 is still in use. Both of the earlier A-model cameras were phased out after September 1958.

During the period when he was designing lenses for the CIA's overhead reconnaissance program, James Baker was also working on classified lens designs for the Air Force and unclassified designs for the Smithsonian Institution. To protect the security of Baker's work for the Agency, Herbert Miller of the Development Projects Staff told Baker to work on lenses for the U-2 in the open and not make any effort to classify the documents connected with the project. Miller believed that by not calling attention to the effort through the use of special security measures, the project could be completed faster and still not be compromised. This "hiding in the open" strategy proved very successful.[21]

[21] Ibid.

In addition to the camera systems, the U-2 carried one other important item of optical equipment, a periscope. Designed by James Baker and built by Walter Baird of Baird Associates, the optical periscope helped pilots recognize targets beneath the aircraft and also proved to be a valuable navigational aid.[22]

PREPARATIONS FOR TESTING THE U-2

As work progressed in California on the airframe, in Connecticut on the engines, and in Boston on the camera system, the top officials of the Development Projects Staff flew to California and Nevada to search for a site where the aircraft could be tested safely and secretly. On 12 April 1955 Richard Bissell and Col. Osmund Ritland (the senior Air Force officer on the project staff) flew over Nevada with Kelly Johnson in a small Beechcraft plane piloted by Lockheed's chief test pilot, Tony LeVier. They spotted what appeared to be an airstrip by a salt flat known as Groom Lake, near the northeast corner of the Atomic Energy Commission's (AEC) Nevada Proving Ground. After debating about landing on the old airstrip, LeVier set the plane down on the lakebed, and all four walked over to examine the strip. The facility had been used during World War II as an aerial gunnery range for Army Air Corps pilots. From the air the strip appeared to be paved, but on closer inspection it turned out to have originally been fashioned from compacted earth that had turned into ankle-deep dust after more than a decade of disuse. If LeVier had attempted to land on the airstrip, the plane would probably have nosed over when the wheels sank into the loose soil, killing or injuring all of the key figures in the U-2 project.[23]

Bissell and his colleagues all agreed that Groom Lake would make an ideal site for testing the U-2 and training its pilots. Upon returning to Washington, Bissell discovered that Groom Lake was not part of the AEC proving ground. After consulting with Dulles, Bissell and Miller asked the Atomic Energy Commission to add the Groom Lake area to its real estate holdings in Nevada. AEC Chairman Adm. Lewis Strauss readily agreed, and President Eisenhower also approved the addition of this strip of wasteland, known by its map designation as Area 51, to the Nevada Test Site. The outlines of Area 51

[22] Information supplied by James Baker to Donald E. Welzenbach, 12 May 1986 (U).

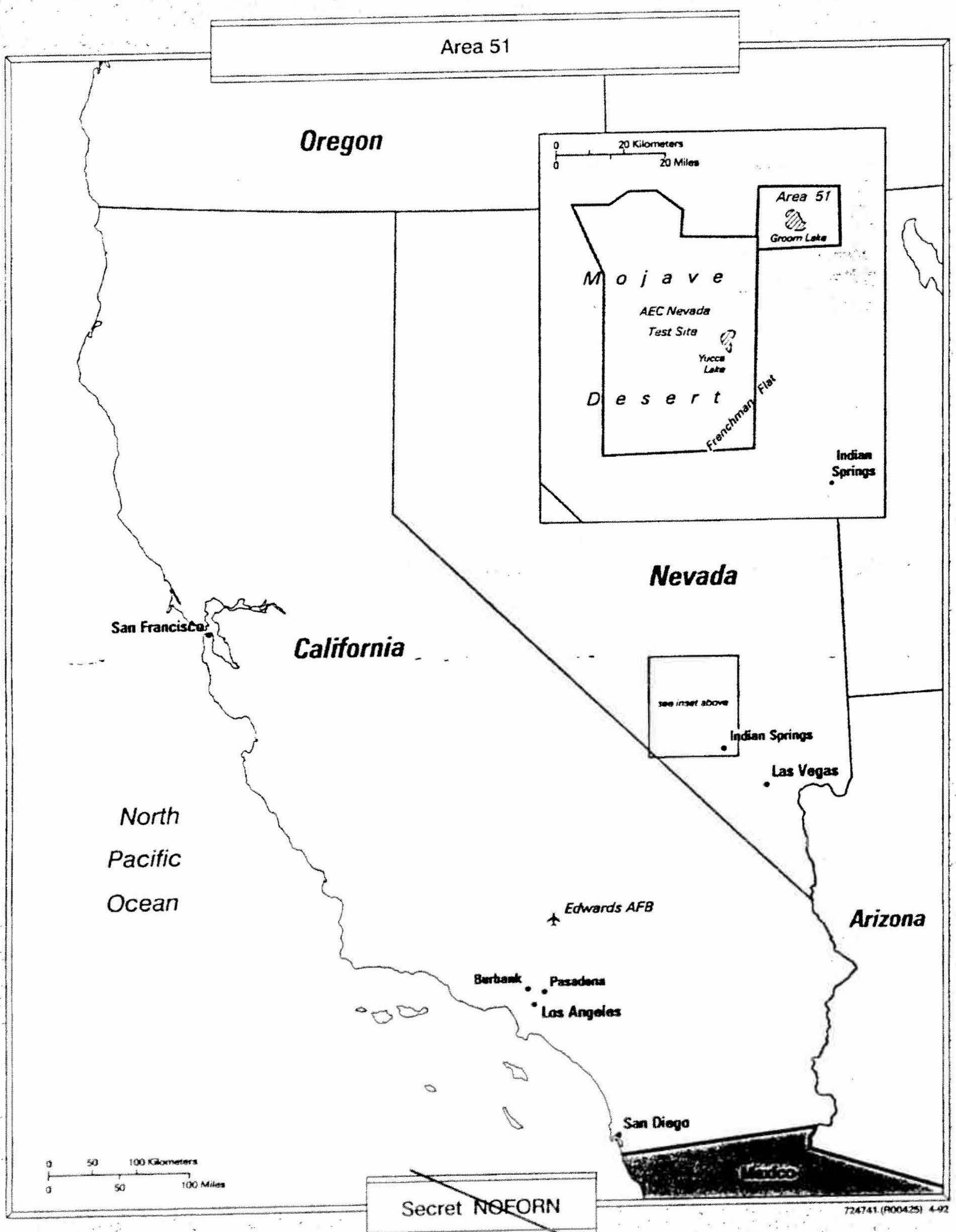
[23] *OSA History*, chap. 8, pp. 1-2 (TS Codeword); Miller, *Lockheed U-2*, pp. 19-20.

Area 51, the Ranch

are shown on current unclassified maps as a small rectangular area adjoining the northeast corner of the much larger Nevada Test Site. To make the new facility in the middle of nowhere sound more attractive to his workers, Kelly Johnson called it the Paradise Ranch, which was soon shortened to the Ranch.[24]

Although the dry lakebed could have served as a landing strip, project managers decided that a paved runway was needed so that testing could also take place during the times when rainwater runoff from nearby mountains filled the lake (at such times the base acquired yet another unofficial name, Watertown Strip). By July 1955 the base was ready, and Agency, Air Force, and Lockheed personnel began moving in.

[24] *OSA History*, chap. 8, pp. 2-6 (TS Codeword); Johnson, "Log for Project X," 25-29 April 1955; Clarence L. "Kelly" Johnson with Maggie Smith, *Kelly: More Than My Share of It All* (Washington, DC: Smithsonian Institute Press, 1985), p. 123.


Area 51
Oregon
20 Kilometers
20 Miles
Area 51
Groom Lake
Mojave
AEC Nevada
Test Site
Yucca
Lake
Desert
Frenchman Flat
Indian
Springs
Nevada
San Francisco
California
see inset above
Indian Springs
Las Vegas
North
Pacific
Ocean
Edwards AFB
Arizona
Burbank
Pasadena
Los Angeles
San Diego
Mexico
0 50 100 Kilometers
0 50 100 Miles
Secret NOFORN
724741 (R00425) 4-92

SECURITY FOR THE U-2 PROJECT

On 29 April 1955, Richard Bissell signed an agreement with the Air Force and the Navy (which at that time was also interested in the U-2) in which the services agreed that the CIA "assumed primary responsibility for all security" for the overhead reconnaissance project (AQUATONE). From this time on, the CIA has been responsible for the security of overhead programs. This responsibility has placed a heavy burden on the Office of Security for establishing procedures to keep large numbers of contracts untraceable to the Central Intelligence Agency. The Office of Security has also had to determine which contractor employees require security clearances and has had to devise physical security measures for the various manufacturing facilities. Keeping the U-2 and subsequent overhead systems secret has been a time-consuming and costly undertaking.[25]

The most important aspect of the security program for the U-2 project was the creation of an entire new compartmented system for the product of U-2 missions. Access to the photographs taken by the U-2 would be strictly controlled, which often limited the ability of CIA analysts to use the products of U-2 missions.

The terminology used to describe U-2 aircraft and pilots also played a part in maintaining the security of the overhead reconnaissance program. To reduce the chances of a security breach, the Agency always referred to its high-altitude aircraft as "articles," with each aircraft having its own "article number." Similarly, the pilots were always called "drivers." In cable traffic the aircraft were known as KWEXTRA-00 (the two-digit number identified the precise aircraft; these numbers were not related to the three-digit article numbers assigned by the factory). The pilots were referred to as KWGLITTER-00 (the two-digit number identified the precise pilot). Thus, even if a message or document about overflight activities fell into unfriendly hands, the contents would simply refer to codewords or at worst to "articles" and "drivers," giving no indication of the nature of the program.[26]

Even the aircraft's onboard equipment required the involvement of CIA security planners. Thus, when Kelly Johnson ordered altimeters from the Kollman Instrument Company, he specified that the

[25] *OSA History*, chap. 7, pp. 4-6 (TS Codeword).

[26] Information supplied by James Cunningham to Donald E. Welzenbach (S).

devices had to be calibrated to 80,000 feet. This immediately raised eyebrows at Kollman because its instruments only went to 45,000 feet. Agency security personnel quickly briefed several Kollman officials and produced a cover story that the altimeters were to be used on experimental rocket planes.[27]

THE CIA - AIR FORCE PARTNERSHIP

At the initial interagency meetings to establish the U-2 program in December 1954, the participants did not work out a clear delineation of responsibilities between the CIA and the Air Force. They agreed only that the Air Force would supply the engines and the Agency would pay for the airframes and cameras. With a myriad of details still unsettled, CIA and Air Force representatives began to work on an interagency agreement that would assign specific responsibilities for the program. These negotiations proved difficult. Discussions on this subject between DCI Allen Dulles and Air Force Chief of Staff Nathan Twining began in March 1955. Twining wanted SAC, headed by Gen. Curtis E. LeMay, to run the project once the planes and pilots were ready to fly, but Dulles opposed such an arrangement. The CIA-USAF talks dragged on for several months, with Twining determined that SAC should have full control once the aircraft was deployed. Eventually President Eisenhower settled the dispute. "I want this whole thing to be a civilian operation," the President wrote. "If uniformed personnel of the armed services of the United States fly over Russia, it is an act of war—legally—and I don't want any part of it." [28]

With the issue of control over the program settled, the two agencies soon worked out the remaining details. On 3 August 1955, Dulles and Twining met at SAC headquarters in Omaha to sign the basic agreement, titled "Organization and Delineation of Responsibilities—Project OILSTONE" (OILSTONE was the Air Force codename for the project). This pact gave the Air Force responsibility for pilot selection and training, weather information, mission plotting, and operational support. The Agency was responsible for cameras, security, contracting, film processing, and arrangements for foreign bases, and it also had a voice in the selection of pilots. All aeronautical aspects of the

[27] Ibid.

[28] *OSA History*, chap. 3, pp. 8-15 (TS Codeword); Beschloss, *Mayday*, pp. 105-107.

project—the construction and testing of the aircraft—remained the exclusive province of Lockheed.[29]

As a result of this agreement, CIA remained in control of the program, but the Air Force played a very important role as well. As Richard Bissell later remarked about the U-2 project, "The Air Force wasn't just in on this as a supporting element, and to a major degree it wasn't in on it just supplying about half the government personnel; but the Air Force held, if you want to be precise, 49 percent of the common stock." [30]

Osmund J. Ritland

One of the first Air Force officers assigned to Project OILSTONE was Col. Osmund J. Ritland. He began coordinating Air Force activities in the U-2 program with Richard Bissell in December 1954. On 27 June 1955, Ritland became Bissell's deputy, although Air Force Chief of Staff Twining did not officially approve this assignment until 4 August, the day after the signing of the CIA–Air Force agreement. In March 1956, Colonel Ritland returned to the Air Force and was followed as deputy project director by Col. Jack A. Gibbs.

Another Air Force officer, Lt. Col. Leo P. Geary, joined the program in June 1955 and remained with it until August 1966, longer than any of the other project managers. Using the Air Force Inspector General's office as cover with the title of Project Officer, AFCIG-5, Geary served as the focal point for all Defense Department support to the U-2 and OXCART programs. His 11 years with the overhead reconnaissance projects provided a high degree of Air Force continuity.[31]

TECHNICAL CHALLENGES TO HIGH-ALTITUDE FLIGHT

To get the U-2 aircraft ready to fly, Lockheed engineers had to solve problems never before encountered. Among these problems was the need for a fuel that would not boil off and evaporate at the very high altitudes for which the aircraft was designed. Gen. James H. Doolittle

[29] *OSA History*, chap. 3, p. 15 and annex 14 (TS Codeword).

[30] Speech given by Richard Bissell at CIA Headquarters, 12 October 1965 (TS Codeword).

[31] Brig. Gen. Leo A. Geary (USAF-Ret.), interview by Donald E. Welzenbach, tape recording, 3 April 1986 (S); *OSA History*, chap. 3, p. 3 (TS Codeword).

Leo P. Geary

(USAF, Ret.), a vice president of the Shell Oil Company who had long been involved in overhead reconnaissance (most recently as a member of the Technological Capabilities Panel), arranged for Shell to develop a special low-volatility, low-vapor-pressure kerosene fuel for the craft. The result was a dense mixture, known as LF-1A, JP-TS (thermally stable), or JP-7, with a boiling point of 300°F at sea level. Manufacturing this special fuel required petroleum byproducts that Shell normally used to make its "Flit" fly and bug spray. In order to produce several hundred thousand gallons of LF-1A for the U-2 project in the spring and summer of 1955, Shell had to limit the production of Flit, causing a nationwide shortage. Because of the new fuel's density, it required special tanks and modifications to the aircraft's fuel-control and ignition systems.[32]

Even more important than the problem of boiling fuel was the problem of boiling blood, namely the pilot's. At altitudes above 65,000 feet, fluids in the human body will vaporize unless the body can be kept under pressure. Furthermore, the reduced atmospheric pressure placed considerable stress on the pilot's cardiovascular system and did not provide adequate oxygenation of the blood. Keeping the pilot alive at the extreme altitudes required for overflights therefore called for a totally different approach to environmental equipment; it required a system that could maintain pressure over much of the pilot's body. The technology that enabled U-2 pilots to operate for extended periods in reduced atmospheric pressure would later play a major role in the manned space program.

Advising the Agency on high-altitude survival were two highly experienced Air Force doctors, Col. Donald D. Flickinger and Col. W. Randolph Lovelace, II. Dr. Lovelace had begun his research on high-altitude flight before World War II and was a coinventor of the standard Air Force oxygen mask. In the early 1950s, he and Flickinger made daring parachute jumps from B-47 bombers to test pilot-survival gear under extreme conditions. Flickinger served as the medical adviser to Project AQUATONE for almost a decade.[33]

Flickinger and Lovelace suggested that the Agency ask the David Clark Company of Worcester, Massachusetts, manufacturer of environmental suits for Air Force pilots, to submit designs for more

[32] Land interview (TS Codeword); Bissell interview (S); James A. Cunningham, Jr., interview by Donald E. Welzenbach, Washington, DC, tape recording, 4 October 1983 (TS Codeword).

[33] OSA History, chap. 10, pp. 29-34 (TS Codeword).

MC-2 partial-pressure suit (seen on pilot Francis Gary Powers)

advanced gear for the U-2 pilots. David Clark expert Joseph Ruseckas then developed a complex life-support system, which was the first partially pressurized "spacesuit" for keeping humans alive for lengthy periods at ultrahigh altitudes. The effort to provide a safe environment for pilots at high altitudes also involved the Firewel Company of Buffalo, New York, which pressurized the U-2 cockpit to create an interior environment equivalent to the air pressure at an altitude of 28,000 feet. The system was designed so that, if the interior cockpit pressure fell below the 28,000-feet level, the pilot's suit would automatically inflate. In either case, he could obtain oxygen only through his helmet.[44]

[44] Ibid., chap. 5, p. 19 (TS Codeword).

The early models of these MC-2 and MC-3 partial-pressure suits were very uncomfortable for the pilots. To prevent loss of pressure, the heavy coverall had to fit tightly at the wrists and ankles (in the early models of these suits, the feet were not included in the pressurization scheme). The pilot had to wear gloves and a heavy helmet that tended to chafe his neck and shoulders and was prone to fogging. Problems with the pilot life-support system were believed to have been the cause of several early crashes of the U-2.

Having gotten a pilot into this bulky suit and shoehorned him into his seat in the cockpit, the next problem was how to get him out in an emergency. The U-2 cockpit was very small, and the early models did not have an ejection seat. Even after an ejection seat was installed, pilots were reluctant to use it because they were afraid they would lose their legs below the knees when they were blown out of the cockpit. To save weight, the first pilot's seat was extremely simple with no height adjustment mechanism. Designed for pilots of above-average height, the seat could be adjusted for shorter pilots by inserting wooden blocks beneath the seat to raise it. In later versions of the aircraft, Kelly Johnson added a fully adjustable seat.[35]

The Air Force undertook bailout experiments at high altitudes from balloons in the autumn of 1955 to determine if the suit designed for the U-2 pilot would also protect him during his parachute descent once he was separated from the life-support mechanisms inside the aircraft. To avoid getting the "bends" during such descents or during the long flights, pilots had to don their pressure suits and begin breathing oxygen at least 90 minutes before takeoff so that their bodies would have time to dissipate nitrogen. This procedure was known as prebreathing. Once the pilots were in their suits, eating and drinking became a major problem, as did urination. The first model of the pressure suit, used by Lockheed test pilots, made no provision for urination. A subsequent model required the pilot to be catheterized before donning his flying suit. This method of permitting urination during flight proved very uncomfortable and, by the autumn of 1955, was replaced with an external bladder arrangement that made the catheter unnecessary. To reduce elimination, pilots ate a low-bulk, high-protein diet on the day before and the morning of each mission.

[35] Lecture by Maj. Gen. Patrick J. Halloran (former Air Force U-2 pilot) at the National Air & Space Museum, 24 April 1986 (U).

Pilot undergoing prebreathing

To prevent pilots from becoming dessicated during the long missions—a condition aggravated by their having to breathe pure oxygen—provision was made for them to drink sweetened water. This was accomplished by providing a small self-sealing hole in the face mask through which the pilot could push a strawlike tube attached to the water supply. Project personnel also pioneered in the development of ready-to-eat foods in squeezable containers. These were primarily bacon- or cheese-flavored mixtures that the pilot could squeeze into his mouth using the self-sealing hole in the face mask. Despite all these precautions, U-2 pilots normally lost 3 to 6 pounds of body weight during an eight-hour mission.[36]

Food and water were not the only items provided to pilots on overflight missions; they also received a suicide pill. During the early 1950s, tales of Soviet secret police torture of captured foreign agents

[36] Information supplied by James Cunningham and former U-2 pilots Carmine Vito, Hervey Stockman, Jacob Kratt, and Glendon Dunaway to Donald E. Welzenbach, May 1986.

led Bissell and Cunningham to approach Dr. Alex Batlin of Technical Services Division in the Directorate of Plans[37] for ideas to help "captured" U-2 pilots avoid such suffering. Batlin suggested the method used by Nazi war criminal Hermann Goering, a thin glass ampule containing liquid potassium cyanide. He said a pilot had only to put the ampule in his mouth and bite down on the glass; death would follow in 10 to 15 seconds. Project AQUATONE ordered six of the poison ampules, called L-pills, and offered one to each pilot just before a mission. It was up to each pilot to decide if he wanted to take an L-pill with him. Some did; most did not.[38]

DELIVERY OF THE FIRST U-2

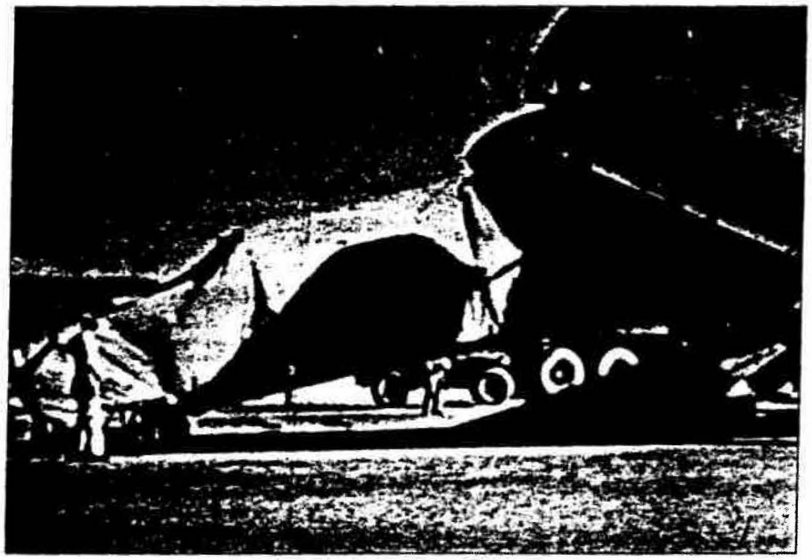
On 25 July, less than eight months after the go-ahead call from Trevor Gardner, Kelly Johnson was ready to deliver the first aircraft, known as article 341, to the "Paradise Ranch" site. With its long, slender wings and tail assembly removed, the aircraft was wrapped in tarpaulins, loaded aboard a C-124, and flown to Groom Lake, where Lockheed mechanics spent the next six days readying the craft for its maiden flight.

Before "Kelly's Angel" could actually take to the air, however, it needed an Air Force designator. Col. Allman T. Culbertson from the Air Force's Office of the Director of Research and Development pointed this out to Lieutenant Colonel Geary in July 1955, and the two officers then looked through the aircraft designator handbook to see what the options were. They decided that they could not call the project aircraft a bomber, fighter, or transport plane, and they did not want anyone to know that the new plane was for reconnaissance, so Geary and Culbertson decided that it should come under the utility aircraft category. At the time, there were only two utility aircraft on the books, a U-1 and a U-3. Geary told Culbertson that the Lockheed CL-282 was going to be known officially as the U-2.[39]

[37] At the time this Directorate was known as the Deputy Directorate/Plans, with the slash interpreted to mean either "for" or "of." Terminology for the major subdivisions of the CIA and their directors has varied over the past four decades. For the sake of consistency, all titles of Directorates and Deputy Directors have been placed in the current Agency format: the organization is known as the "Directorate of X" and the head is known as the "Deputy Director for X."

[38] Information supplied by James Cunningham to Donald E. Welzenbach; Sayre Stevens, Memorandum for the Record, "Discussion with Dr. Alex Batlin Re Project MKNAOMI," July 1975 (S).

[39] Geary interview (S).



Arrival of U-2 prototype at Area 51 (left); Article 341, the U-2 prototype (below)

Johnson had designed the U-2 to use the Pratt & Whitney (P&W) J57/P-31 engine, which developed 13,000 pounds of thrust and weighed 3,820 pounds, giving it a power-to-weight ratio of 3.4:1. When the U-2 first took to the air, however, these engines were not available because the entire production was needed to power specially configured Canberra RB-57Ds for the Air Force. The first U-2s therefore used P&W J57/P-37 engines, which were 276 pounds heavier and delivered only 10,200 pounds of thrust at sea level; the resulting power-to-weight ratio of 2.7:1 was almost 20 percent less efficient than the preferred P-31 version.[40]

To conduct lengthy missions over hostile territory, the U-2 needed to carry a large amount of fuel. Kelly Johnson used a "wet-wing" design for the U-2, which meant that fuel was not stored in separate fuel tanks but rather in the wing itself. Each wing was divided into two leak-proof compartments, and fuel was pumped into all the cavities within these areas; only the outer 6 feet of the wings were not used for fuel storage. The U-2 also had a 100-gallon reserve tank in its nose. Later, in 1957, Johnson increased the fuel capacity of the U-2 by adding 100-gallon "slipper" tanks under each wing, projecting slightly ahead of the leading edge.

One of the most important considerations in the U-2's fuel system was the need to maintain aircraft trim as the fuel was consumed. The aircraft therefore contained a complex system of feed lines and valves draining to a central sump, which made it impossible to provide the pilot with an empty/full type of fuel gauge. None of the first 50 U-2s had normal fuel gauges. Instead there were mechanical fuel totalizer/counters. Before the start of a mission, the ground crew set the counters to indicate the total amount of fuel in the wings, and then a flow meter subtracted the gallons of fuel actually consumed during the flight. The pilot kept a log of the fuel consumption shown by the counters and compared it with estimates made by mission planners for each leg of the flight. As a double check, U-2 pilots also kept track of their fuel consumption by monitoring airspeed and time in the air. Most pilots became quite expert at this. Several who did not came up short of their home base during the 20 years these planes were flown.[41]

INITIAL TESTING OF THE U-2

Preliminary taxi trials began on 27 July 1955, when the first run down the newly completed runway took the plane to 50 knots. Lockheed's chief test pilot, Tony LeVier, was at the controls. A second taxi trial

[40] *OSA History*, chap. 8, p. 13 (TS Codeword).

[41] Information supplied by Norman Nelson, former director of Lockheed's Skunk Works, to Donald E. Welzenbach, 14 March 1986 (U); Miller, *Lockheed U-2*, pp. 77, 96.

followed on 1 August. LeVier accelerated to 70 knots and began to try the ailerons. "It was at this point that I became aware of being airborne," LeVier noted afterward, "which left me with utter amazement, as I had no intentions whatsoever of flying. I immediately started back toward the ground, but had difficulty determining my height because the lakebed had no markings to judge distance or height. I made contact with the ground in a left bank of approximately 10 degrees." The U-2 bounced back into the air, but LeVier was able to bring it back down for a second landing. He then applied the brakes with little effect, and the aircraft rolled for a long distance before coming to a stop.[42]

Bissell, Cunningham, and Johnson saw the aircraft fall and bounce. Leaping into a jeep, they roared off toward the plane. They signaled to LeVier to climb out and then used fire extinguishers to put out a fire in the brakes. At a debriefing session that followed, LeVier complained about the poor performance of the brakes and the absence of markings on the runway. Damage to the prototype U-2 was very minor: blown tires, a leaking oleostrut on the undercarriage, and damaged brakes. This unplanned flight was but a foretaste of the airworthiness of the U-2. New pilots all had difficulty in getting the U-2's wheels on the ground because at low speeds it would remain in ground effect and glide effortlessly above the runway for great distances.

Taxi trials continued for one more day and were followed by the first planned flight on 4 August 1955. LeVier was again at the controls and had been instructed by Kelly Johnson to land the U-2 by making initial contact with the main or forward landing gear and letting the plane settle back on the rear wheel. LeVier had disagreed with this approach, believing that the U-2 would bounce if he tried to touch down on the forward gear first. After flying the aircraft up to 8,000 feet, LeVier leveled off and began cycling the landing gear up and down; then he tested the flaps and the plane's stability and control systems. Finally, LeVier made his first landing approach. As the U-2 settled down, the forward landing gear touched the runway and the plane skipped and bounced into the air. LeVier made a second attempt to land front wheels first, and again the plane bounded into the air.

[42] Transcripts of the test pilots' and observers' comments on the initial U-2 test flights have been published in "Secret First Flight of Article 001," *Spyplanes* vol. 2, 1988, pp 64-71, 82-85.

First flight of the U-2, 4 August 1955

With Kelly Johnson watching from a chase plane and giving a constant stream of instructions, LeVier made three more unsuccessful landing attempts. With the light fading and a thunderstorm fast approaching from the mountains to the west, LeVier made one last approach using the method he had advocated: letting the aircraft touch on its rear wheel first. This time the U-2 made a near-perfect landing, which came just in the nick of time. Ten minutes later, the thunderstorm began dumping an unheard-of 2 inches of rain, flooding the dry lakebed and making the airstrip unusable.[43]

Now that the first problems in flying and landing the U-2 had been worked out, Kelly Johnson scheduled the "official" first flight for 8 August 1955. This time outsiders were present, including Richard Bissell, Col. Osmond Ritland, Richard Horner, and Garrison Norton. The U-2 flew to 32,000 feet and performed very well. Kelly Johnson had met his eight-month deadline.[44]

[43] Ibid., pp. 21-22; Johnson, "Log for Project X," 4 August 1955.

[44] Johnson, "Log for Project X," 8 August 1955.

LeVier made an additional 19 flights in article 341 before moving on to other Lockheed flight test programs in early September. This first phase of U-2 testing explored the craft's stall envelope, took the aircraft to its maximum stress limit (2.5 g's), and explored its speed potential. LeVier soon flew the aircraft at its maximum speed of Mach 0.85. Flight tests continued, with the U-2 ascending to altitudes never before attained in sustained flight. On 16 August LeVier took the aircraft up to 52,000 feet. In preparation for this flight, the 42-year-old test pilot completed the Air Force partial-pressure suit training program, becoming the oldest pilot to do so. Testing at even higher altitudes continued, and on 8 September the U-2 reached its initial design altitude of 65,600 feet.[45]

On 22 September 1955, the U-2 experienced its first flameout at 64,000 feet—more than 12 miles up. After a brief restart, the J57/P-37 engine again flamed out at 60,000 feet, and the aircraft descended to 35,000 feet before the engine could be relit. Engineers from Pratt & Whitney immediately set to work on this problem. The P-37 model engine had significantly poorer combustion characteristics than the preferred but unavailable P-31 version and therefore tended to flame out at high altitudes. Combustion problems usually became apparent as the U-2 began the final part of its climb from 57,000 to 65,000 feet, causing pilots to refer to this area as the "badlands" or the "chimney." Flameouts bedeviled the U-2 project until sufficient numbers of the more powerful P-31 engines became available in the spring of 1956.[46]

Meanwhile, with the airworthiness of the U-2 airframe proven, Lockheed set up a production line in the Skunk Works, but delivery of even the second-choice J57/P-37 engines became a major problem. Pratt & Whitney's full production capacity for these engines for the next year was contracted to the Air Force for use in F-100 fighters and KC-135 tankers. Colonel Geary, with the help of a colleague in the Air Force Materiel Command, managed to arrange the diversion of a number of these engines from a shipment destined for Boeing's KC-135 production line, making it possible to continue building the U-2s.[47]

[45] *OSA Chronology*, p. 7 (TS Codeword); Miller, *Lockheed U-2*, p. 22.

[46] *OSA History*, chap. 8, pp. 12-14 (TS Codeword).

[47] Geary interview (S).

As the deliveries of U-2 airframes to the testing site increased, a major logistic problem arose: how to transfer Lockheed employees from Burbank to Area 51 without arousing a great deal of curiosity. The project staff decided that the simplest approach would be to fly the essential personnel to the site on Monday morning and return them to Burbank on Friday evening. Frequent flights were also necessary to bring in supplies and visitors from contractors and headquarters. Therefore, a regularly scheduled Military Air Transport Service (MATS) flight using a USAF C-54 aircraft began on 3 October 1955. James Cunningham promptly dubbed this activity "Bissell's Narrow-Gauge Airline." Less than seven weeks after it started, a MATS aircraft bound for Area 51 crashed on 17 November, killing all 14 persons aboard the plane, including the Project Security Officer, CIA's William H. Marr, four members of his staff, and personnel from Lockheed and Hycon. This crash represented the greatest single loss of life in the entire U-2 program.[48]

U-2s, UFOs, AND OPERATION BLUE BOOK

High-altitude testing of the U-2 soon led to an unexpected side effect—a tremendous increase in reports of unidentified flying objects (UFOs). In the mid-1950s, most commercial airliners flew at altitudes between 10,000 and 20,000 feet and military aircraft like the B-47s and B-57s operated at altitudes below 40,000 feet. Consequently, once U-2s started flying at altitudes above 60,000 feet, air-traffic controllers began receiving increasing numbers of UFO reports.

Such reports were most prevalent in the early evening hours from pilots of airliners flying from east to west. When the sun dropped below the horizon of an airliner flying at 20,000 feet, the plane was in darkness. But, if a U-2 was airborne in the vicinity of the airliner at the same time, its horizon from an altitude of 60,000 feet was considerably more distant, and, being so high in the sky, its silver wings would catch and reflect the rays of the sun and appear to the airliner pilot, 40,000 feet below, to be fiery objects. Even during daylight hours, the silver bodies of the high-flying U-2s could catch the sun and cause reflections or glints that could be seen at lower altitudes and even on the ground. At this time, no one believed manned flight was possible above 60,000 feet, so no one expected to see an object so high in the sky.

[48] *OSA History*, chap. 7, pp. 17-19 (TS Codeword).

Not only did the airline pilots report their sightings to air-traffic controllers, but they and ground-based observers also wrote letters to the Air Force unit at Wright Air Development Command in Dayton charged with investigating such phenomena. This, in turn, led to the Air Force's Operation BLUE BOOK. Based at Wright-Patterson, the operation collected all reports of UFO sightings. Air Force investigators then attempted to explain such sightings by linking them to natural phenomena. BLUE BOOK investigators regularly called on the Agency's Project Staff in Washington to check reported UFO sightings against U-2 flight logs. This enabled the investigators to eliminate the majority of the UFO reports, although they could not reveal to the letter writers the true cause of the UFO sightings. U-2 and later OXCART flights accounted for more than one-half of all UFO reports during the late 1950s and most of the 1960s.[49]

HIRING U-2 PILOTS

In authorizing the U-2 project, President Eisenhower told DCI Dulles that he wanted the pilots of these planes to be non-US citizens. It was his belief that, should a U-2 come down in hostile territory, it would be much easier for the United States to deny any responsibility for the activity if the pilot was not an American.

The initial effort to find U-2 pilots was assigned to the Directorate of Plans Air/Maritime Division (AMD). The DDP had excellent contacts [redacted] AMD operatives [redacted] asked that discreet inquiries be made to see if any [redacted] fliers were interested in a high-paying covert project. [redacted] brought to the United States for training. Meanwhile, AMD hired an [redacted] flier residing in England, and he also came to the United States for training.

In theory the use of foreign pilots seemed quite logical; in practice it did not work out. The [redacted] and could only fly light aircraft. Language was also a barrier for the [redacted] although several were good fliers. Because Lieutenant Colonel Geary had taken a class of [redacted] through flying school at Randolph AFB in 1950, he got the job of training the [redacted]

[49] Information supplied by James Cunningham to Donald E. Welzenbach (U).

recruits in mid-1955. Geary arranged for an Air Force officer of [redacted] to stay with the group during a preliminary training program at Luke Air Force Base. The plan to use foreign pilots soon ran into trouble when only [redacted] pilots passed the school and reported to Area 51. They made only a few flights in the U-2, and by the autumn of 1955 they were out of the program.[50]

Even before the elimination of the [redacted] it was clear that there would not be enough trained foreign pilots available in time for deployment. Bissell therefore had to start the search for U-2 pilots all over again. Lt. Gen. Emmett (Rosy) O'Donnell, the Air Force's Deputy Chief of Staff for Personnel, authorized the use of Air Force pilots and provided considerable assistance in the search for pilots who met the high standards established by the Agency and the Air Force. The search included only SAC fighter pilots who held reserve commissions. The use of regular Air Force pilots was not considered because of the complexities involved in having them resign from the Air Force, a procedure that was necessary in order to hire them as civilians for the AQUATONE project.

SAC pilots interested in the U-2 project had to be willing to resign from the Air Force and assume civilian status—a process known as sheep-dipping—in order to conduct the overflights. Although Air Force pilots were attracted by the challenge of flying U-2s over hostile territory, they were reluctant to leave the service and give up their seniority. To overcome pilots' reluctance, the Agency offered handsome salaries, and the Air Force promised each pilot that, upon satisfactory conclusion of his employment with the Agency, he could return to his unit. In the meantime, he would be considered for promotion along with his contemporaries who had continued their Air Force careers.[51]

The selection process for Agency U-2 pilots was very rigorous. Because of the strain involved in flying at extreme altitudes for long periods of time, painstaking efforts were made to exclude all pilots who might be nervous or unstable in any way. The physical and psychological screening of potential U-2 pilots was conducted by the Lovelace Foundation for Medical Education and Research in Albuquerque, New Mexico, under a contract signed with the CIA on

[50] *OSA History*, chap. 10, pp. 1-10 (TS Codeword); Geary interview (S).

[51] *OSA History*, chap. 10, pp. 5-6 (TS Codeword); Geary interview (S); Francis Gary Powers with Curt Gentry, *Operation Overflight* (New York: Holt, Rinehart, and Wilson, 1970), pp. 25-27.

28 November 1955. The CIA's insistence on more stringent physical and mental examinations than those used by the Air Force to select pilots for its U-2 fleet resulted in a higher rejection rate of candidates. The Agency's selection criteria remained high throughout its manned overflight program and resulted in a much lower accident rate for CIA U-2 pilots than for their counterparts in the Air Force program.[52]

PILOT TRAINING

Even before the recruiting effort got under way, the Air Force and CIA began to develop a pilot training program. Under the terms of the OILSTONE agreement between the Agency and the Air Force, responsibility for pilot training lay with SAC. This essential activity was carried out under the supervision of Col. William F. Yancey, who was assigned to March AFB and flew to nearby Area 51 each day. Colonel Yancey was in charge of six SAC pilots who were to be trained by Lockheed test pilots to fly the U-2. Once they became qualified, these SAC pilots would become the trainers for the "sheep-dipped" former Reserve SAC pilots, who would fly U-2 missions for the CIA.

The original U-2 test pilot, Tony LeVier, trained several other Lockheed test pilots in the difficult art of flying the U-2. Eventually there were enough trained Lockheed pilots available to test the aircraft coming off the assembly line and also train the SAC pilots. Training was difficult because there was no two-seat model of the U-2. All instruction had to be given on the ground before takeoff and then over the radio once the craft was airborne. Almost 15 years elapsed before a two-seat U-2 was available for training new pilots. Despite the difficulties involved in training U-2 pilots, Colonel Yancey had a cadre of six qualified Air Force U-2 pilots by September 1955. These six were now ready to train the Agency's pilots.[53]

Training pilots was not easy because the U-2 was a mixture of glider and jet. Although those chosen for the overflight program were all qualified fighter pilots, they now had to learn to fly the delicate U-2. Its large wings had tremendous lift but were also very fragile

[52] *OSA History*, chap. 10, pp. 5-6, chap. 5, p. 18 (TS Codeword).

[53] *OSA History*, chap. 11, pp. 1-7 (TS Codeword).

and could not survive the stresses of loops and barrel rolls. Moreover, the original U-2s were placarded, which meant that they could not be flown at sea level faster than 190 knots in smooth air or 150 knots in rough air. At operational altitude, where the air was much less dense, they could not exceed Mach 0.8 (394 knots). Speeds in excess of these limits could cause the wings or tail section to fall off.

Airspeed was a very critical factor for the U-2. At maximum altitude only 6 knots separated the speeds at which low-speed stall and high-speed buffet occurred. Pilots called this narrow range of acceptable airspeeds at maximum altitude the "coffin corner" because at this point the U-2 was always on the brink of falling out of the sky. If the aircraft slowed beyond the low-speed stall limit, it would lose lift and begin to fall, causing stresses that would tear the wings and tail off. A little too much speed would lead to buffeting, which would also cause the loss of the wings or tail. Flying conditions such as these required a U-2 pilot's full attention when he was not using the autopilot. Airspeed was such a critical factor that Kelly Johnson added a vernier adjustment to the throttle to allow the pilot to make minute alterations to the fuel supply.[54]

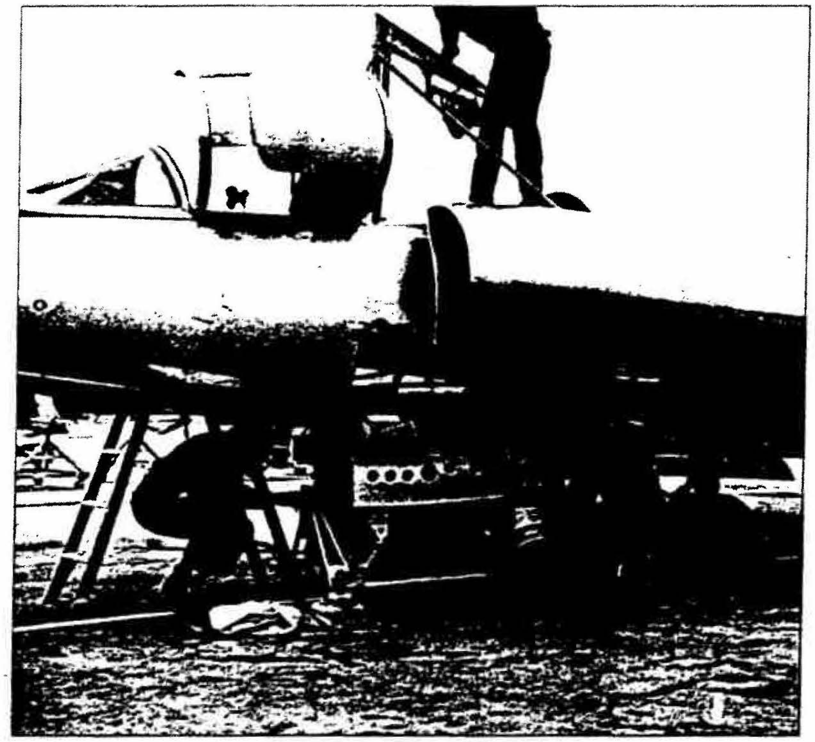
Among the unique devices developed for the U-2 was a small sextant for making celestial "fixes" during the long overflights. Because cloud cover often prevented U-2 pilots from locating navigational points on the earth through the periscope, the sextant turned out to be the pilots' principal navigational instrument during the first three years of deployment. When clouds were not a factor, however, the periscope proved highly accurate for navigation. During the final tests before the aircraft became operational, U-2 pilots found they could navigate by dead reckoning with an error of less than 1 nautical mile over a 1,000-nm course.[55]

FINAL TESTS OF THE U-2

Flight-testing of the U-2 continued throughout the fall and winter of 1955-56 in order to test all the various systems. By mid-January 1956, SAC officials were so impressed that they also wanted to purchase a fleet of these planes. On 30 January, DCI Dulles agreed to

[54] Cunningham interview (TS Codeword); John Parangosky, interview by Donald E. Welzenbach, tape recording, 6 March 1986 (S); information supplied by James Cherbonneaux to Donald E. Welzenbach (S).

[55] Cunningham interview (TS Codeword).



A-2 camera being installed in U-2

have CIA act as executive agent for this transaction, which the Air Force called Project DRAGON LADY. To maintain secrecy, the Air Force transferred funds to the CIA, which then placed an order with Lockheed for 29 U-2s in configurations to be determined by the Air Force. The Air Force later bought two more U-2s, for a total of 31. The aircraft purchased for the Air Force were known as the Follow-On Group, which was soon shortened to FOG.[56]

Once enough pilots had been trained, Project AQUATONE managers concentrated on checking out the complete U-2 system: planes, pilots, navigation systems, life-support systems, and cameras. From 10 through 14 April 1956, U-2s equipped with A-2 cameras took off from Area 51 and made eight overflights of the United States in order to test the various flight and camera systems as part of the standard Air Force Operational Readiness Inspection. Colonel Yancey and his detachment served as observers during this weeklong exercise.

[56] *OSA History*, chap. 5, pp. 25-26 (TS Codeword).

U-2 detachment in formation over Nevada

Colonel Yancey's group carefully examined all aspects of the U-2 unit from flight crews to camera technicians and mission programmers. When the exercise was over, Yancey reported that the detachment was ready for deployment. He then briefed a high-level Pentagon panel that included the Secretary of the Air Force and the Chief of Air Staff. These officials concurred with Yancey's determination that the U-2 was ready for deployment.[57]

During these final tests in the spring of 1956, the U-2 once again demonstrated its unique airworthiness. On 14 April 1956, James Cunningham was sitting in his office in Washington when he received a call from Area 51 informing him that a westward-bound U-2 had experienced a flameout over the Mississippi River at the western border of Tennessee. After restarting his engine, the pilot reported a second flameout and engine vibrations so violent that he was unable to get the power plant to start again. Early in the program Bissell and Ritland had foreseen such an emergency and, with the cooperation of the Air Force, had arranged for sealed orders to be delivered to every airbase in the continental United States giving instructions about what to do if a U-2 needed to make an emergency landing.

Cunningham had the project office ask the pilot how far he could glide so they could determine which SAC base should be alerted. The pilot, who by this time was over Arkansas, radioed back that, given the prevailing winds and the U-2's 21:1 glide ratio, he thought he could reach Albuquerque, New Mexico. Within minutes Cunningham was on the phone to Colonel Geary in the Pentagon, who then had the Air Force's Assistant Director of Operations, Brig. Gen. Ralph E.

[57] Bissell interview (S); *OSA History*, chap. 11, pp. 15-16 (TS Codeword).

Koon, call the commander of Kirtland AFB near Albuquerque. General Koon told the base commander about the sealed orders and explained that an unusual aircraft would make a deadstick landing at Kirtland within the next half hour. The general then instructed the base commander to have air police keep everyone away from the craft and get it inside a hanger as quickly as possible.

After a half hour passed, the base commander called the Pentagon to ask where the crippled aircraft was. As he was speaking, the officer saw the U-2 touch down on the runway and remarked, "It's not a plane, it's a glider!" Even more surprised were the air police who surrounded the craft when it came to a halt. As the pilot climbed from the cockpit in his "space" suit, one air policeman remarked that the pilot looked like a man from Mars. The pilot, Jacob Kratt, later reported to Cunningham that, from the beginning of the first flameout until the landing at Albuquerque, the U-2 had covered over 900 miles, including more than 300 by gliding.[58]

Aside from this extraordinary gliding ability, however, the U-2 was a very difficult aircraft to fly. Its very light weight, which enabled it to achieve extreme altitude, also made it very fragile. The aircraft was also very sleek, and it sliced through the air with little drag. This feature was dangerous, however, because the U-2 was not built to withstand the G-forces of high speed. Pilots had to be extremely careful to keep the craft in a slightly nose-up attitude when flying at operational altitude. If the nose dropped only a degree or two into the nose-down position, the plane would gain speed at a dramatic rate, exceeding the placarded speed limit in less than a minute, at which point the aircraft would begin to come apart. Pilots, therefore, had to pay close attention to the aircraft's speed indicator because at 65,000 feet there was no physical sensation of speed, without objects close at hand for the eye to use as a reference.[59]

THREE FATAL CRASHES IN 1956

The first fatality directly connected with flying the U-2 occurred on 15 May 1956, when test pilot Wilburn S. Rose, flying article 345A, had trouble dropping his pogos, the outrigger wheels that keep the

[58] Bissell interview (S); Cunningham interview (TS Codeword); Brig. Gen. Leo A. Geary, interview by Gregory W. Pedlow, Colorado Springs, Colorado, 12 October 1988 (S).

[59] James Cherbonneaux, Carmine Vito, and Hervey Stockman (former U-2 pilots), interview by Donald E. Welzenbach, Washington, DC, May 1986 (S).

wings parallel to the ground during takeoff. Once airborne, Rose made a low-level pass over the airstrip and shook loose the lefthand pogo. When he attempted to make a righthand turn to come back over the runway to shake loose the remaining pogo, Rose stalled the U-2 and it plunged to earth, disintegrating over a wide area. Three months later, on 31 August 1956, a second fatal crash occurred during a night-flying exercise. Frank G. Grace stalled article 354 at an altitude of about 50 feet when he tried to climb too steeply at takeoff. The craft fell, cartwheeled on its left wing, and struck a power pole near the runway. More experienced U-2 pilots always cut back abruptly on the throttle as soon as the pogo sticks fell away in order to avoid such stalls.

Before the year was out, two more U-2s were destroyed in crashes, one of them fatal. On 17 September 1956, article 346 lost part of its right wing while on its takeoff ascent from Lindsey Air Force Base in Wiesbaden, Germany. The aircraft disintegrated in mid-air, killing pilot Howard Carey. The loss of article 357 on 19 December 1956 resulted from pilot hypoxia. A small leak prematurely depleted the oxygen supply and impaired Robert J. Ericson's judgment as he flew over Arizona. Because of his inability to act quickly and keep track of his aircraft's speed, the U-2 exceeded the placarded speed of 190 knots and literally disintegrated when it reached 270 knots. Ericson managed to jettison the canopy and was sucked out of the aircraft at 28,000 feet. His chute opened automatically at 15,000 feet, and he landed without injury. The aircraft was a total loss.[60]

COORDINATION OF COLLECTION REQUIREMENTS

From the very beginning of the U-2 program, it was apparent that some sort of an interagency task force or office would be needed to develop and coordinate collection requirements for the covert overhead reconnaissance effort. In a three-page memorandum to DCI Dulles on 5 November 1954 setting forth the ideas of the Technological Capabilities Panel's Project 3 on this subject, Edwin Land wrote:

> *It is recommended that . . . a permanent task force, including Air Force supporting elements, be set up under suitable cover to provide guidance on procurement, to consolidate requirements*

[60] U-2 Accident Reports, folders 4, 10, and 14, OSA records, job 67-B-415, box 1 (S).

and plan missions in view of priority and feasibility, to maintain the operation on a continuing basis, and to carry out the dissemination of the resulting information in a manner consistent with its special security requirements.[61]

James Q. Reber

When the U-2's development and testing approached completion, Land's recommendation was put into effect. Following a meeting with Deputy Secretary of Defense Donald Quarles and Trevor Gardner (who had been promoted from his special assistant post to become Assistant Secretary of the Air Force for Research and Development), Richard Bissell established an Ad Hoc Requirements Committee (ARC) on 1 December 1955. He then named James Q. Reber to be Intelligence Requirements Officer for the U-2 project and chairman of the ARC. Reber was already experienced in coordination with other intelligence agencies, for he had headed the Directorate of Intelligence DI Office of Intelligence Coordination for four years. The first full-scale ARC meeting took place on 1 February 1956 with representatives from the Army, Navy, and Air Force present. Attending for the CIA were representatives from the Office of Research and Reports (ORR) and the Office of Scientific Intelligence (OSI). The CIA membership later expanded to include the Office of Current Intelligence (OCI) and a representative from the Directorate of Plans. In 1957 the National Security Agency (NSA) also began sending a representative. The State Department followed suit in 1960, although it had been receiving reports from the committee all along.[62]

ARC's main task was to draw up lists of collection requirements, primarily for the U-2, but also for other means of collection. These lists prioritized targets according to their ability to meet the three major national intelligence objectives concerning the Soviet Union in the mid-1950s: long-range bombers, guided missiles, and nuclear energy. The committee issued its list of targets for the use of the entire intelligence community using all available means of collection, not just for the CIA with the U-2.[63]

---

[61] *OSA History*, chap. 1, annex 1 (TS Codeword).

[62] Minutes of the Ad Hoc Requirements Committee of 1 February 1956, Intelligence Community (IC) Staff records, COMIREX, job 33-B-121A, box 1, "ARC Minutes, 1956-1957;" Memorandum for the Joint Study Group from James Q. Reber, "Handling of Requirements for the U-2," 15 August 1960, IC Staff records, job 33-T-123A, box 10, "CHALICE (General)" (TS Codeword).

[63] Memorandum for the Joint Study Group from James Q. Reber, "Handling of Requirements for the U-2," 15 August 1960, IC Staff records, job 33-T-123A, box 10, "CHALICE (General)" (TS Codeword).

Arthur C. Lundahl

ARC gave the top priority target list to the Project Director, and the project staff's operations section then used the list to plan the flightpaths for U-2 missions. Although the requirements committee was not responsible for developing flight plans, it assisted the planners with detailed target information as required. When a flight plan was ready for submission to the President for approval, the committee drew up a detailed justification for the selection of the targets. This paper accompanied the flight plan.[64]

In developing and prioritizing lists of targets, the committee members had to take into account the varying needs and interests of their parent organizations. Thus, the CIA representatives generally emphasized strategic intelligence: aircraft and munitions factories, power-generating complexes, nuclear establishments, roads, bridges, inland waterways. In contrast, the military services usually placed a heavier emphasis on order-of-battle data. The Air Force, in particular, had a strong interest in gathering intelligence on the location of Soviet and East European airfields and radars.

Although the committee members kept the interests of their services or agencies in mind, their awareness of the vital nature of their mission kept the level of cooperation high. The group always attempted to reach a consensus before issuing its recommendations, although occasionally this was not possible and one or more agencies would add a dissent to the recommendation of the committee as a whole.[65]

PREPARATIONS TO HANDLE THE PRODUCT OF U-2 MISSIONS

On 13 December 1954, DCI Allen Dulles and his assistant, Richard Bissell, briefed Arthur C. Lundahl, the chief of CIA's Photo-Intelligence Division (PID), on Project AQUATONE. At DCI Dulles's direction, Lundahl immediately set in motion within his division a compartmented effort, known as Project EQUINE, to plan for the exploitation of overhead photography from the U-2 project. With only 13 members, the PID staff was too small to handle the expected

[64] Ibid.; James Q. Reber, interview by Donald E. Welzenbach and Gregory W. Pedlow, Washington, DC, 21 May 1987 (S).

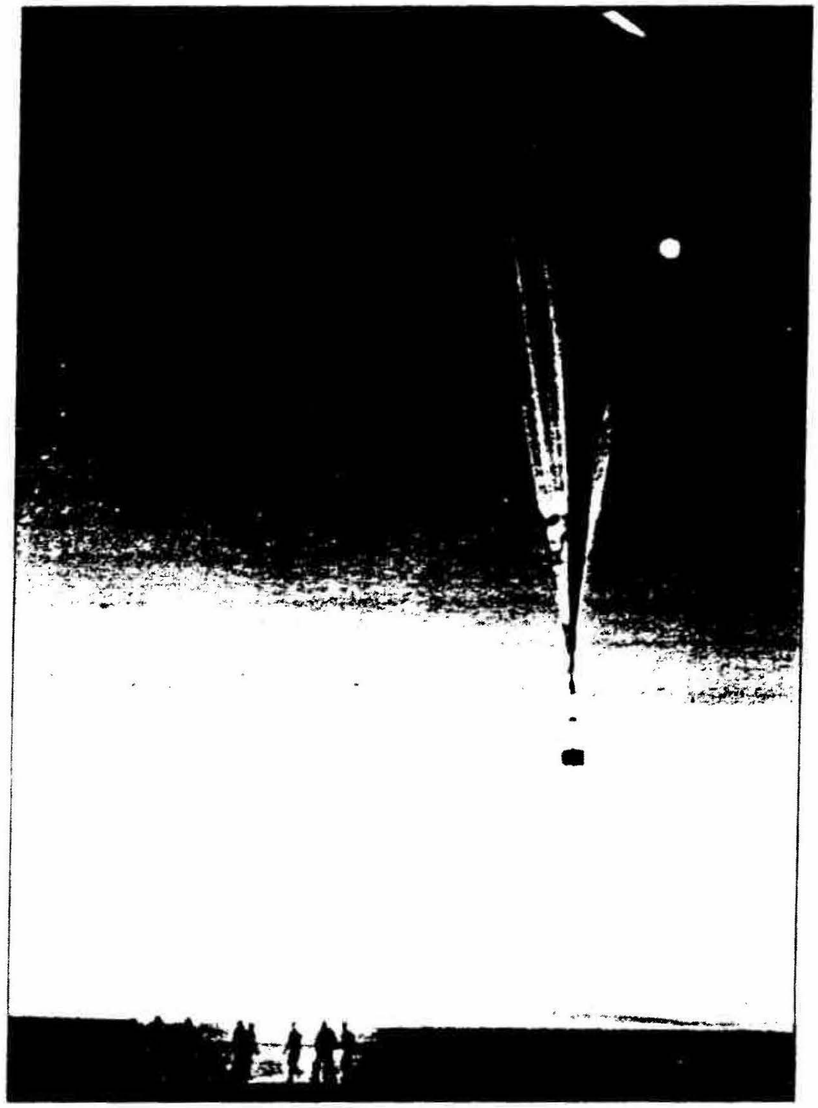
[65] Reber interview (S).

The Steuart Building, home of the Photo-Intelligence Division

flood of photographs that the U-2 would bring back, so in May 1955 the Directorate of Support (DS) authorized expanding PID to 44 persons. Soon afterward the division moved from its room in M Building to larger quarters in Que Building.

The Photo-Intelligence Division continued to expand in anticipation of large quantities of U-2 photography. Its authorized strength doubled in January 1956 when a new project known as HTAUTOMAT came into existence to exploit U-2 photography. All of the products from this project would be placed in the new control system. By the summer of 1956, the PID had moved to larger quarters in the Steuart Building at 5th Street and New York Avenue, NW. PID photointerpreters had already begun to work with U-2 photography following a series of missions in April 1956, when U-2s photographed a number of US installations that were considered analogous to high-priority Soviet installations. As a result of these preparations, PID was ready for the mass of photography that began coming when U-2 operations commenced in the summer of 1956.[66]

[66] For a more detailed history of photointerpretation in the CIA, see [redacted] *The National Photographic Interpretation Center*, vol. I, *Antecedents and Early Years*, Directorate of Science and Technology Historical Series NPIC-2, December 1972, pp. 171-194 (S).



Project GENETRIX balloon launch

THE IMPACT OF THE AIR FORCE PROJECT GENETRIX BALLOONS

While the Agency was making its final preparations for U-2 overflights, the Air Force started a reconnaissance project that would cause considerable protest around the world and threaten the existence of the U-2 overflight program before it even began. Project GENETRIX involved the use of camera-carrying balloons to obtain high-altitude photography of Eastern Europe, the Soviet Union, and the People's Republic of China. This project had its origins in a RAND Corporation study from 1951. By the end of 1955, the Air Force had overcome a number of technical problems in camera design and recovery techniques and had manufactured a large number of balloons for use in the project. President Eisenhower gave his approval on 27 December 1955, and two weeks later the launches from bases in Western Europe began. By the end of February 1956, the Air Force had launched a total of 516 balloons.[67]

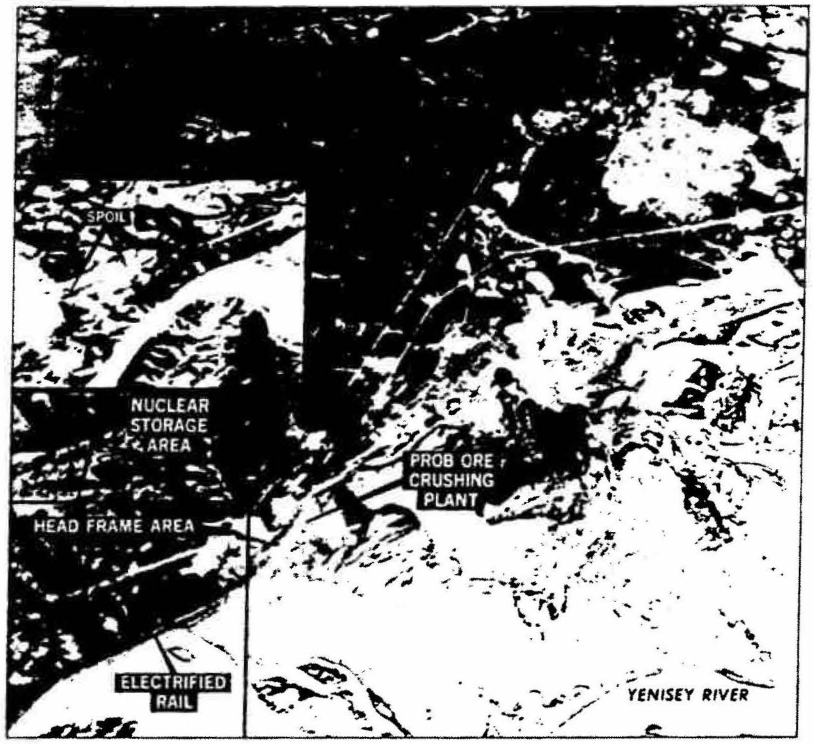
Project GENETRIX was much less successful than its sponsors had hoped. Once launched, the balloons were at the mercy of the prevailing winds, and many tended to drift toward southern Europe and then across the Black Sea and the desert areas of China. These balloons therefore missed the prime target areas, which lay in the higher latitudes. Large numbers of balloons did not succeed in crossing the Soviet Union and China, some because they were shot down by hostile aircraft, others because they prematurely expended their ballast supplies and descended too soon. Only 46 payloads were eventually recovered (one more than a year later and the last not until 1958) from the 516 balloons that had been launched. In four of these payloads the camera had malfunctioned, and in another eight the photography was of no intelligence value. Thus, only 34 balloons succeeded in obtaining useful photographs.[68]

The low success rate of the Project GENETRIX balloons was not the only problem encountered; far more serious was the storm of protest and unfavorable publicity that the balloon overflights provoked. Although the Air Force had issued a cover story that the balloons were being used for weather research connected with the International Geophysical Year, East European nations protested strongly to the United States and to international aviation authorities, claiming that the balloons endangered civilian aircraft. The Soviet Union sent strongly worded protest notes to the United States and the nations from which the balloons had been launched. The Soviets also collected numerous polyethelene gasbags, camera payloads, and transmitters from GENETRIX balloons and put them on display in Moscow for the world press.[69]

[67] P. G. Strong, Attachment to Memorandum for DCI Dulles, "Project GENETRIX Summary," 15 February 1956 (S).

[68] Final Report, Project 119L, 1st Air Division (Meteorological Survey) Strategic Air Command, 5 March 1956, D-582, General Summary (S, declassified 1979).

[69] *New York Times*, 10 February 1956, p. 1; *Omaha World Herald*, 11 February 1956, p. 1.



Photograph of Dodonovo Atomic Energy complex taken by a Project GENETRIX balloon

All of this publicity and protest led President Eisenhower to conclude that "the balloons gave more legitimate grounds for irritation than could be matched by the good obtained from them," and he ordered the project halted. On 7 February 1956 Secretary of State Dulles informed the Soviet Union that no more "weather research" balloons would be released, but he did not offer an apology for the overflights.[70]

Despite the furor caused by GENETRIX, Air Force Chief of Staff Twining proposed yet another balloon project only five weeks later, in mid-March 1956. This project would employ even higher flying balloons than GENETRIX and would be ready in 18 months. President Eisenhower informed the Air Force, however, that he was "not interested in any more balloons."[71]

[70] Andrew J. Goodpaster, Memorandum for the Record, "10 February 1956 Conference of Joint Chiefs of Staff with the President," WHOSS, Alpha, DDEL (TS, declassified 1980); Stephen E. Ambrose, *Eisenhower: The President* vol. 2 (New York: Simon and Schuster, 1984), p. 310.

[71] Quoted in Ambrose, *Eisenhower: The President*, p. 310.

Although the photo intelligence gained from Project GENETRIX was limited in quantity, it was still some of the best and most complete photography obtained of the Soviet Union since World War II. It was referred to as "pioneer" photography because it provided a baseline for all future overhead photography. Even innocuous photos of such things as forests and streams proved valuable in later years when U-2 and satellite photography revealed construction activity.

Of still greater importance to the U-2 program, however, was the data that US and NATO radars obtained as they tracked the paths of the balloons—whose average altitude was 45,800 feet—over the Soviet Bloc. This data provided the most accurate record to date of high-altitude wind currents, knowledge that meteorologists were later able to put to use to determine optimum flightpaths for U-2 flights.

One completely fortuitous development from Project GENETRIX had nothing to do with the cameras but involved a steel bar. This bar served a dual purpose: the rigging of the huge polyethylene gasbag was secured to the top of the bar and the camera-payload and automatic-ballasting equipment was attached to the bottom. By sheer chance, the length of the bar—91 centimeters—corresponded to the wavelength of the radio frequency used by a Soviet radar known by its NATO designator as TOKEN. This was an S-band radar used by Soviet forces for early warning and ground-controlled intercept. The bar on the GENETRIX balloons resonated when struck by TOKEN radar pulses, making it possible for radar operators at US and NATO installations on the periphery of the Soviet Union to locate a number of previously unknown TOKEN radars.

These radar findings, coupled with other intercepts made during the balloon flights, provided extensive data on Warsaw Pact radar networks, radar sets, and ground-controlled interception techniques. Analysis of these intercepts revealed the altitude capabilities and tracking accuracy of radars, the methods used by Warsaw Pact nations to notify each other of the balloons' passage (handing off), and the altitudes at which Soviet aircraft could intercept the balloons. All of this information could be directly applied to future U-2 missions.[72]

[72] Final Report, Project 119L, 1st Air Division (Meteorological Survey) Strategic Air Command, 5 March 1956, D-582, General Summary (TS, declassified 1979).

These positive results from Project GENETRIX did not outweigh the political liabilities of the international protests. CIA officials became concerned that the ill will generated by balloon overflights could sour the Eisenhower administration on all overflights, including those by the U-2, which was just about ready for deployment. Therefore, DDCI Cabell wrote to Air Force Chief of Staff Twining in February 1956 to warn against further balloon flights because of the "additional political pressures being generated against all balloon operations and overflights, thus increasing the difficulties of policy decisions which would permit such operations in the future." [71]

In addition to its concern for the future of the U-2 program, the Agency feared that President Eisenhower's anger at balloon overflights might result in the curtailment of the balloon program that the Free Europe Committee—a covert Agency operation based in West Germany—used to release propaganda pamphlets over Eastern Europe.

AQUATONE BRIEFINGS FOR SELECTED MEMBERS OF CONGRESS

Although knowledge of the U-2 project was a closely guarded secret within both the Agency and the Eisenhower administration, DCI Dulles decided that a few key members of Congress should be told about the project. On 24 February 1956, Dulles met with Senators Leverett Saltonstall and Richard B. Russell, the ranking members of the Senate Armed Services Committee and its subcommittee on the CIA. He shared with them the details of Project AQUATONE and then asked their opinion on whether some members of the House of Representatives should also be informed. As a result of the senators' recommendation that the senior members of the House Appropriations Committee should be briefed, Dulles later met with its ranking members, Representatives John Taber and Clarence Cannon. Official Congressional knowledge of the U-2 project remained confined to this small group for the next four years. The House Armed Services Committee and its CIA subcommittee did not receive a CIA briefing on the U-2 project until after the loss of Francis Gary Powers's U-2 over the Soviet Union in May 1960.[74]

[71] Philip G. Strong, Attachment to Memorandum for DCI Dulles, "Project GENETRIX Summary," 15 February 1956, *OSI records* (S).

[74] John S. Warner, Legislative Counsel, Memorandum for the Record, "AQUATONE Briefings," 18 November 1957, Office of Congressional Affairs records, job 61-357, box 2 (S); Warner interview (S).

THE U-2 COVER STORY

In February 1956, while the controversy over balloon flights was still raging and the U-2 was completing its final airworthiness tests, Richard Bissell and his staff began working on a cover story for overseas operations. It was important to have a plausible reason for deploying such an unusual looking plane, whose glider wings and odd landing gear were certain to arouse curiosity.

Bissell decided that the best cover for the deployment of the U-2 was an ostensible mission of high-altitude weather research by the National Advisory Committee on Aeronautics (NACA). Such a cover story, however, needed the approval of all concerned: Air Force intelligence, the Air Weather Service, the Third Air Force, the Seventh Air Division, the SAC U-2 project officer, the Air Force Headquarters project officer, and NACA's top official, Dr. Hugh Dryden. Moreover, the CIA Scientific Advisory Committee was also consulted about the cover plan.

Senior CIA officials and the other agencies involved in providing cover for the U-2 approved the final version of the overall cover story at the end of March 1956. The project staff then began working on contingency plans for the loss of a U-2 over hostile territory. Bissell advised the project's cover officer to "produce a document which sets forth all actions to be taken . . . not only press releases and the public *line* to be taken, but also the suspension of operations and at least an indication of the diplomatic action. . . .We should at least make the attempt in this case to be prepared for the worst in a really orderly fashion." The cover officer then prepared emergency procedures based on the overall weather research cover story, and Bissell approved these plans. There was one final high-level look at the cover story on 21 June 1956, the day after the first U-2 mission over Eastern Europe, when Bissell met with General Goodpaster, James Killian, and Edwin Land to discuss the pending overflights of the Soviet Union, including the proposed emergency procedures. Killian and Land disagreed with Bissell's concept and made a much bolder and more forthright proposal: in the event of the loss of a U-2 over hostile territory, the United States should not try to deny responsibility but should state that overflights were being conducted "to guard against surprise attack." This proposal was put aside for further thought (which it never received), and Bissell's weather research cover remained the basis for statements to be made after a loss. The project staff then went on to prepare a number of different statements to be used in various scenarios, including one in which the pilot was captured. Even in such a case, however, the proposed policy was for the United States to stick to the weather research cover story, a course of action that would prove disastrous in May 1960.[75]

[75] *OSA History*, chap. 8, pp. 30-35; chap. 11, annex 73 (TS Codeword).

Blank

Blank