

Unlikely relatives

OBSERVATION BALLOONS AND RECONNAISSANCE SATELLITES

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Balloons rank among man's oldest methods of aerial surveillance. By the time of the American Civil War and the Franco-Prussian War of 1870, observers were using hot-air balloons to get up in the sky for a better view of the "other side of the hill." With the advent of photography, balloons could carry cameras into the sky to record the disposition of enemy forces and emplacements.

The appearance of the airplane as an implement of war in World War I relegated balloons to the lowly task of supporting barrage nets and wires in an attempt to prevent bombing by enemy aircraft. No longer was the balloon looked upon as a high altitude camera platform. Its most noble effort during the next three decades was in lifting meteorological packages, known as radiosondes, to extreme altitudes in order to measure air pressure and temperature and wind velocities.

Hardly anyone gave balloon-borne cameras another thought until the Iron Curtain descended across Europe after World War II and restricted communication between the Soviet bloc of nations and the rest of the world.

Meteorologists were still using balloons in their research, however, and in the summer of 1951, the US Air Force's Cambridge Research Center began an experiment along lines suggested by Rand Corporation meteorologist William W. Kellogg. Known by its codename *MOBY DICK*, this effort involved floating hundreds of large, helium-filled, polyethylene balloons, carrying gondolas filled with scientific instruments, from west to east across the continental United States at altitudes between 15,000 and 30,000 meters (50,000-100,000 feet) in order to measure high-altitude wind fields. These balloons, known as model 66CT, were manufactured by General Mills, Incorporated. They were 20 meters (65 feet) tall when inflated and carried automatic ballasting systems and beacon transmitters that emitted signals every two minutes. By tracking the radio beacons, Air Force meteorologists could plot each balloon's course and speed as it transited the nation. The *MOBY DICK* effort in 1952-53 mapped the jet streams whose vagaries so affect our weather systems.¹

MOBY DICK gondolas were equipped with pressure-sensing devices so that, when they descended below 8,500 meters (28,000 feet) to where they might jeopardize civil aviation, the gondolas could be cut loose from the balloons and float to earth on parachutes. Each gondola carried a placard promising, in large letters, a \$25 reward to anyone who reported its whereabouts to the Air Force. Some *MOBY DICK* balloons, of course, never fell to earth in the United States, but kept right on floating, out over the Atlantic, some as far as Europe, a few as far as the Soviet Union.

¹ Paul Worthman in "Notes" to W.W. Rostow, *Open Skies*, Austin, University of Texas Press, 1982, pp. 189-94.

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Studies in Intelligence

From Meteorology to Intelligence

Rand's Will Kellogg had worked on the idea of high-altitude, camera-carrying balloons as early as November 1950. He undertook the project, known as GOPHER, at the request of the Air Force's Scientific Advisory Board. Kellogg postulated that balloons released close to USSR borders might float all the way across the vast Soviet landmass, taking pictures as they went, and fetch up somewhere along the Pacific littoral, preferably near Japan. The camera-carrying balloon idea appealed to planners in Air Force headquarters who, in late 1951 simultaneous with the MOBY DICK effort, directed Wright Air Development Command (WADC) in Dayton, Ohio, to produce an operational plastic camera-carrying balloon to fly over the USSR. Subsequently, Air Force Colonel George W. Goddard, an aerial reconnaissance expert at WADC, approached Professor Duncan Macdonald of the Boston University Optical Research Laboratory (BUORL) about designing a camera that could be turned on at dawn and off at dusk and be capable of filming the earth from varying altitudes.

The Air Force referred to this project as Weapon System-119L and gave it a new codename, GRANDSON. It was undertaken with the encouragement and participation of Edwin H. Land, inventor of the Polaroid filter and camera and long-time member of numerous US government scientific advisory panels.

Parts of the system were carried over from the MOBY DICK operation, primarily the gasbag, the automatic ballasting device, radio beacon, automatic release device, and parachute. The payload was a BUORL-designed 9 x 9-inch format framing camera with a 127-mm (5-inch) lens. It had two film supplies plus a photo-cell device to turn it on and off. The entire payload weighed almost 680 kg (1,500 pounds), 270 kg (600 pounds) of which was the camera payload.

Considering the size of the camera containers—larger and heavier than a refrigerator—and the value of film to be exposed over prime Soviet targets, Air Force planners had to devise a method for retrieving them before they struck the ground or landed in water. Working with the twin-boom Fairchild "Packet" C-119 transport aircraft, WADC designers fashioned a device that was attached to the rear of the airplane. It was like a limp slingshot, with a grappling hook at the end of a steel cable strung between the two arms of the unit. The cable was threaded along one arm and attached to a winch inside the plane. The strategy was to use this device to snag the descending GRANDSON gondolas before they fell to earth.

The trick was to capture the parachute shroud lines rather than the gondola itself or the fabric of the chute. This was not an easy task. Despite considerable practicing and training, by early 1953 WADC technicians considered the project a disaster. One C-119 aircrew had almost crashed and the program was temporarily halted. Before it resumed in the spring of 1953, the project was transferred to the Cambridge Research Center's Atmospheric Devices Laboratory in Massachusetts and placed under Air Force Lieutenant Colonel Paul Worthman. By August 1954, one of Worthman's colleagues, Major Eugene Duff, succeeded

in perfecting the technique that permitted the capture of parachuting gondolas before either they or the aircraft hit the ground.²

Getting permission to send WS-119L balloons across the USSR was even a more difficult challenge. First, the Air Force had to prove that the balloons could actually transit the extensive Asian landmass. In December 1954, in a project called GRAYBACK, Air Force personnel launched eight MOBY DICK-type balloons from Scotland expecting them to float on the jet-stream currents across Europe and the Soviet Union. None did. They all went south and ended up making lazy circles over North Africa and Yugoslavia. Another attempt was made in January 1955, but none of these balloons stayed aloft.

At this point, the Central Intelligence Agency became involved, but not officially. The Agency's Assistant Director (Collection) for Scientific Intelligence was a retired Marine colonel named Philip G. Strong. He liked to ferret out every new idea he could find in either the Agency or the Pentagon. In those days, his Agency office was in a temporary building near the Reflecting Pool on the Mall, but he also had a desk in a room at the Pentagon. Colonel Strong was a member of several Air Force scientific advisory groups, and through this connection he had learned of the vicissitudes of the WS-119L project. Strong was also aware of several projects within the Agency's Directorate of Plans (now the Directorate of Operations) which involved large balloons. He discovered that DDP operatives had floated a balloon from Scotland across the Soviet Union and retrieved it near South Korea. Strong reported this to the Air Force and also handed over some photos which had been taken by the new BUORL camera, developed for the WS-119L project, from a high-altitude balloon tethered over southern California.³

Air Force officials used both Strong's evidence that a balloon could make the passage across the Soviet Union and the BUORL camera photographs to persuade President Eisenhower, on 27 December 1955, to give a green light to the WS-119L effort, now renamed Project GENETRIX.

The GENETRIX effort was carried out over a 27-day period in January and February 1956 with results far short of expectations. Only 44 payloads were recovered initially from among the 516 GENETRIX balloons launched and just 32 of these had usable photography. Most of those recovered were found in the sea around Japan. A 45th payload was recovered a year later; it had drifted to Adak in the Aleutian Islands. Although much of the photography from the recovered cameras was of clouds, there were also some worthwhile results. Dodonovo, the vast nuclear refining facility in Soviet Siberia, was discovered in GENETRIX photography. CIA's Photo Intelligence Division, then headed by Arthur C. Lundahl, sent a photointerpreter to the Air Force Aeronautical Chart and Information Center at St. Louis to help exploit GENETRIX photography.

Grounds for Irritation

While the 32 recovered balloon payloads produced some useful results, those that were not recovered created a diplomatic flap of embarrassing

² Worthman, "Notes" in *Open Skies*, p. 192.

³ Project GENETRIX Summary, Attachment to Memo for DCI from P.C. Strong, 15 Feb 56.

proportions. Hundreds of the balloons either fell or were shot down over East Europe and the Soviet Union. This brought formal protests not only to the United States but also to the International Civil Aviation Organization (ICAO). Czechoslovakia complained to ICAO that at night the GENETRIX balloons sank so low in the atmosphere as to endanger civil aviation. The USSR mounted a large display of GENETRIX cameras, equipment, and photographs on 10 February 1956 in the courtyard of Spiridonovka Palace, the residence of Foreign Minister V. M. Molotov. The next day, in protest notes to Washington, Bonn, and Ankara, the Soviets accused the United States of carrying out a "brink of war" policy.⁴

These repercussions brought a strong reaction from President Eisenhower who concluded that "the balloons gave more legitimate grounds for irritation than could be matched by the good obtained from them." Ike ordered an end to Project GENETRIX.⁵

The demise of Project GENETRIX was not the end of espionage balloons. During the late spring of 1955, the Air Force's Air Weather Service discovered a quirk in jet-stream activity. For a six-week period in May and June, the normal west-to-east flow of the jet stream, at altitudes of 16,750 meters (55,000 feet), ended in an anomaly over the Bering Sea off the coast of Alaska. During this brief period, these swift moving air currents, as they approached the Alaskan coast, turned sharply upward another 16,750 meters, reversed direction, and began moving from east to west at an altitude of 33,500 meters (110,000 feet).

Believing that they alone were aware of this jet-stream anomaly, officials at the Cambridge Research Center's Atmospheric Devices Laboratory proposed a new balloon program, this one known as WS-461L. When the GENETRIX balloons had drifted over the Soviet Union at altitudes up to 16,750 meters, the Soviets tracked them with their radars and often could see them. Air Force planners believed that if objects of similar size were to float twice as high they would be invisible and, hence, beyond interdiction.

This new Air Force effort involved a larger gasbag, (aerostat) and changes to the gondola in order to protect the camera payload from the intense cold at the edge of the earth's atmosphere. More important, an entirely new camera was needed, one that would have greater acuity than the GENETRIX device and which could return usable imagery from twice the GENETRIX altitude. Once again, the Air Force turned to BUORL's Duncan Macdonald for assistance. One of Macdonald's colleagues, Walter Levison, came up with the idea to adapt 19th-century panoramic camera technology by pivoting a lens tube through a 120-degree arc and focusing its image onto a curved piece of 70-mm film. By employing a longer lens than the GENETRIX camera, 305 mm (12 inches) instead of 127 mm (5 inches), Levison believed that high-acuity photographs could be obtained from altitudes greater than 30,000 meters. Work on the camera progressed through 1956 and early 1957. When some test results from the new device were shown to Rand Corporation camera expert Amrom Katz later that year, he nicknamed it the HYAC (high-acuity) camera. Project WS-461L languished throughout 1957 and half of 1958. By this time the U-2 had

⁴ *New York Times*, 10 Feb 56, p. 1.

⁵ A. J. Goodpaster, Memo for Record, 10 Feb 56, Conference of Joint Chiefs of Staff with President, White House Office of Staff Secretary, Alpha, D.D. Eisenhower Library.

made occasional deep penetrations of Soviet airspace and there was no interest at all in balloons. In fact, President Eisenhower was irritated at the mere mention of balloons.

Events in the late summer and autumn of 1957 were unsettling to Americans. In August 1957, the Soviet Union launched a "super-long-distance multi-stage intercontinental ballistic rocket," which Tass said made it "possible to send missiles to any part of the world." Less than six weeks later, to America's consternation, Tass announced the orbiting of Sputnik-I, the first earth satellite. In early November 1957, the Soviets launched Sputnik-II carrying a dog named Laika and a television camera.

US tests of the Atlas missile had been annoyingly unsuccessful and the Navy's Vanguard project to orbit a grapefruit-sized satellite was on hold when these three startling Soviet successes occurred. Congress began holding hearings. Before the year was out, there was "missile gap" talk.

In the autumn of 1957, shortly after Sputnik-I, a committee of scientists assured President Eisenhower that our missile efforts were not behind the Soviets, and that we could have orbited a satellite before the Soviet Union, had our priorities been different. Deputy Defense Secretary Donald Quarles told Ike that "the Russians have in fact done us a good turn, unintentionally, in establishing the concept of freedom of international space." Eisenhower then asked Quarles about the prospects for a reconnaissance vehicle, a satellite that could take pictures and beam them back to earth. Quarles replied that the Air Force had a research program in that area that was coming along nicely.⁶ Moreover, Eisenhower was trying hard to get the Soviets to the bargaining table to discuss surprise attack, arms control, and a test-ban treaty. From the President's viewpoint, his efforts to negotiate with the Soviets were hindered by balloons and U-2 overflights of the USSR. Every time a U-2 made a deep-penetration flight over Soviet territory—even though such flights were rare—the USSR sent a strong protest note and sometimes followed up with an aide-memoire detailing the flight paths. The Soviets were to down a U-2 on 1 May 1960. Down, also, would come the Eisenhower-Khrushchev summit in Paris.

Eisenhower had authorized deploying the U-2 in early 1956, only three months after the GENETRIX balloon project. He did so because his advisers led him to believe that the high-flying aircraft might prove "invisible" to Soviet radars and that only "a very minor percentage" of these flights would be picked up.⁷ This was not the case. As early as 19 July 1956, only two weeks after the first successful overflight of Moscow,⁸ the President told Allen Dulles that he had lost "enthusiasm" for the U-2 project.⁹

President Eisenhower's increasing skepticism explains his order on 7 March 1958 for a complete stand-down of U-2 overflights of the Soviet Union following

⁶ Stephen E. Ambrose, *Eisenhower, the President*, New York, Simon and Shuster, 1984, p. 427-28.

⁷ The men most responsible for persuading Eisenhower to agree to the U-2 program were Dr. James R. Killian, Jr., president of Massachusetts Institute of Technology, and Edwin Land of Polaroid Corporation. See Killian's *Sputnik, Scientists, and Eisenhower—A Memoir of the First Special Assistant to the President for Science and Technology*, Cambridge, the MIT Press, 1977, p. 82.

⁸ The U-2 that made this Moscow overflight, article 347, is currently on display at the Smithsonian Air and Space Museum.

⁹ Memo for the Record, 19 Jul 56, A.J. Goodpaster, WHOSS, Alpha, DDEL.

a 1 March 1958 U-2 mission over the Soviet Far East.¹⁰ Despite the missile-gap outcry on Capitol Hill, the President refused to allow a U-2 to penetrate Soviet territory for the next 16 months.

U-2 overflights of the USSR were not solely responsible for Eisenhower's growing nervousness. There were other incidents such as the downing of an Agency C-119 over Soviet Armenia on 27 June 1958. On 2 September 1958, an Air Force C-119 was also shot down over Soviet Armenia. Eisenhower explained his attitude toward deep-penetration overflights of the Soviet Union on several occasions in 1958 and 1959. In December 1958, at a session of the President's Board of Consultants on Foreign Intelligence Activities, Eisenhower questioned the "continuation of the overflight reconnaissance program," asking "whether the intelligence which we received from this source is worth the exacerbation of international tension which results."¹¹ In February 1959, the President's Chief of Staff Nathan Twining, Defense Secretary Neil McElroy, and his deputy, Donald Quarles, that U-2 overflights constituted "undue provocation." He added that "nothing would make him request authority to declare war more quickly than violation of our airspace by Soviet aircraft."¹² By this time U-2s had made 19 deep-penetration flights over the Soviet Union and numerous flights along Soviet borders. When McElroy urged Eisenhower to permit more overflights to get more pictures, the President demurred. He said he thought that reconnaissance satellites were "coming along nicely" and wanted U-2 flights "held to a minimum depending on the availability of this new equipment," that is, the satellites.¹³

Quest for Invisibility

On the other hand, President Eisenhower's enthusiasm for the reconnaissance-satellite program directly reflected his hope that some means could be found to collect intelligence on the Soviet Union without upsetting his efforts to negotiate agreements with the Soviets on surprise attack and disarmament. He looked favorably on any technological effort that promised "invisibility." This was precisely the approach the Air Force used on 25 June 1958 when it asked permission to deploy its new WS-461L balloons which would float at twice the altitude of the earlier GENETRIX devices and were sure to go unseen by the Soviets. Deputy Defense Secretary Quarles told Eisenhower that this larger balloon's chance of being detected was rather small and the chance of identification or shootdown practically nil.¹⁴

The President reluctantly agreed to the new balloon project. He added that he did not decried the value of the special information thus obtained, except when it cost embarrassment and increased tension. Having gained presidential approval, the Air Force moved swiftly. The balloons had to be deployed from a Navy aircraft carrier in the Bering Sea, beneath the area where the jet stream changed altitude. Each payload carried a timing device to separate the gondola

¹⁰ Ambrose, *Eisenhower, the President*, p. 455-56.

¹¹ J. S. D. Eisenhower, MCP, 16 Dec 58, dated 22 Dec 58, WHOSS, Alpha, DDEL.

¹² Ambrose, *Eisenhower, the President*, p. 513-14.

¹³ Ambrose, *Eisenhower, the President*, p. 513.

¹⁴ A. J. Goodpaster, Memo for Record, 25 Jun 58, WHOSS, Alpha, DDEL.

from the gasbag after the balloon had transited Asia and arrived over West Europe, where it could be snagged in midair as it parachuted to earth.

This east-to-west trip was estimated to take 400 hours or about 16 days. Launch was set for 4 July 1958, the second anniversary of the first U-2 overflight of the Soviet Union. An Air Force technician aboard the aircraft carrier set the timers during the final checkout of the payloads before the launch. When launch-time arrived, gale-force surface winds forced postponement on 4 July, and then again the next two days.

On 7 July 1958, three of the huge gasbags lifted off the carrier's flight deck and began their westerly journey across the northern Soviet Union, according to plan—almost. No one aboard the carrier had remembered to reset the timing devices, which had already been running about 80 hours when the balloons were launched.

Nothing was heard from or about the balloons until Monday, 28 July 1958. On that date the United States received a strong note from the Polish Government protesting the overflight of a U.S.-made, camera-carrying balloon that had fallen to earth in central Poland. The next day, a similar note was received from the Soviet Union protesting the passage of the WS-461L balloons through its airspace. Stephen Ambrose, in his recent biography of President Eisenhower, tells how Ike responded to this news:

Eisenhower tried to get Secretary McElroy on the phone, but he had gone home, so the President talked to his deputy, Quarles, instead. As (Ike's secretary Ann C.) Whitman recorded his end of the conversation, Eisenhower "complained, in salty language, about the laxity in the defense forces—he said he would have, if he had done some of the things that have been done in the last few days—shot himself . . . The President suggested firing a few people—and said that people in the service either ought to obey orders or get the hell out of the service."

Eisenhower followed this up with a formal memorandum for the Secretary of Defense, telling him that "there is disturbing evidence of a deterioration in the processes of discipline and responsibility within the armed forces." He cited, in particular, "unauthorized decisions which have apparently resulted in certain balloons falling within the territory of the Communist bloc," and the U-2 flights over routes "that contravened my standing orders." He wanted action taken, "at once," to tighten discipline. Five days later, Eisenhower groaned and cursed in helpless anger when John Foster Dulles reported to him yet another protest from the Soviets about balloons.¹⁵

Ike also ordered General Goodpaster to tell the Air Force that Project WS-461L "is to be discontinued at once and every cent that has been made available as part of any project involving crossing the Iron Curtain is to be impounded and no further expenditures are to be made."¹⁶

¹⁵ Ambrose, *Eisenhower, the President*, p. 475-76.

¹⁶ A. J. Goodpaster, Memo for Record, 29 Jul 58, WHOSS, Alpha, DDEL.

Only one of the three WS-461L payloads was found, but not until a year later in Iceland. Balloons, once again, sank into obscurity, which was just where President Eisenhower wanted them to be. Little did he realize that had it not been for his trials and tribulations with both of the balloon efforts, his much hoped for reconnaissance satellite might not have succeeded as soon as it did.

This was so because each balloon effort provided an essential part of the reconnaissance-satellite project. Project GENETRIX or WS-119L developed a wishbone or limp slingshot device attached to a C-119 for snatching the WS-119L payloads. This very device was used to snag the first film capsule from space almost four and a half years later, on 19 August 1960. And there is more to the story than just the air-snatch technology.

A better camera for the higher flying WS-461L balloons led to the development of the Macdonald-Levison HYAC camera. With its great acuity and lightweight design, HYAC could be adapted for use in the first generation of photosatellites. Its focal length was increased and the film supply mechanism was made more complex, but the concept of the pivoting lens tube and curved film path was the same.¹⁷

Thus the first space-based photo-reconnaissance system evolved not from systems developed for use in aircraft but from the oldest aerial technology, balloons.

And the reconnaissance satellite was, at least diplomatically, "invisible" as President Eisenhower had hoped. It became possible to begin negotiations on disarmament, strategic arms limitation, nuclear nonproliferation, and test bans. Then, having lessened tension and made negotiation possible, the reconnaissance satellites began providing verification of Soviet compliance with the terms of the various agreements.

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¹⁷ The HYAC camera is also on display at the Smithsonian Air and Space Museum.