

Stealth, Countermeasures, and ELINT, 1960-1975 (U)

Gene Potat

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Gene Potat spent the bulk of his career in the Directorate of Science and Technology.

The late 1950s were the heydays of the U-2 reconnaissance aircraft as it flew with impunity over the Soviet Union, bringing back the most-sought-after intelligence at the time: confirmation that there was no real bomber or ballistic missile gap with the Soviet Union. But the U-2 also brought back something else: a foreshadowing of its own impending demise. The U-2 camera, along with its rudimentary electronics intelligence (ELINT) receivers, had begun to pick up indications of a Soviet antiaircraft defense buildup with new and better surface-to-air (SAM) missiles and radars. The Soviets kept trying to shoot down a U-2 with interceptor fighters and SAMs: they did not succeed until 1 May 1960.

At the time of the shootdown, the CIA's U-2 program office already was well along in developing the U-2's replacement, the OXCART, at Lockheed's Skunk Works in Burbank, California. The OXCART would fly at about 90,000 feet, at Mach 3.3. It would also become the predecessor to the Air Force's better known SR-71 Blackbird. The CIA and the Air Force jointly also had the ultimate reconnaissance system under way in a parallel development, the CORONA satellite, the first in a long series that would eventually replace all overflights, including the OXCART.

Concerns about the vulnerability of the yet-to-fly OXCART to the evolving Soviet air defense network were also the basis for the most secret and sensitive aspect of the project. The OXCART was to be invisible to the Soviet radars—the first-ever stealth aircraft.

The engineering approach to stealth was to create an airplane that would result in an unnoticeable small blip on enemy radar screens by shaping the airplane with razor-sharp edges, or chines, by tilting the rudders inboard to reduce radar reflections, and by using as much composite radar-absorbing material as practical. But how small a radar target was small enough? That depended on how good the Soviet air defense radars were. But there were more intelligence questions about the Soviet air defense radars than there were answers.

The Intelligence Community (IC) had no hard information about the transmitter power of Soviet radars, their receiver sensitivity, the spatial coverage of their beams, or even how widespread they were deployed. The CIA's Clandestine Service did not have a single officer assigned to the Soviet Union because the US Ambassador in Moscow would not permit it. At that time, ELINT could not provide answers to such hard questions. Further, few in the ELINT community knew anything about the OXCART program, and fewer still knew anything about the stealth aspects of the program. It seemed to come down to making the best intelligence estimate possible with regard to Soviet radar capabilities for dealing with a high and fast airplane with a small radar cross section. In the words of other intelligence veterans, "Estimating is what you do when you do not know and cannot find out."

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Primary Sources

To understand why ELINT and the intelligence estimating process had so little to offer, and how both were regarded, one needs to take a closer look at both in the early years of the Cold War. During the first decade or so after the National Security Act of 1947 created the CIA and the National Security Agency (NSA), what we know today as SIGINT was, by and large, divided into three disciplines:

- Communications intelligence (COMINT), derived from NSA's intercept, decryption, and analysis of foreign communications.
- ELINT, based on the intercept and analysis of signals, other than communications (such as radar and other signals associated with weapon systems), and carried out by practically every element within the IC.
- Telemetry intelligence (TELINT), usually from the collection and analysis of telemetry from missiles in flight, mostly by the CIA.

These three, in conjunction with aerial photography coming mostly from the U-2s flying over the Soviet Union, provided most intelligence available at the time to intelligence analysts. The analysts also drew on information from clandestine or open sources, and they included their own views, biases, and guesses in the process of producing National Intelligence Estimates (NIEs), the intelligence "bibles" on Soviet strategic and tactical technologies and capabilities, and on Soviet intentions.

But there were three problems with NIEs. First, no product is ever better

than its sources, and they were often too meager. Second, NIEs were often dangerously wrong on crucial strategic issues. For example, just before the Cuban missile crisis of 1962, an NIE concluded that the USSR would not place strategic weapons in Cuba—even though there was some evidence that it already had some missiles there. Third, there was often insufficient information available to produce even a guess, much less an estimate, on such esoteric topics as a radar's ability to detect stealthy aircraft. When available, COMINT and photography were considered the most credible sources of intelligence, and they provided the bulk of the NIE contributions.

No Regard for ELINT

ELINT's contribution was virtually nil, and intelligence analysts considered it next to useless. One prominent CIA operations officer said that the Clandestine Service considered ELINT a five-letter cussword, that he viewed ELINT as worthless, and that only agents could be relied on for worthwhile information.

ELINT was mostly a passive, rudimentary means of collection. It involved getting a radio receiver and recorder within line of sight of the Soviet radars or other sources of important noncommunications signals. From radio direction finding

and the recordings, one could fairly well determine the radar's location, and the signal's general frequency, pulse rate, and pulse width. From these signal parameters, an analyst could then estimate the radar's performance but not with any great accuracy or certainty.

The challenge was to find a way to intercept these radar signals beyond our line of sight, or horizon, as well as those radar signals that were within our line of sight but which the Soviets, who truly understood radiation security, simply kept off the air. The object of all this ELINT collection by various IC elements was to contribute to the Department of Defense's *Electronic Order of Battle* (EOB), a publication listing the locations of the various radars or signal sources for a number of consumers. The EOB was rather incomplete, and thus unreliable, because most Soviet radars were well out of sight of any ELINT collection assets.

This was the scene at the end of 1959, when I was a new engineer assigned to the CIA's ELINT Staff Office (ESO) in the Office of Scientific Intelligence (OSI). I was soon cleared into the OXCART project and also into the stealth aspect. One of my early encounters was with a group of OSI analysts discussing a newly intercepted signal, apparently picked up by an ELINT site in Berlin. The analysts had sketched the signal's characteristics on a blackboard. I suggested that it probably was a missile guidance signal, because of its similarities to guidance signals I had been working with earlier at Bell Telephone Laboratories in New Jersey and at Cape Canaveral as a missile guidance development engineer.

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The mystery signal indeed turned out to be the long-sought SA-2 GUIDELINE SAM guidance signal. Additional ELINT intercepts over the ensuing years would reveal enough about the signal to build electronic jammers able to counter the SA-2. I learned later that the Soviets had easily acquired US patent information on which the SA-2's FAN SONG radar was based. The Soviets had easy access to US technology, while we had hardly any access to theirs.

Difficult Questions

The OXCART mission planners were especially concerned about just how widespread the Soviet early warning radars were and where they were located. It seemed impossible, however, to determine the number, exact location, or any other technical information on those radars. I recalled an occasion at Cape Canaveral in the 1950s, when the signal from a ground-based radar located 1,000 miles beyond our horizon was picked up at the Cape; the signal was reflected off a Thor IRBM during a test flight. The suggestion was then made that this same phenomenon (later called bistatic intercept) could be used to intercept Soviet high-powered radars well over the horizon by pointing the ELINT antennas at the Soviet ballistic missiles during their flight testing, by using the missile's radio beacon for pointing or programming the ELINT antennas to follow the missile's predicted trajectory. Previously, the common practice had been to point the ELINT antennas at the horizon in the direction of the target radars. It is little wonder that no signals were ever intercepted.

George M., the head of the ESO, thought the idea worth pursuing and suggested I run the idea by a couple of highly regarded ELINT experts from private industry to fine-tune the concept before proceeding. Consequently, I was sent to California to discuss the idea with Dr. William Perry of Sylvania's Electronic Defense Laboratories in Mountain View and with Dr. Albert ("Bud") Wheelon of TRW in Los Angeles, both of whom offered technical and moral support. There were no computers in those days, so the feasibility studies and engineering calculations involved solving spherical trigonometry equations using slide rules, tables of logarithms, and hand-cranked mechanical calculators.

George's approach paid dividends with an unusually swift funding approval, and the finished system, which I named MELODY after one of my favorite-sounding words, was installed at CIA's ELINT and COMINT site on the shores of the Caspian Sea in northern Iran. Over the ensuing years, MELODY produced bistatic intercepts of virtually all the ground-based Soviet missile tracking radars, including all ABM radars at a test range 1,000 miles away. The fixed location of MELODY and the limited trajectories of the Soviet missiles being tracked, however, still did not provide the locations of all the air defense radars throughout the Soviet

Union that were needed by the OXCART planners.

A New Challenge

A new Soviet air defense early warning radar, the TALL KING, began to appear about this time, which, if deployed widely, appeared to improve significantly the Soviets' air defenses. The TALL KING quickly became the nemesis of the OXCART planners. MELODY's success with the high-powered, missile-related radars led to the idea of using the moon as a distant bistatic reflector to intercept and locate the Soviet TALL KING radars emplaced throughout the Soviet Union.

At the same time, the Lincoln Laboratories, America's premier radar-development house, had been engaged in a "radar astronomy race" with its Soviet counterparts to see which side would be first to detect and characterize the moon's surface using radar. Lincoln won, handily. I visited Dr. John Evans at Lincoln Labs and discussed the moon radar results and the bistatic ELINT idea. Drawing on the Lincoln Labs' understanding of the moon as a reflector of radar signals, sensitive ELINT receivers, tuned to the TALL KING frequency, were attached to the 60-foot RCA radar antenna just off the New Jersey Turnpike near Moorestown and pointed at the moon (the Lincoln Labs' giant radar antenna were preoccupied with more radar astronomy experiments). The ELINT receivers were also optimized for the effects of the moon as a reflector, that is, using the Lincoln Labs' "marched filter" techniques. Over time, as the Earth and moon revolved and rotated, all the Soviet TALL KINGs came into view one at a time, and their precise geographic loca-

tions were plotted. The large number of TALL KINGs that were found and the incredibly complete radar coverage of the Soviet Union was not good news for the OXCART Program Office—or the US Air Force Strategic Air Command (SAC), which had to plot wartime bomber penetration routes.

Lockheed had made its own estimates of the OXCART's vulnerability to Soviet radars, which some felt were overly optimistic. Although some earlier efforts had already been made to quantify the older Soviet radars' capabilities by measuring their power and patterns, they had only limited results. Now assigned to the OXCART Program Office, I asked for, and was granted, the job of trying to get the hard engineering data needed on the threat radars to put the vulnerability issue to rest. The first step was to ask OSI to set up a special "Vulnerability Analysis Group" to work with the hard engineering data we expected to obtain. The group worked closely with my ELINT collectors, advising us on the data they needed (there were no formal requirements for anything we did at that time) and by suggesting collection operation ideas.

A Talented Team

In looking at the Soviet air defense radars, particularly the TALL KING, and, to a lesser degree, at all the other major acquisition, target, and missile-tracking and guidance radars, the obvious place to start was where the earlier efforts left off, but with a system that would produce repeatable and unquestionable results. I assembled a small group of engineers who were known for their innovative

natures, their understanding of the Soviet air defense system, and their ability to operate anywhere in the world.

The core group never consisted of more than six people. Al N. was to run a C-97 flying ELINT laboratory operating in the Berlin air corridors, which had line-of-sight access to East German-based Soviet radars, and Richard B. ran a similarly equipped RB-47 reconnaissance aircraft operating around the periphery of the Soviet Union. Jack W., an Air Force master sergeant who had to have been the original model for television's Sergeant Bilko, ran the ground operations.

PPMS Activity

These projects lead to a series of airborne Power and Pattern Measurement Systems (PPMS) that could measure a radar's spatial coverage and its radiated power with extreme precision. The PPMS would eventually be upgraded for measuring other important radar signal parameters, including radiofrequency coherence, polarization, and internal and external signal structure details which provided even further insight into a radar's performance that would be vital to the Vulnerability Analysis Group and to the designers and builders of electronic jammers.

The precise dimensions of the TALL KING antenna were also needed for our calculations of the antenna gain for use in our radar equations. One US military attache got close-in ground photographs of the radar in East Germany. The antenna was mounted on a small brick base, and we asked for the dimensions of one

of the bricks. It turned out the bricks were from the nearby Pritzwalk Brick Factory. When we asked the Clandestine Service to get us a Pritzwalk brick, we dared not admit it was for an ELINT project. We were happy to give the impression that it was to be hollowed out to conceal something.

Our PPMS were installed in a series of Air Force planes, starting with a C-97 and an RB-47, then C-130s, and finally modern RC-135s. PPMS missions were flown around the world, along the periphery of all Communist countries, and in the Berlin air corridors. Of equal importance, these projects led to an extremely close and easy working relationship among the CIA, NSA, and the Air Force. Technical reports on the product of each mission were published by the CIA's Office of ELINT (OEL) and distributed throughout the defense and intelligence communities, as well as to the industry's electronic countermeasures designers. These reports led to a flood of requests for more information about both old and new radars, which generated more missions.

One of the earliest benefits of this accurately measured air defense coverage was that it revealed that the Soviets' low-altitude coverage was far better than our analysts' earlier estimates, and SAC quickly changed its SIOP plans for wartime penetration to a much lower and survivable altitude. The projects also answered the analysts' question of whether the TALL KING radar also had a height-finding capability for determining an aircraft's altitude as well as its bearing and range. One of our RB-47s, towing its PPMS antenna a mile behind the aircraft while over the Sea of Japan, abruptly

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descended 5,000 feet and then quickly climbed back to cruise altitude. A nearby US SIGINT station was able to confirm that the Soviets' radar had in fact observed the aircraft's altitude change while the aircraft's own warning receivers confirmed no other radars were tracking it at the time. Although under strict orders never to deviate from a steady, nonthreatening flight profile near the Soviet border, the pilot explained his actions to his superior as turbulence avoidance.

Project PALLADIUM

We now knew the Soviet air defense radars' power and spatial coverage, but that was only half the answer to the OXCART's stealth—and health. We also needed to know the sensitivity of the Soviets' radar receivers and the proficiency of their operators. The OXCART Program Office had a stable of top outside scientists to draw on, and, with their help and suggestions, I came up with a scheme to electronically generate and inject carefully calibrated false targets into the Soviet radars, deceiving them into seeing and tracking a ghost aircraft.

Basically, we received the radar's signal and fed it into a variable delay line before transmitting the signal back to the radar. By smoothly varying the length of the delay line, we could simulate the false target's range and speed. Knowing the radar's power and coverage from the PPMS projects, we could now simulate an aircraft of any radar cross section from an invisible stealth airplane to one that made a large blip on Soviet radar screens—and anything in between, at any speed and altitude, and fly it along any path.

Bud Wheelon, now the CIA's new Deputy Director for Science and Technology, dubbed our project PALLADIUM. Now, the real trick was to find some way of knowing which of our blips the Soviets could see on their radar screens—the smallest size blip being a measure of the sensitivity of the Soviets' radars and the skill of their operators. We began looking at a number of possible Soviet reactions that might give us clues as to whether our aircraft was seen. The clues ranged from monitoring the Soviets' communications, to their switching on other radars to acquire and identify the intruder. Richard B. suggested we team with NSA to provide the SIGINT monitoring of Soviet reaction to our ghost aircraft. This link was easily decrypted—and in real time. This feedback turned out to be the real key to several PALLADIUM successes.

Every PALLADIUM operation consisted of a CIA team with its ghost aircraft system, an NSA team with its special COMINT and decryption equipment, and a military operational support team. Covert PALLADIUM operations were carried out against a variety of Soviet radars around the world, from ground bases, naval ships, and submarines—submarine antenna installations being the more tricky. The logistics of such operations were often a nightmare. For example, one winter, when heavy snows closed all

airports in northern Japan, Jack W. spent more than three weeks transporting his large PALLADIUM van by train. Because of the small rail tunnels, he spent about three weeks in northern Japan, in the dead of winter, hauling his van of PALLADIUM equipment off trains and trucking and sledging it over the mountains—and putting it back on another train on the other side. Once operational, Jack flew his black ghost in and out of the Soviet air defenses.

Fooling the Cubans

When the Soviets moved into Cuba with their missiles and associated air defense radars, many of which were installed near the coast, it presented a golden opportunity to measure the system sensitivity of the SA-2 missile radar. One particularly memorable operation, conducted during the Cuban missile crisis, had the PALLADIUM system mounted on a destroyer out of Key West. The destroyer lay well off the Cuban coast, just out of sight of the Soviet radars near Havana, but with our PALLADIUM transmitting antenna just breaking the horizon. The false aircraft was made to appear to be a US fighter plane out of Key West about to overfly Cuba. A Navy submarine slipped in close to Havana Bay, and it was to surface just long enough to release a timed series of balloon-borne metalized spheres of different sizes. The idea was for the early warning radar to track our electronic aircraft and then for the submarine to surface and release the "calibrated" spheres up into the path of the oncoming false aircraft. It took a bit of coordination and timing to keep the destroyer, submarine, and false aircraft all in

line between the Havana radar and Key West.

We hoped that the Soviets would track and report the intruding aircraft and then turn on their SA-2 target tracking radar in preparation for firing their missiles—and would report seeing the other strange targets, or spheres, as well. The smallest of the metallic spheres reported seen by the SA-2 radar operators would correspond to the size, or smallest radar cross section, aircraft that could be detected and tracked.

We got the answers we went after, but it was not without some excitement—and entertainment. Cuban fighter planes had fired on a Liberian freighter the day before, although the ship's Liberian flag, which is easily mistaken for the American flag, was quite visible. This led us to expect that the Cubans and Soviets would not hesitate to attack a US-flagged vessel. In the middle of the operation, Cuban fighter planes began circling over the spot where the submarine had surfaced, and another fighter plane gave chase to our ghost. We had no trouble in manipulating the PALLADIUM system controls to keep our ghost aircraft always just ahead of the pursuing Cuban planes. When the Cuban pilot radioed back to his controllers that he had the intruding aircraft in sight and was about to make a firing pass to shoot it down, we all had the same idea at the same instant. The technician moved his finger to the switch, I nodded yes, and he switched off the PALLADIUM system.

We were now concerned that the submarine might have lingered on the surface after releasing his balloon-borne radar targets and might be unaware of the fighters circling overhead. I asked the destroyer's captain

if he could broadcast a quick, short message, in the open, to the submarine to submerge and get out of the bay. The captain passed the word to transmit the message. An eager seaman responded by hitting the intercom button and shouted down to the radio operator below deck. "Dive! Dive." And then added in response to a question from the radio operator, "No, not us. Tell the submarine to do it."

Important Achievements

By now, we felt we knew at least as much about the Soviets' radar air defenses as they did. We also knew that their radars were excellent, state of the art, and that their operators were equally proficient. We also knew which of their radars had low power, maintenance problems, or were otherwise not functioning up to par—and where the US Air Force might safely penetrate in wartime. We had finished our special mission in support of the OXCART stealth program and gave our collected data, now called Quality ELINT, to the OSI analysts. The analysts then finished their vulnerability analysis job by concluding that the OXCART would indeed be detected and tracked by the Soviets, which by then was no surprise to any of us. The OSI analysts put it to me differently, saying that we had just proved the Earth was round and that, as soon as the OXCART came over the horizon, the Soviet air defense radars would immediately see and track it. At the same time, we had also established realistic stealth radar cross section goals that, if met by the next generation of stealth aircraft, would allow the aircraft to fly with impunity right through the Soviet radar beams. The F-117 stealth fighter

would be the first aircraft to meet these goals.

Seeking Countermeasures

Even before we had finished our projects, it had become obvious that, if the OXCART could not fly stealthily, it could in the meantime fly safely, relying on its superior performance to outfly the SA-2 missiles. But we would need a stable of effective electronic countermeasures systems in the future. Our small group had already spun off two other groups: one to take on the job of developing electronic jammers and warning receivers for the OXCART and the U-2s that were still flying, albeit over China rather than the Soviet Union; and a second group to continue investigations into revolutionary techniques to reduce further the OXCART's radar cross section to an acceptable level.

The second group came up with some novel schemes, such as the mounting of special electron guns on the OXCART to generate a radar-absorbing electron cloud in front of the aircraft. The new electronic jammer group in turn began to task a new, more responsive generation of ELINT collectors to obtain even more detailed information about the Soviet radar signals. One of the U-2 missile warning receivers they developed was even modified and installed in an Air Force fighter plane and became the basis of a later system called WILD WEASEL, used to locate and destroy SA-2 SAM sites in North Vietnam. WILD WEASEL became the stuff of great stories and legends about the derring-do of the pilots who hunted down the SA-2 sites, launched their radar-killing missiles in close, and dodged the

missiles fired at them during the encounters.

Word quickly spread about our group's newfound knowledge on Soviet and Chinese radars, and calls came in from around the world seeking more information about certain operational features of specific radars. Requests even came in from submarine skippers wanting to know how certain Chinese surface search radars could detect a target as small as their periscopes, which compromised their position to enemy patrol boats. We assured them that the radars could not possibly see their small periscopes, but that they were likely seeing the submarine's ECM (SIGINT) mast. The mast was also raised above and behind the periscope; it was about the size of a totem pole, and it made an ideal target as the motion of the waves varied the mast's length, effectively optimizing it for detection by the radar. After lowering the ECM mast, the submarines were no longer detected.

Gulf of Tonkin Incident

In early August 1964, our small office received an extraordinary, and prophetic, query. My boss handed me a copy of a message from the radar operator on the US destroyer Maddox, which was operating in the Gulf of Tonkin, off the coast of North Vietnam. The message described how the Maddox, and another destroyer, the Turner Joy had been attacked for the second time by North Vietnamese torpedo boats—and that the attacking boats were seen only on the ships' radar and heard by the ships' sonar operators. That morning, I was asked, "The people upstairs want to know if those torpedo boats were real, or could the Maddox's radar

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have been spoofed electronically?" A fast read of the message gave few clues, and I asked if there was any more information available or expected. I came up with a list of things I needed to know to give a confident answer, such as visibility in the gulf at the time of the incident, any reports of lightning or thunderstorms in the area, the speed of the torpedo boats seen as moving radically toward the Maddox, and the presence of other ships or aircraft in the area. My boss went away with the questions, but he returned to say that nothing else would be forthcoming and that I was to do the best I could with the information I had—and soon.

After a fretful hour, I concluded the targets were most probably real, that the Maddox had not been spoofed. I would have been much more confident, however; if I could have had answers to my questions. I felt like one of the analysts I had criticized for always coming up with only a best guess—and it was not a comfortable feeling. (I later tried unsuccessfully for over a year to obtain answers to my original questions and to learn more about the situation in the Gulf of Tonkin that day.)

The Washington Post headlines the next morning carried President Johnson's authorization to the start in the bombing of North Vietnam in retaliation for the attacks. I learned later that the original query had

come from the White House, and that Secretary of Defense McNamara and others were there, along with Director of Central Intelligence John McCone. I surmised that McCone was the likely source of the request, because he knew about PALLADIUM and our spoofing expertise.

HEN HOUSE

The special OXCART collection projects had taken on a life of their own. Our focus soon shifted to a broader range of other so-called intractable technical problems. We went after the signals others needed, wherever and however possible. About this time, satellite photography had disclosed a huge new radar deep in the Soviet hinterland, the HEN HOUSE. The analysts "estimated" that it was a phased-array radar with some sort of space surveillance capability. By now, early ELINT satellites were in orbit, and the radar's frequency was known to be in the VHF band. A second HEN HOUSE was also under construction in the northeastern Soviet Union, a couple of hundred miles inland from Riga but still well beyond any ELINT receivers line of sight.

Judging from the size of the radar and its probable high power, I felt we should be able to pick up its signal, even when it was not pointed our way, out to several hundred miles; the signal would be scattered forward and over the horizon via a phenomenon known as tropospheric-scatter of radio waves. Studying a map, I found an island in the Baltic Sea that looked to be at about the right distance from the HEN HOUSE to install a tropospheric-scatter receiver that could intercept and continuously monitor the radar.

once construction was completed and it went on the air.

After extensive negotiations seeking approval for access to the island, dual antennas were installed, about 50 wavelengths apart, to reduce the expected atmospheric fading and the receiver was put on automatic pilot, or unattended operation, and then we waited. The BRIAR PATCH troposcatter system finally picked up the very first HEN HOUSE transmission and every subsequent transmission.

We learned that the radar tracked US satellites from the first orbit, and that the Soviets had an incredibly effective espionage network in place to tip off the HEN HOUSE when a US intelligence satellite was about to be launched. When there was a lengthy hold of an impending launch from Vandenberg Air Force Base in California, the HEN HOUSE would switch off and come back on the air the instant the satellite lifted off from Vandenberg. The HEN HOUSE would thus have a track on the satellite on its first pass overhead.

We also learned that the HEN HOUSE tracked aircraft just as well and as often as satellites. This idea of monitoring a radar's operations full-time was analogous to the concept of traffic analysis in COMINT. In the HEN HOUSE case, the radar's precise frequency indicated its pointing angle, which was then correlated with the most likely targets being tracked.

OXCART flight operations out of Okinawa were eventually halted and the fleet of 13 airplanes permanently grounded while their sister aircraft, the SR-71 Blackbird, took to the air. With the nation's SIGINT activities

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now being consolidated under NSA auspices, NSA and the Air Force carried on and expanded our special collection programs.

Caught Cheating

One of MELODY's more significant successes would come about much later, during negotiations with the Soviets on the 1972 ABM treaty—which included an obligation not to give non-ABM systems, such as the SA-5 anti-aircraft missiles, capabilities to counter strategic ballistic missiles—and not to test them in an ABM mode. As a prelude to an NIE on the subject, intelligence analysts were debating whether the SA-5 could be upgraded to become an ABM and whether the Soviets might try to test it covertly in an ABM mode.

After nearly a year of trying to come up with an agreed-on estimate of SA-5 capabilities and Soviet intentions, some analysts believed that the Soviets should never be expected to cheat on such an important treaty. I suggested that we assume that the Soviets, based on their history, should be expected to cheat on the treaty by testing their SA-5 against one of their own

ballistic missiles, and that we should try to find a way to catch them at it. Much to the chagrin of the analysts, MELODY answered the questions within a few weeks. MELODY had been quickly modified by adding a special ELINT receiver tuned to the SA-5's ground-based target-tracking radar frequency—which was known by then. We relied on a radar located in another country for pickup of Soviet IRBM launches. The SA-5 target tracking signals were bistratically intercepted from the Sary Shagan missile test site, 1,000 miles away, as the Soviets repeatedly tested the SA-5 in the forbidden ABM role.

During one of the ensuing Geneva negotiating sessions, Secretary of State Kissinger, using intelligence derived from the MELODY intercepts, looked his Soviet counterpart in the eye and read him the dates and times the Soviets had cheated on the treaty. The cheating immediately ceased, and the Soviets began a molehunt for the spy in their midst that most surely had tipped us off.

Counting Troops

During the Vietnam war, CIA's special task force on South Vietnam was engaged in a heated debate with the Army and the Secretary of Defense's office over just how many North Vietnamese soldiers were infiltrating into South Vietnam. The CIA estimates were much larger than those of the Department of Defense. A quick study revealed that the Air Force had emplaced acoustic sensors along the Ho Chi Minh Trail (Project IGLOO WHITE) in an attempt to detect and count infiltrators. Both the Air Force and Navy had SIGINT planes, a C-130 and a C-121, orbiting off the Vietnamese

coast to intercept and count the number of small radios carried by the infiltrating groups, always traveling in fixed numbers, on their trek south on the trail. An estimate was obtained by multiplying the radios by the number of men per group. The problem was that the orbiting SIGINT airplanes could not fly high enough to intercept all the radios on the long trail.

Our suggested solution was to get an airplane, in this case the U-2, that could fly high enough to intercept all the radios simultaneously for an accurate count. The Air Force soon found a special COMINT receiver in its inventory and had the operation underway in about a month. Each U-2 could stay aloft 12 hours, and two could provide 24-hour coverage. The infiltration rate turned out to be more like a flood. I was relieved to move on to another assignment before the Defense Department

received the news of a more accurate count.

Trailblazing

During the years that our small group of engineers was in existence, we would occasionally discuss just how far we could go in terms of probing, spoofing, and injecting false targets and information into an enemy's electronic network to learn covertly more about his hidden capabilities and intentions. We also brainstormed about what responses and observables we might look for when radiation security, energy encryption, and deception were used. The process had no name at that time, but, in retrospect, we were unwitting participants in the origins of what is now known as information warfare