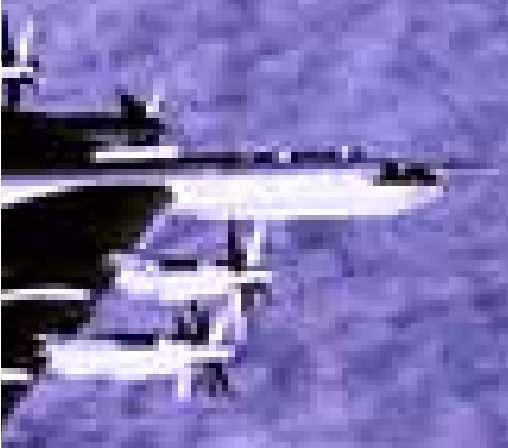
In its heyday, it included a Ground Observer Corps, radar picket lines in the far north, SAGE centers, and almost 1,500 interceptors.

The

In the mid-1980s, F-4s out of the 57th Fighter–Interceptor Squadron escort a new Soviet Bear-H bomber on reconnaissance patrol off North America. This typical Cold War scene was replayed recently as Air National Guard F-15As intercepted a Russian Tu-95 Bear near Iceland, a NATO member.

Rise of Air Defense

By Walter J. Boyne



Last June 25, a pair of Tu-95 Bear bombers raced out of Russia and seemed to be about to enter the airspace of Iceland, a NATO nation. Two F-15A fighters from the Louisiana Air National Guard's 159th Fighter Wing, which had been deployed to Reykjavik, scrambled and rose to meet the Bears, warning them off. The Bears turned onto another course and departed the area. The intercept marked only another round in the continuing, eight-decades-long history of American air defense operations.

In 1916, no less a visionary than Alexander Graham Bell warned about the possibility of airship raids on the US. For the next 25 years, experts studied the problem of air defense and lay the foundation for the future. During World War II, there was a sizeable effort to defend the country from aerial attack, and in the years immediately following World War II, the Soviet Union presented a threat in the form of Tu-4 bombers.

The US reacted slowly to the Soviet air threat, not from slothfulness but because of the drastic adverse effects of rapid demobilization of US Army Air

Forces and greatly shrunken postwar budgets. In time, however, the newly independent Air Force would meet the Soviet bomber challenge head-on with a massive response. From a small beginning, more than a dozen ever more sophisticated interceptor aircraft were introduced, ranging from World War II P-61 Black Widows to today's F-15s. Total numbers rose from a single P-61 to a peak strength of almost 1,500 interceptors of various kinds.

In addition to the airplanes, there were sophisticated Surface-to-Air Missiles; immense radar systems built through the trackless Arctic; a huge, enthusiastic Ground Observer Corps; picket ships; Texas Towers; and airborne command-and-control aircraft. All were integrated into a series of computer-based control systems.

The Ground Observer Corps was reconstituted in 1950 to become part of the first line of defense against air attacks in the post–World War II years. Volunteers like these carried on operations until the corps was deactivated in 1959.

Threats Near and Far

There were many hotly contested political issues. At the most basic level in the Air Force, there was concern that funds to create an "impenetrable air defense" would be obtained by siphoning money away from Strategic Air Command's mission of nuclear deterrence. Apart from the intramural disputes, USAF's battles with the Army over control of SAMs and other issues were particularly bitter.

The initial requirement was to stop a handful of conventionally armed piston engine–powered bombers on a one-way mission, flying a predictable course. The threat swiftly grew to the prospect of an attack by hundreds of turboprop and jet bombers armed with thermonuclear weapons and attacking from different directions. Meeting such a threat required the creation of a huge system. It consumed billions of dollars. It required leadership, foresight, and brilliant science.

Even more important, its day-by-day success hinged on the dedication of pilots, mechanics, radar operators, and all of the other anonymous personnel who fought off the extreme cold weather and endless hours of boredom to stand guard against an enemy they hoped would never come.

Air Defense Command duty was almost always difficult. Many bases were located in the north and weather conditions were often miserable. In the early days, bases had few amenities, and alert crews had to stand by their aircraft in drafty hangars. In the far north, snow was sometimes so deep that an aircraft taking off could not be seen until it lifted above the snow walls lining the runway. After an intercept, landings were made at the snowbound runway with minimum visibility and ceiling. ADC pilots were almost always superb at their work.

Activation of Air Defense Command took place in March 1946 at Mitchel Field, N.Y. It was part of a general reorganization of the US Army Air Forces. It was commanded by Lt. Gen. George E. Stratemeyer, former head of USAAF in China. Stratemeyer drove himself, attempting to accomplish tasks for which resources would not be forthcoming.

At the time, the leading air defense specialist was Maj. Gen. Gordon P. Saville, who had formulated his ideas as an instructor at the Air Corps Tactical School. He had been heavily involved in the air defense issue early in World War II. He even wrote AAF's handbook "Air Defense Doctrine" in 1941.

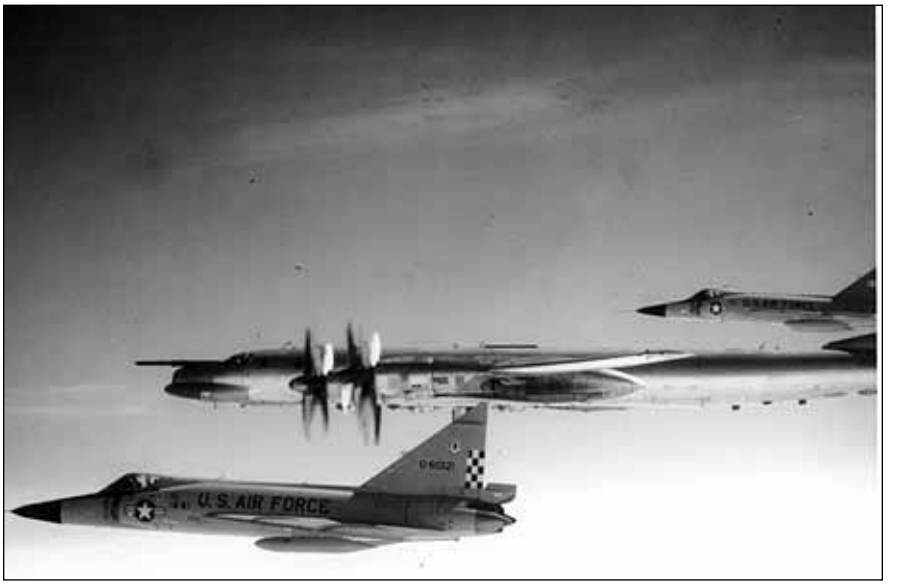
Saville had given much serious thought to the Claire Chennault–style warning system, which made heavy use of ground observers connected to central filter sta-

Shown here on air defense alert, the radar-equipped F-86D filled in the gap in the early 1950s while a more ideal long-range, supersonic, high-altitude fighter–interceptor was developed. Some pilots called this aircraft the "Sabre Dog."

tions. He advocated and promoted growth of radar stations, Ground Observer Corps, and control centers that would be useful for the future.

The Georgia–born Saville was a tough customer who, if he had to, would run roughshod over an opponent to accomplish his mission. By 1944, however, most people viewed the probability of an Axis air attack as negligible and Saville was given other duties. It was not until 1948 that he returned to the air defense problem under ADC and Stratemeyer.

Saville was assigned as a special projects officer in June 1948, with the mission of reviving ADC from the shambles of demobilization. His flamboyant personality and regulation-defying ways were regarded as the price the Air Force had to pay for his brilliant intellect.



F-102 Delta Daggers escort a Soviet Tu-95 Bear. The Dagger, which won the "1954 Interceptor" competition, entered service in 1956. At peak deployment there were more than 25 F-102 squadrons.

These three F-89D Scorpions, assigned to the 64th Fighter–Interceptor Squadron, Elmendorf AFB, Alaska, performed air defense duty in the Arctic, from Alaska to Greenland and Iceland. This model carried 104 2.75-inch folding-wing air-to-air rockets in its wingtip pods.

Hands-On Experience

He and his commander had a foundation for the effort. In World War II, USAAF had acquired great experience with air defense systems. It confronted the Luftwaffe in three vicious years of fighting over Europe. Japan's defenses, while less formidable than those of Nazi Germany, presented many problems. The service also had acquired much valuable knowledge through the development of its own radar stations and interceptor units in the US.

What both Stratemeyer and Saville lacked, however, were the airplanes, personnel, and funds for ADC's mission. Assets were almost nonexistent. There were two night fighter squadrons. One was a purely paper organization, while the other, initially, had one officer and two enlisted men.

Postwar budgets for the military were cut beyond the bone, and the services were constantly shifting and scrambling to cover shortfalls. On Dec. 1, 1948, USAF established the new Continental Air Command, with Stratemeyer in charge, as a coordinating agency for ADC and Tactical Air Command and the training of the Air National Guard and Air Force Reserve. Simultaneously, Saville became head of an ADC which was now a subordinate organization.

He continued to plug away at the problem, however. As the Soviet threat became generally recognized, so did a requirement for adequate early warning. In the earliest effort to provide it, USAF came up with a system in 1947 known as "Radar Fence Plan," which called for 411 radar stations and 18 control centers and was projected to cost $600 million. The cost of the plan clearly exceeded the Air Force ability to pay, and Saville was asked to develop a less expensive version.

Saville's answer was something that became known as the "Permanent System." It was to consist of 85 radar stations and 11 control centers, in the United States and Alaska. The cost was estimated to be about $116 million, spread over the period 1949–50. It became fully operational in April 1953.

However, the Air Force was loath to ignore the immediate threat, and it built a temporary system, sarcastically but aptly called "Lashup." It comprised 43 sites by 1950. The system used World War II AN/CPS-5 search radar systems that were deficient in range and in low-altitude detection capability. In addition, 36 ANG fighter units were called to active duty for the mission.

By the early 1960s, detecting incoming Soviet ICBMs had become more important than intercepting an attack by Soviet bombers. NORAD expanded in the 1960s primarily in response to this new threat.

Back to Radar

Lashup had the great value of introducing the US again to the concept of a radar air defense system. It was soon augmented by three more-effective systems whose inputs would be fed to one of the bigger gambles of the period—the Semiautomatic Ground Environment system, designed to control fighters and fight the air defense battle. SAGE had begun as a concept in the Air Defense Systems Engineering Committee, headed by eminent Massachusetts Institute of Technology scientist George E. Valley. Valley foresaw that computers would develop to the point that they could be used to control an air defense system. He was right, and he was backed by ADC commanders throughout the years.

In the early 1950s, the Soviet military threat began to expand rapidly. The United States responded primarily by building up the striking power of the Air Force's Strategic Air Command, which grew steadily in offensive power with the acquisition of jet bombers and tankers and, later, Intercontinental Ballistic Missiles. Deterrence occupied the top rung of the strategic ladder.

Yet the requirement for air defense was by then widely recognized. ADC was reinstated as a full major command in January 1951, with Lt. Gen. Ennis C. Whitehead as commander and ADC headquarters established at Ent AFB, Colo. More importantly, the air defense mission now began to receive major appropriations. It was used mainly to buy an adequate interceptor force, and ADC operated a succession of ever more sophisticated radar systems supplemented by advanced SAMs.

The Royal Canadian Air Force proved to be a boon partner with the United States, both in the responsibilities it assumed in the construction of the warning systems and in the provision of effective air defense squadrons. In some respects, the air defense mission was to RCAF what the nuclear deterrent mission was to USAF—its No. 1 reason for being.

In the early 1950s, the two North American air forces launched construction of the Pinetree Line and completed it in June 1954. Consisting of 33 stations, it extended on both sides of the international border and provided warning and ground-control-intercept activities. The United States paid for 22 of the stations and provided personnel for 18.

Canada then constructed the Mid–Canada Line, building it entirely with its own resources. Built along the 55th parallel, the early warning system was also called the McGill Line, after the scientists at McGill University who planned and designed it. Not so much a radar warning line as an unmanned microwave fence, the line signaled when something—anything—flew over it. The Mid–Canada Line became operational in 1957 and cost approximately $220 million.

Above the Arctic Circle

It was then that military officials began to entertain the prospect of building a warning line in the far north, inside the Arctic Circle. High cost projections disturbed Air Force leaders, who believed the money could be better spent on bomb shelters and base dispersal efforts. However, USAF conducted experiments in conjunction with the Lincoln Laboratory of MIT and became convinced that a Distant Early Warning Line was feasible.

Once again working in cooperation

An F-106 launches an ATR-2A (the training version of the AIR-2A Genie rocket). Operating with the SAGE system, the Delta Dart could be flown automatically from wheels up to flareout before touchdown.

with Canada's air force, USAF in December 1954 placed a contract for the construction of the DEW Line.

The DEW Line, built along an irregular path extending from Cape Lisburne, Alaska, to the west coast of Greenland, with auxiliary stations situated even further east, was a mammoth undertaking. It was the largest construction project ever attempted in the Arctic, and it required the movement of hundreds of shiploads of material and thousands of sorties by American transport airplanes. The workforce toiled day and night, seven days a week, to make the July 31, 1957, date when responsibility was to be transferred to USAF. Twenty-five lives were lost in the process.

The "White Alice" communications system was built to link airborne warning and control aircraft with the DEW Line radar. Ultimately, 49 sites were built, extending along the Aleutian archipelago out to Shemya, Alaska. There were few places where boredom was more pervasive.

On the ground in the late 1950s, air defense in the far north included radars on the DEW Line, amid windswept peaks on the frozen landscape. Construction of the DEW Line was the largest building project in the Arctic.

A more radical idea for early warning: Texas Towers, named for their resemblance to oil-drilling platforms. The radar stations rose from the sea, off the northeast coast of the US. This is TT-3, located south of Nantucket, Mass. The last of the towers was decommissioned in 1963.

The success of the DEW Line smoothed the way for the creation of the Ballistic Missile Early Warning System, which was completed in 1963 after five years of intensive effort. The BMEWS sites included Thule AB in Greenland, Clear AS in Alaska, and RAF Fylingdales Moor in England. In addition, the number of radar stations had increased dramatically during the decade of the 1950s, with 300 small automatic radar sites adding coverage.

The Pinetree, Mid–Canada, and DEW Lines all were integrated into the SAGE system. The SAGE project had gotten a major boost from the ADC commander, the brilliant Gen. Benjamin W. Chidlaw. Chidlaw had done remarkable work during World War II, supervising some of the most advanced projects at Wright Field in Ohio before becoming a combat commander in Europe. When he took command of ADC in August 1951, he concluded that it had the capability to destroy only about 10 percent of an incoming bomber force, and he was determined to improve the situation with technology. Chidlaw's answer was SAGE, which he promoted relentlessly.

After years of development effort, the SAGE system became operational on June 26, 1958, when the New York sector came on line. Air Force enthusiasm for SAGE led to the planning of an intricate network of eight air defense regions within the continental United States and 32 SAGE direction centers. It was linked to 54 fighter–interceptor squadrons backed up by 66 Nike–Ajax SAM battalions.

Shifting Emphasis

In the early 1960s, however, SAGE was overtaken by events, as USAF shifted its emphasis away from intercepting bombers and toward the detection of ICBMs. It also had initial operating difficulties, with operators tending to prefer well-known manual techniques of controlling interceptors rather than relying on automated information. SAGE was never tested in battle, but it gave the US Air Force a crash course in computer technology that would stand it in good stead in the future.

The need to extend the radar warning lines and to fill gaps in coverage, particularly for low-flying aircraft, led to the use of other means of detection.

The BOMARC—shown here at Cape Canaveral AFB, Fla.—was USAF's ground-fired weapon for area defense and was operational from 1959 to the 1970s. Deployed at 10 sites, BOMARCs were integrated into the SAGE system.

In 1953, USAF began using the EC-121 Warning Star as an early warning aircraft. The military EC-121s flew out of Otis AFB, Mass., on the East Coast and McClellan AFB, Calif., in the west. Eventually, USAF operated 11 squadrons. The early EC-121s had relatively primitive electronic systems and were not very reliable. Over time, however, the equipment improved and the EC-121s could be linked directly to the SAGE network. The success of the EC-121s could be attributed to the aircrews who flew the long missions and to the patience of the ground crews who kept the maintenance-prone airplanes airborne. The success of the EC-121s led to the later generation of the E-3 Airborne Warning and Control System aircraft.

The Air Force took some unconventional steps, too. It even harked back to the early 1940s by reconstituting a Ground Observer Corps. During World War II, more than 1.5 million US civilians had trained in the GOC. They were almost too enthusiastic, though, and tended to deluge Ground Control Intercept sites with well-meaning but unhelpful phone calls. The program was discontinued in 1944. In February 1950, Whitehead called for a Ground Observer Corps of 160,000 members to help plug the gaps in low-altitude coverage. The GOC was not deactivated until 1959.

The radical extent to which USAF would go for radar warning time was best evidenced by the sea-based platforms called Texas Towers. These resembled oil-drilling rigs and were placed on shoals about 100 miles off the northeast coast of the United States. The Air Force proposed five towers, but only three were built. The first, Texas Tower Two (TT-2), began operation 110 miles east of Cape Cod in December 1955.

A staff of 54 was installed on each tower, which would roll and groan from being pitched in the sea swells and from vibration of equipment. It was difficult duty, and it turned tragic on Jan. 15, 1961, when all 28 members of a caretaker crew died when a winter gale caused the collapse of TT-4. The last of the towers, TT-3, was decommissioned in 1963.

The question of who was to control US air defense became a source of considerable tension between the Air Force and the Army. The Army wished to retain control of its anti-aircraft artillery and felt that their claim was enhanced by development of the Hawk and Nike series of Surface-to-Air Missiles. The Air Force developed its own SAM, the BOMARC (for Boeing–Michigan Aeronautical Research Center), and wished to control all aspects of air defense, including ground-fired weapons.

It was a difficult issue, going to

The Lineage of the Air Defense Fighter

When the Cold War began, bomber technology was ascendant and would continue to be so for more than a decade. That P-61 did not have the capabilities to engage the Soviet Tu-4 bomber. Its successor, the F-82 Twin Mustang, was even more disappointing. It took a long time to get into production and did not perform well in inclement weather.

The early jet fighters, such as the P-80 and P-84, lacked all-weather capability and were deemed useless for air defense purposes. Much hope was placed on two jet-powered interceptors, the XP-87 Blackhawk and the XP-89 Scorpion. (Designations changed to XF-87 and XF-89.) They, in their turn, proved to be inadequate. The XF-87 was cancelled and the Scorpion had to undergo extensive redesign.

While the Scorpions were maturing, the F-94 Starfire was pressed into service as an "interim" interceptor. North American in 1949 pushed an interceptor version of the Sabre, the F-86D. Despite the demands its complexity made upon a single pilot, the F-86D was backed by senior Air Force officials. Some 2,504 would be built and it would in time be the most numerous interceptor in the Air Defense Command fleet, with more than 1,000 in service by the end of 1955.

The F-86D was not ideal, however, for its afterburner consumed a great deal of fuel in getting it to altitude, and the pilot was overburdened by cockpit tasks.

At the same time that a decision was made to use the F-86D, a design competition for a "1954 Interceptor" was held by the Air Force. Criteria for the 1954 Interceptor included long range, supersonic speed, and high-altitude capability. It was to be integrated with the ground-based radar system and be guided automatically to the target. The interceptor's own radar and fire-control system would make the interception, fire the weapons, and then guide the aircraft automatically back to the home field.

The winner of the competition—the F-102 Delta Dagger—did not enter service until 1956, and then only to serve as a stopgap until the arrival of the F-106 Delta Dart. "The Six" became operational in 1959, and, when the bugs were worked out, met all of the expectations of the 1954 Interceptor competition. However, the 200 black boxes of the MA-1 system were a maintenance challenge.

To augment the interceptor force, ADC brought the F-104 Starfighter into service in 1956 and the F-101B Voodoo in 1959. The F-104 was too small to house all the necessary equipment for a first line interceptor. It was retired to the Air National Guard by 1960. The F-101s proved to be excellent interceptors, almost equal to the F-106s, and remained in service until the 1980s.

the very heart of roles and missions. Defense authorities ultimately decided that the Army would deploy the Nike for point defense and the Air Force would deploy BOMARC for area defense.

BOMARC was an ambitious project. Seven years of testing passed before the missile became operational in 1959. Some 500 nuclear-tipped BOMARCs were deployed at 10 sites (two in Canada), and the missile was integrated into the SAGE system. Performance was remarkable for the time, with a speed of about Mach 2.5, a ceiling of 80,000 feet, and a range of 200 miles. BOMARC's onboard radar guided it to its target. The proximity-fused nuclear warhead was intended for use against Soviet formations. The missile stayed in service until the early 1970s.

Photo by Theo Van Geffen

Air National Guard units played a key role in the US air defense mission during the Cold War and continue to do so today. Above, a KC-135 refuels F-4s from the Minnesota and California ANG.

An F-15 from the 21st Tactical Fighter Wing intercepts this Soviet Bear-H off Alaska's northern coast in July 1985. Back then, Soviet aircraft routinely tested North America's air defenses.

Birth of NORAD

The Army didn't like the Air Force's organizational ideas, either. In 1954, Chidlaw produced a plan for a US Air Defense Command, a joint command featuring close coordination and cooperation of Army, Navy, and USAF units concerned with air defense. He also suggested that Canada be invited to participate. The Army was outraged and expressed its deep disapproval.

The Army's reaction notwithstanding, the Joint Chiefs of Staff embraced Chidlaw's idea, using it as the basis for the formation, in 1954, of Continental Air Defense Command. Chidlaw himself became the first commander of the Colorado Springs, Colo.–based CONAD, which was the progenitor of North American Air (now Aerospace) Defense Command, established in 1957.

NORAD expanded greatly in the 1960s but principally because of the emerging Soviet ICBM threat. Robert S. McNamara, Secretary of Defense in the Kennedy and Johnson Administrations, concluded that the ICBM problem was so overwhelming that it rendered relatively inconsequential the threat of Soviet bomber attack. The American air defense system had risen from postwar wreckage to become the most sophisticated ever, but, with the rise of the ICBM, emphasis on air defense against bombers went into a sharp decline.

ADC's mission was reduced over time. In 1980, ADC was once again inactivated, and its assets were divided between the Air Force's Tactical Air Command and Strategic Air Command. Today, ADC's proud heritage is maintained by NORAD, Air Combat Command, the Air National Guard, and the Air Force Reserve, as was made clear on a recent day in the skies around Iceland. ■

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