AIR & SPACE POWER History

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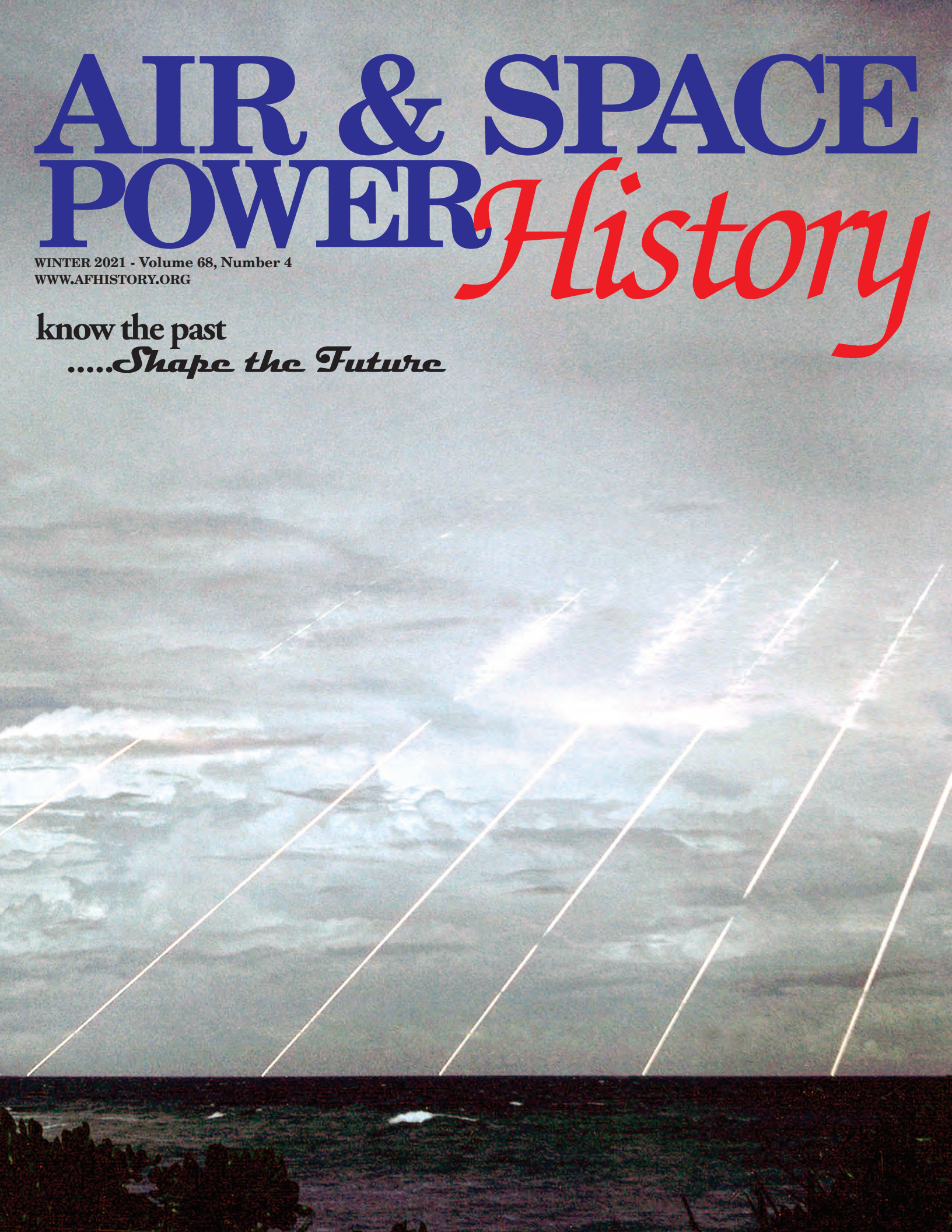

Center: McConnell. Clockwise from Top Right: Doolittle and LeMay, Chapman, Leavitt, Phillips, James and Olds, Pitsenbarger.

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Features

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COVER: LGM-118A Peacekeeper missile system being tested at the Kwajalein Atoll in the Marshall Islands.

Air Force Historical Foundation
P.O. Box 790
Clinton, MD 20735-0790
(301) 736-1959

E-mail: angelabear@afhistory.org
On the Web at http://www.afhistory.org

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Editor
Richard I. Wolf

Editor Emeritus
Jacob Neufeld

Book Review Editor
Scott A. Willey

Advertising
Jim Vertenten

Circulation
Angela J. Bear

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Address **LETTERS** and **manuscripts** to:

Air & Space Power History
148 Bay Drive
Sudbury, MA 01776
e-mail: airpowerhistory@yahoo.com

Correspondence regarding missed issues or changes of address should be addressed to the **CIRCULATION OFFICE**:

Air & Space Power History
P.O. Box 790
Clinton, MD 20735-0790
(301) 736-1959
e-mail: angelabear@afhistory.org

ADVERTISING

Jim Vertenten
P.O. Box 790
Clinton, MD 20735-0790
(301) 736-1959
e-mail: ed@afhistory.org

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President's Message

Dear Foundation Members and Friends,

It is a great honor to serve as the President of the Air Force Historical Foundation and a great comfort to share leadership with our Chairman, General Holmes. The last two years have been challenging for the foundation and the Nation, but they allowed us to look back over our achievements as an organization and adjust our focus on the future.

When General Spaatz and a handful of other air power pioneers founded the Air Force Historical Foundation, it was dedicated to "preserving the history and traditions of American aviation, with emphasis on the U.S. Air Force, its predecessor organizations, and the men and women whose lives and dreams were devoted to flight."

As General Holmes and I attempt to temporarily fill those pioneers' very big shoes, we will focus on expanding our founders' vision, not only to include our new Space Force, but to rededicate our energy into making the Air Force Historical Foundation more responsive to and inclusive of future generations. Our goal is to make sure Air Force and Space Force history is collected, preserved and available to anyone who wants to learn more about our shared heritage. The Air Forces' 75th Anniversary provides an opportunity and a framework for continuing this process.

We believe that creating a more interactive website with expanded searchable archives is a good place to start. With that in mind, we are working on multiple projects to digitize original material from great Air Force and Space Force leaders, as well as projects to capture oral histories from current active duty and Reserve members of both services. We hope to begin with *Project 9/12*, a series of recorded interviews with Airmen and Guardians beginning with September 11, 2001, and continuing through the end of the twenty-year war in Afghanistan.

We know that multiple organizations have dedicated themselves to collecting air and space power history and that they've done a great job. Since our goal is to make sure history is available to all, we are starting a pilot program to partner with air and space museums around the country. General Barry, one of our board members, has agreed to lead this mission. We plan to participate in various museum events and to provide descriptions of the museums, their collections, and the focus of their research on our website with links to their websites.

Another project under construction is the development of a virtual book group. We plan to post a list of recommended books and to host an interactive, online book discussion with authors, experts and historians. Perhaps we'll start with our own book, *75 Great Airmen*, by Dr. Rebecca Grant, the foundation's tribute to the 75th Anniversary of the Air Force.

In the meantime, *Air and Space Power History* will continue to focus on scholarly studies of air and space power—what happened, what worked, what didn't work and why.

Our Awards Dinner, originally scheduled last October, has been rescheduled to Monday, May 2, 2022. Please watch for more information. We look forward to hosting our recipients and celebrating their achievements with all of you. This year we are honoring General John W Raymond, USSF, with the Spaatz Award, Dr. Daniel Haulman with the Holley Award, the 28th Bomb Wing with the Doolittle Award, Dr. Brent D Ziarnick will receive the Best Book Award and Col. Jason A. Altieri the Best Article Award.

As General Holmes and I begin our term, we want to let you know how important you are to the Air Force Historical Foundation. We want to make these next few years a joint journey with you as our partners. We plan to listen to your suggestions and include you as we move forward. That said, we have a request. We would like our members to become more active in the foundation by starting with participating in the nomination process for our 2022 award recipients. Please let us know who you think we should honor and why.

In closing, we would like to thank you for this opportunity and for all you've done to support this historic foundation. I'm sure General Spaatz and that handful of air power pioneers are looking down and smiling.

Respectfully,

Jonna Doolittle Hoppes,
President

From the Editor

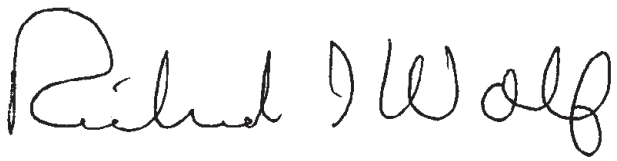
Our issue this time seems to be covering a broad spectrum of Air and Space History. The President's Message has some insight into future plans.

Our first article is by many-time contributor Theo van Geffen.This time he turns his attention to Desert Storm, as he writes about Joint Task Force—Proven Force. Very interesting read and some interesting numbers.

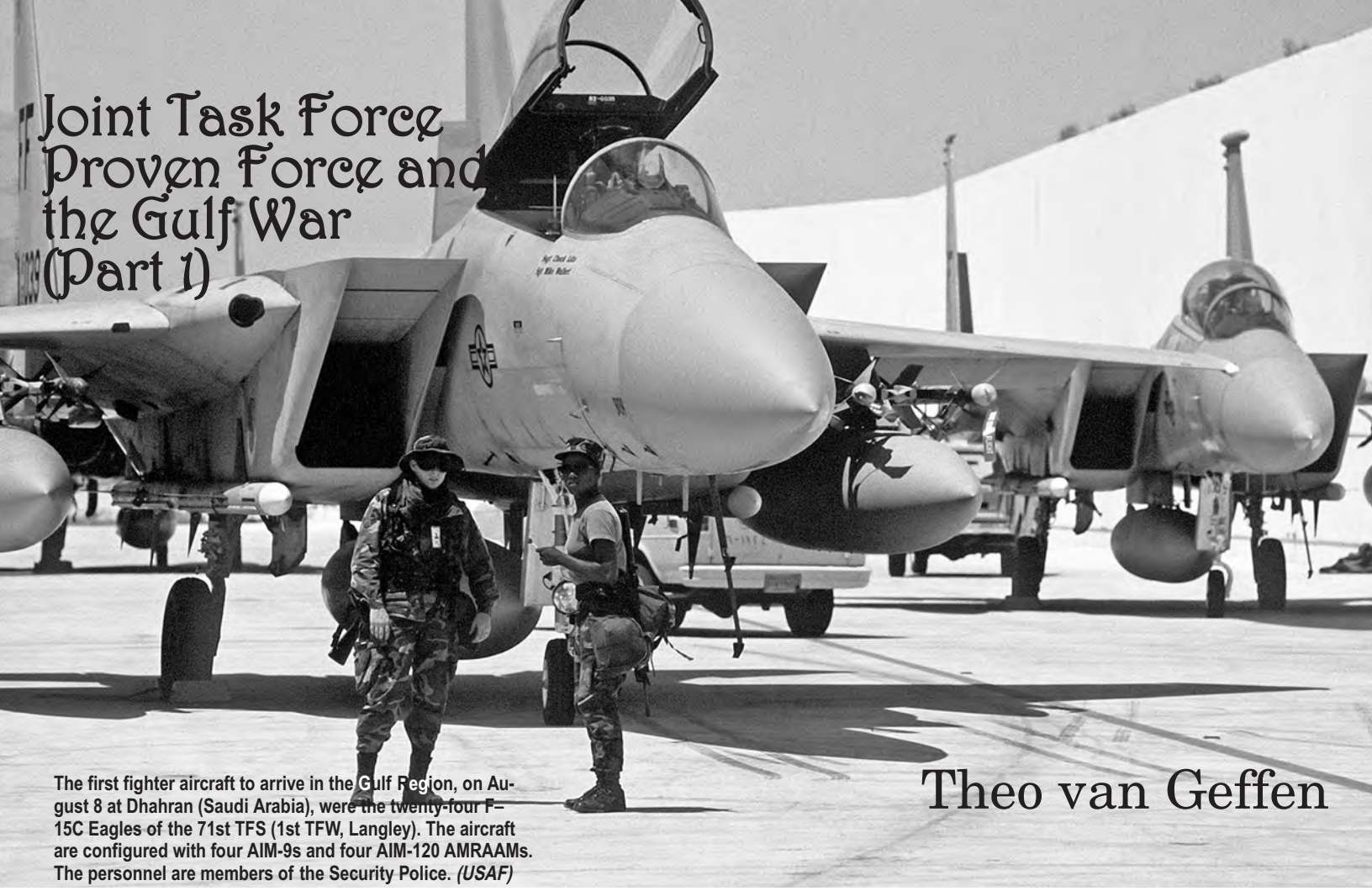
Our second article is by much-published missile author David K. Stumpf, who this time is writing about a small corner of missile development, the ability to measure the accuracy of missile systems. Take a look at it, it's very comprehensive.

Our third article is the story of Robert Manning Gray, a Doolittle Raider who survived the raid, but not World War II. Enjoy it. Don't skip over it to get to the reviews of which there are 20 this time.

The President's Message begins on page 3. Don't miss Upcoming Events on page 62, although I fear you must continue to take all dates in that section as still uncertain at this point. If you see something scheduled, be sure to check with the organization sponsoring the event to ensure it will take place. And the closing story is this issue's Mystery. Enjoy!



Joint Task Force Proven Force and the Gulf War (Part 1)



The first fighter aircraft to arrive in the Gulf Region, on August 8 at Dhahran (Saudi Arabia), were the twenty-four F–15C Eagles of the 71st TFS (1st TFW, Langley). The aircraft are configured with four AIM-9s and four AIM-120 AMRAAMs. The personnel are members of the Security Police. *(USAF)*

Theo van Geffen

Starting in August 1990, U.S. and allied forces arrived in numbers in the Gulf region to persuade Iraq's Saddam Hussein to give up Kuwait, which was occupied on August 2, and claimed as Iraq's 19th province. In mid-January, a second front was opened from Incirlik Air Base (Turkey). A score of aircraft types were involved. In a multi-part article we will have a closer look at the involvement of several aircraft types, including the B–52G Stratofortress and F–4G Phantom. This part will discuss the 'birth' of Joint Task Force PROVEN FORCE (JTF-PF) and B–52G operations.

Air campaign

The first USAF aircraft to arrive in the Gulf region, on August 8 at Riyadh, were five E–3A/B Airborne Warning and Control System (AWACS) aircraft from Tinker's 552nd Airborne Warning and Control Wing (AWCW). They did so prior to the arrival in the afternoon from Langley AFB, Virginia, of twenty-four F–15Cs of the 71st TFS/1st TFW at Dhahran (Saudi Arabia). The Squadron immediately started to augment Royal Saudi Air Force (RSAF) air defense alert and CAP (Combat Air Patrol) operations. Also on the 8th, Great Britain committed itself, with the first Tornado F.Mk 3s arriving from Cyprus at Dhahran on August 11. The number of USAF aircraft in-theater on November 1 was 718 (Phase I), including 20/B–52G, 36/F–4G and 14/EF–111A. F–16s topped the list with 120 deployed.

January 15, 1991 was the deadline the United Nations Security Council had agreed upon earlier to expel Iraqi troops from Kuwait using force when the country would still be occupied. By then, the number of USAF aircraft had increased to 1,132 (Phase II). With 210 aircraft, F–16s once more topped the list. The number of B–52Gs had increased to twenty-one, the F–4G number was forty-eight and of the EF–111A, eighteen.

Normandy

On January 16, the DESERT STORM air campaign plan was completed with an Air Tasking Order (ATO) issued for each 24-hour period, 0300-0259Z (0600-0559L). However, the period for the Day 1 ATO was 16/1800Z-18/0700Z Jan. The air war began with two days of pre-planned operations, which were the most thoroughly planned and most complex air operations of the war.

H-hour was 17/0300L Jan. At H-90 (0130L) January 17 (16/2230Z Jan), Navy ships in the Persian Gulf and Red Sea started launching fifty-two BGM–109 Tomahawk cruise missiles towards targets in Baghdad, of which about one-third

At H-21 (0239L), twenty-one minutes prior to the start of DESERT STORM, Task Force NORMANDY was on their way to their targets in Iraq. It included four MH–53J PAVE LOW III helicopters, acting as pathfinders for eight US Army AH–64A Apache attack helicopters. An MC–130E was airborne as tanker support, while MH–47Ds were available with FARRP equipment to refuel the Apaches when necessary. Both sites were destroyed with AGM-114 Hellfire missiles, Hydra 70 rockets and the Apache's 30-mm gun. ***(USAF)***

against the electrical power grid. Their Time-on-Targets (TOTs) was 0306-0311L. At H-21 (0239L), Task Force NORMANDY, four MH–53J PAVE LOW III helicopters (20th Special Operations Squadron (SOS)/1st Special Operations Wing [SOW, Hurlburt]) acted as pathfinders for eight U.S. Army AH–64A Apache attack helicopters (1st Battalion/101st Aviation Regiment [Ft Campbell, KY]) to their targets in Iraq, two Early Warning (EW) radar sites about fifty nautical miles (NM) north and north northeast of Ar'Ar. The MH–53J's FLIR (Forward-Looking Infrared) and TFR (Terrain-Following Radar) permitted safe flight at extremely low altitudes at night, with GPS (Global Positioning System) permitting precise navigation. The first rehearsal for the mission, initially called EAGER ANVIL, was flown in the second week of October. Five rehearsals followed. The joint briefing at Al Jouf, Saudi Arabia took place at 2130L. The border was crossed at 0212L. An MC–130E of the 9th SOS (also 1st SOW) was airborne as tanker support, while MH–47Ds of the 3rd Battalion/160th Special Operations Aviation Regiment (SOAR) were available with FARRP (Forward Area Refueling and Rearming Point) equipment to refuel the Apaches when necessary. Both sites were destroyed with AGM-114 Hellfire missiles, Hydra 70 rockets and the Apache's 30-mm gun. The result was the creation of a 'hole' in Iraq's electronic warfare coverage for the strike package, including, among others, twenty-two F–15E Strike Eagles and three EF–111As, which were fragged for the western Scud sites around H-2 and H-3 airfields. For the same purpose and at H-9 (0251L), an F–117A of the 37th TFW (all F–117A strikes were flown by single aircraft) dropped the first bomb of the war, a GBU-27 PAVEWAY III 2,000-lb penetrating LGB (Laser-Guided Bomb), striking the Nukhayb Intercept Operations Center. It was the central reporting node in southern Iraq and best positioned to coordinate Iraqi defensive efforts against succeeding allied SEAD (Suppression of Enemy Air Defenses) attacks by F–4Gs. Capt Marcel Kerdavid, Weapons Officer for the 415th TFS and F–117A pilot,

That first target was hit by two F–117s one minute apart. At 0300L, we hit Baghdad targets simultaneously with five F–117s, followed by two aircraft one minute later, also simultaneously, but with a different DMPI, Desired Mean Point of Impact. My target was the Khark Telecommunications Tower in downtown Baghdad. It required a laser spot on a latticed tower and I took that challenge. Original plan was to drop a 2,000-lb GBU-10 PAVEWAY II, but my #2 engine would not start on my scheduled aircraft, so I went to a spare, which was configured with a GBU-27. The GBU-10 was fused to blow the top off the tower. The fuse on the GBU-27 could not be changed as it was meant to be a penetrator. Luckily after entering the top of the tower it apparently did not have the energy to exit, which I feared it would, and it blew up halfway down the tower.

In the meantime, seven Barksdale B–52G aircrews had launched thirty-five CALCMs (Conventional Air-Launched Cruise Missiles) from two launch points in Saudi Arabia (see later). Also, four F–111Fs of Tactical Fighter Wing Provisional, 48 (TFWP 48) struck the heavily defended airfield Ali Al Salem, ingressing to the target area at low altitude and high speed in the darkness of night. BQM-74 drones were launched from just south of the Iraqi border towards Baghdad to decoy radars, create confusion and false targets to enhance F–4G Wild Weasel targeting. Fixed-wing Coalition aircraft flew 2,759 sorties, including 1,515 by USAF aircraft. B–52Gs flew thirty-one sorties (see 'Day 1').

Suspension

G-day started at 0400L on February 24 with 100,000 Coalition troops initiating the ground war, which turned out to become a 100-hour campaign. A total of 3,280 coalition sorties were flown that day, the largest number to date. Forty-three B–52Gs struck Iraqi defenses and infantry positions in the KTO (Kuwait Theater of Operations). Because of the rapid advance of ground troops into

Theo van Geffen has been an aviation journalist and historian since 1977. He is from Utrecht, The Netherlands. His focus is the history of the F–105 Thunderchief and the units it was assigned to, and of the Air War in Southeast Asia. Mr. van Geffen has flown in USAF aircraft like the B–1B Lancer, EC–130E ABCCC, Century fighters F–101B Voodoo, F–105F, and F–106B Delta Dart, F–15B / D Eagle and the F–16B Fighting Falcon. He was the first program speaker at the THUD-OUT at Hill AFB on February 25, 1984 and one week later he became the last F–105 back seater ever while flying the next to last flyable F–105F to Little Rock AFB.

Kuwait and Iraq, retargeting of preplanned Close Air Support (CAS) and BAI (Battlefield Air Interdiction) sorties was required, including of inbound B–52s. On February 27, Kuwait City was liberated and Pres Bush ordered the suspension of offensive military operations as of midnight eastern time. As a result, on 28/0800L, a Coalition-declared ceasefire went into effect. Sixteen days later, redeployment of 545,000 U.S. troops was initiated. Iraq, on April 11, accepted all terms of the UN cease-fire resolution and at 1000 EST, the Gulf War officially ended.

In the forty-three days of the war, Coalition forces flew 118,661 sorties with the USAF share being 69,406 sorties. Of note is that A–10As and F–111Fs flew more than double the peacetime UTE. Because of the long CAP missions, in which 8-hour sorties were not uncommon, F–15C Eagles flew an Average Sortie Duration (ASD), which was 3.5 times the peacetime average.

B–52G Stratofortress

According to the USAF, the role of the B–52 in the Gulf War was revalidated, with only the G-model being involved in DESERT SHIELD/STORM and PROVEN FORCE. The first of 193 B–52Gs built was delivered to Strategic Air Command (SAC) in February 1959.

Ninety-eight on-line Gs were modified to carry twelve nuclear AGM-86B ALCMs each. The thirty-nine non-ALCM modified B–52Gs received the ICSMS, Integrated Conventional Stores Management System, and were assigned the primary role of supporting the conventional requirements of theater commanders and naval anti-surface warfare operations. On September 30, 1990, the USAF had 135 B–52Gs. To abide to the terms of the Strategic Arms Reduction Treaty (START), the first B–52G was retired on May 11, 1989 and arrived at the Aerospace Maintenance and Regeneration Center (AMARC) at Davis-Monthan, Arizona to be salvaged. In the first 3½ months of 1991 no B–52Gs were retired.

From the start of DESERT SHIELD, SAC underscored the need to have forward basing. The first discussion to deploy B–52Gs to Southwest Asia was when CINCCENT (Commander in Chief, Central Command), through message 08/0330Z Aug 90 to the Joint Chiefs of Staff (JCS) 'Follow-on Forces Additions', decreased the number of F–16 squadrons requested by JCS 07/2153Z Aug message, from six to four, while adding, among others, five B–52Gs. One day later, at 09/1345Z Aug, JCS issued further deployment orders through C+30 (C–Day/L-Hour was designated as 09/0001Z Aug), which included twenty-three more B–52Gs to perform conventional operations.

On August 24, SAC activated Air Division Provisional, 17 (ADP 17) to organize and administer SAC assets assigned to the Area of Responsibility (AOR). Air Forces Central Command (CENTAF) received operational control of assigned B–52Gs and tactical control of assigned KC–135s and strategic reconnaissance assets. On September 9, Central Command (CENTCOM) was awaiting basing approval to increase theater B–52G strength to twenty-eight.

At H-9 (0251L), an F–117A of the 37th TFW dropped the first bomb of the Gulf War, a GBU-27 PAVEWAY III 2,000-lb penetrating bomb, striking the Nukhayb Intercept Operations Center. The photo shows three of the stealth fighters at their temporary base of Khamis Mushayt (Saudi Arabia). *(USAF)*

When the JCS issued the Phase II deployment order on November 16, for 283 aircraft, it included eight B–52Gs. Aircraft on-call for deployment within 120 hours of the commencement of hostilities included another fourteen B–52Gs. On January 11, 1991, at CENTAF direction, SAC accelerated its tanker force commitment to provide CINCCENT with the requested plus-up of B–52Gs and KC–10A/KC–135 tankers and aircrews.

Diego Garcia

On August 3, 1990, SAC deployed two KC–10A Extenders and one KC–135R Stratotanker from Hickam AFB, Hawaii and Andersen AFB, Guam to Diego Garcia, a tropical island in the Indian Ocean. A second KC–135R at the island remained in place. CENTCOM requested twenty-eight B–52Gs, with five to deploy to Diego Garcia by the 16th, fourteen by August 24, and nine more by September 6. In reality, deployments were on August 12 (seven), August 13 (seven) and August 15 (six). Each of the twenty aircraft was configured with forty-five M-117R 750-pound general purpose bombs. As not enough ramp space was available, the final eight requested B–52Gs could not deploy. The twenty aircraft were assigned to 69th Bombardment Squadron, Heavy (BS)/42nd Bombardment Wing, Heavy (BW) from Loring, AFB, Maine (fourteen) and of the 62nd BS/2nd BW from Barksdale AFB, Lousiana (six) and deployed from Andersen where they participated in a GIANT WARRIOR exercise. The squadrons were augmented by a handful of crews from Castle AFB, California (93rd BW) and Griffiss AFB, New York (416th BW). On August 24, nine days after the arrival of the last six aircraft, Bombardment Wing Provisional, 4300 (BMWP 4300) was designated, activated, and organized at Diego Garcia, and attached to 15th Air Force (15AF). On September 21, SAC went through a similar process regarding Bombardment Squadron Provisional, 4300 (BMSP 4300), Air Refueling Squadron Provisional 4300 (AREFSP 4300) and Consolidated Aircraft Maintenance Squadron (CAMSP 4300) and

B–52G 58-0164 'SAC Time' of the 668th BS (416th BW, Griffiss) sits ready at Jeddah on February 1 for its next combat sortie. The BMWP 1708 aircraft is configured with M-117 750-pound bombs and already flew twenty-five combat sorties. ***(PH3 Chester Falkenhainer)***

assigned the Squadrons to the Wing. On February 1, the Wing possessed 19/B–52G, 7/KC–10A and 5/KC–135R. Effective June 3, the Wing was the last provisional B–52G unit to be inactivated.

Sizeable

On 31/2115Z Aug 90, 219 allied aircraft were on five minute-one hour day/night alert, including seven B–52Gs at Diego Garcia. On September 14, SAC stated that fourteen B–52Gs at Diego Garcia were on alert, loaded with CBUs or M-117 bombs. Also, that of its deployed 186 tankers, thirteen were at the island.

The number of BUFFs (Big Ugly Fat Fellows) in BMSP 4300 remained stable throughout the campaign. On January 16, 1991 the Squadron gained six aircraft which arrived from Andersen's Strategic Wing Provisional, 1500 (SWP 1500), but lost a similar number the next day when the aircraft launched on a combat mission and landed at Jeddah (New). The 1500th in turn received six B–52Hs from CONUS.

It was not surprising that the Diego Garcia BUFFs flew a sizeable number of flying hours. It was not possible to accomplish intermediate-level maintenance and heavy maintenance like corrosion washes, engine changes and phase inspections there (it had been discussed, but was never materialized) and for this reason Wing B–52Gs had to be flown to Andersen where an Intermediate Level Maintenance Center (ILMC) was established. After SWP 1500 had received four spares by August 22, it became possible to regularly rotate B–52Gs between the two bases to provide, for example, corrosion control treatment. However, an Andersen B–52G was to land at Diego Garcia before its B–52G could launch for Andersen. In this way, the number of combat-ready aircraft remained at twenty. The swap-out also enabled the munitions resupply on Diego Garcia. Twenty-eight B–52G phase inspections were accomplished at Andersen, 122 engine changes and sixty BUFFs underwent wash and corrosion control.

Training

The aircrews and maintainers were experienced at conventional operations from deployed locations as they had been trained mostly on a conventional war in Europe. However, they lacked the specific expertise necessary in Southwest Asia. This made it necessary to set up a special training program, to be conducted some 3,000 miles from the AOR. To do this properly, access to the Arabian Peninsula and integration into CENTAF's Airspace Management System were required. On August 20, Saudi Arabia authorized B–52 training. The next day, two B–52Gs flew training missions in the AOR. The aircrews gained a basic orientation of the terrain characteristics and regional communication procedures, including coordination with E-3 AWACS aircraft. Through September 16, sixteen such training sorties were flown, of which eight night low-level sorties on the 16th, while eleven were flown at Diego Garcia. Thereafter, due to the long sorties and the scarcity of resources on the island, training involved only a low number of sorties per month. Mission profiles and routes were developed to provide navigation and packaged fighter operations to maximize efficiency. Two distinct training profiles eventually emerged, one to a local island and one over the Arabian Peninsula. The latter provided the most realistic training, which included, cell takeoff, low-level, heavyweight air refueling, bombing and Electronic Counter- Measures (ECM). Examples were the training

mission on September 23, when five B–52Gs flew a low-level strike mission, supported by F–4Gs providing defense suppression and on October 25, exercise INITIAL HACK, a night strike by a combined package against three airfields of twenty-seven aircraft, including two B–52Gs, two F–117As, two F–4Gs and six Saudi and eight RAF Tornados.

The island profile was much shorter in duration and included cell takeoff, departure and join-up, simulated bombing runs and touch and go landings. The formal result was the development into an Initial Mission Qualification Training (IMQT) program. After CINCSAC, General John T. Chain, had stated he wanted an increase in the frequency of training missions into the AOR, his Director of Operations directed in November that the tempo of training be increased for each bomber crew. As of December 20, Wing B–52Gs had flown 418 DESERT SHIELD sorties for 4,020 hours. On January 15, 1991, all training sorties were discontinued.

As SAC was still looking at increasing the number of B–52G Forward Operating Locations (FOLs), the Command and its 15AF recognized that B–52G aircrews had to be trained in CONUS prior to deploying. In October, 15AF proposed a series of exercises to simulate the combat situations the aircrews were likely to encounter. DESERT WARRIOR was developed by revising the RED FLAG schedule for SAC units. It was to give the aircrews exposure to the CENTAF ATO procedures and tactics. Eight Bomb Wings participated in DESERT WARRIOR and also flew in DESERT STORM. Although the exercise was regarded as a crash course that was beneficial, it was also a stop-gap measure that did not replace the training taking place in-theater.

Day 1

Including the 'Barksdale' sorties, B–52Gs flew thirty-one sorties, fifteen Offensive Counter-Air (OCA) and sixteen BAI sorties, encompassing fifty-six strikes. At about H+40 (0340L), thirteen B–52Gs of BMSP 4300 struck four Iraqi Forward Operating Locations (FOLs), which were located near the Saudi border. It was the first low-altitude B–52 mission ever. Munitions included, for instance, UK-1000 runway cratering bombs and CBU-58/89s. One B–52G received minor damage while leaving the target area. At around 2300L on January 16, the first of sixteen B–52Gs, including three spares, took off. The thirteen primary aircraft later formed four elements composed of three (3) and four aircraft (1). The aircraft were refueled four times by KC–10As. Before arriving at the target areas and to stay below Iraqi radar coverage, the aircraft's altitude dropped to about a few hundred feet above the desert floor. Also, one of the aircrews experienced technical problems and was forced to abort the mission.

Later that day five Squadron BUFFs, joined by twelve F–16Cs, struck telecom and C3 facilities, while the six 'Andersen' B–52Gs flew an early evening mission. Of the aircraft launched from Diego Garcia, five actually hit the Tawakalna Division of the Republican Guard, as one aircrew had to air abort prior to reaching the target area due to maintenance problems.

Second FOL

After it became clear that not all twenty-eight requested B–52Gs could deploy to Diego Garcia, SAC tried for several weeks to find a second B–52 FOL. The Command had one in mind with outstanding facilities and collocation with other SAC assets, but to no avail. It looked like a FOL could be established as on August 23, SAC's Support Battle Staff (SBS) learned that military authorities of a country (its name was deleted) had tentatively approved to deploy fourteen B–52Gs to one of its bases (the name was deleted). However, the joy was short-lived, as on the 29th, SBS was informed by SAC Forward that the approval had been withdrawn. CENTCOM then advised SAC to explore possibilities with regard to Morón AB (Spain) and RAF Fairford (UK).

Efforts to find a second FOL in the AOR were halted on October 2 by Secretary of Defense (SECDEF) Richard B. Cheney, but could be resumed unless hostilities broke out. Eleven days later, the host country authorized the U.S. to deploy fourteen B–52Gs to one of its bases. It looks like the host country was Saudi Arabia and the base King Abdul Aziz IAP, Jeddah. In all Special Orders SAC called the airport 'Jeddah (New)', called from now on 'Jeddah'. (See later).

The highest number of BUFFS deployed on a single day (February 11) was sixty-three at four bases: (1) Diego Garcia, twenty-one; (2) Jeddah, seventeen; (3) Morón, seventeen; and (4) Fairford, eight.

Aircrews, except those at Jeddah, had to fly 2,400-3,000 miles to get to their target area. Being at Morón meant they were stationed furthest from their targets, with sorties averaging fifteen-plus hours. Sorties from Fairford averaged fourteen-plus, from Diego Garcia fifteen and from Jeddah four-plus flying hours.

This also meant a heavy reliance on SAC's tankers for pre- and post-strike air refueling. For this reason, AREFSP

The B–52G still had its .50-caliber tail turret gun when it got involved in the Gulf War. However, the gunner had moved to the main crew compartment where he operated the gun by remote control. On the photo SSgt Brian Land checks the gun of a BMWP 1708 B-52G at Jeddah. ***(PH3 Chester Falkenhainer)***

An element of three B-52Gs of BMWP 1708 configured with M-117 bombs taxiing on February 6 at Jeddah on their way to takeoff. ***(USAF, TSgt Rose Reynolds)***

808 at Milan Malpensa Airport was activated with seven KC–10As, including Extenders from Barksdale's 32nd ARS/2nd BW. The airport was 340 NM north of planned B–52 tracks. Operations began on February 9, but several difficulties had to be overcome, including, for instance, fuel limitation, de-icing of aircraft and the low priority compared to commercial flights. Another squadron that provided pre- and post-strike air refueling for B–52s was AREFSP 807 at Mont de Marsan AB in southwestern France, becoming possible after the country offered the U.S. KC–135 basing rights. The first of up to ten KC–135Rs arrived on February 7, the first U.S. aircraft to be based in the country since 1966. B–52Gs were involved in 2,166 KC–135 and KC–10 refueling events, with 137.2 million pounds of fuel offloaded.

Because of the heavy B–52G bomb loads, a concentrated effort had to be accomplished by, among others, the PACAF/SAC/TAC and USAFE (United States Air Forces in Europe) Directors of Logistics to provide SAC with the necessary munitions. For example, to get the munitions to Diego Garcia, Fairford and Morón, an 'air bridge' was developed, using C–5s, C–141s and CRAF, Civil Reserve Air Fleet, aircraft. The bridge was initiated on January 15, 1991 and terminated on February 27.

Jeddah (New)

After Saudi Arabia had authorized the use of Jeddah by B–52Gs, a three-man team of the 379th BW (Wurtsmith, MI) conducted a site survey for the aircraft's sustainability in the October 16-26 period. On the 28th, the base was approved for B–52G operations. Two days later, the site survey team and the Wing commander briefed the commander of the Eighth AF of the visit. One B–52G deployed on December 20 from Diego Garcia to Jeddah for taxi and parking tests, which proved to be successful. Crew and aircraft returned the same day. Effective December 21, SAC designated, activated and organized BMWP 1708 with assignment to SWP 1700. A similar process took place for BMSP 1708 and CAMSP 1708, both being assigned to the Wing.

On January 17, SAC informed the JCS it had directed the 379th BW to deploy ten B–52Gs to Jeddah. The aircraft closed on January 18 (see later). Ultimately, the number of Buffs assigned was sixteen to eighteen. However, the 379th B–52Gs were not the first BUFFs to call Jeddah their temporary home. The previous night, six aircraft had arrived after flying a combat mission from Diego Garcia.

A total of 823 sorties were flown by the 1708th, an average of twenty-four per day. The high for one day was twenty-nine sorties. Its Munitions Maintenance Support, consisting of twenty-nine load crews from ten different BWs, loaded 36,581 bombs, including 22,542 M-117s and 96 CBU-87s, twenty percent of all bombs expended during the campaign.

On February 23, six 524th BS aircrews deployed to Morón to augment the 801st BMWP. The Squadron employed eighteen aircraft at three different locations: eight at Morón and five each at Jeddah and Fairford. Its BUFFs flew a total of 380 combat sorties (3,189 flying hours), of which 235 by the five Gs at Jeddah. Six air aborts were experienced. Most sorties were flown by B–52G 57-6492 'Old Crow Express', fifty-four (233 flying hours), all from Jeddah. The redeployment of the Wing's personnel and aircraft, called PROUD RETURN, was initiated on March 9. Wing and Squadrons were inactivated effective March 22.

Morón

On January 9, the Spanish government authorized the deployment of B–52Gs to Morón, at least as long as there was no publicity and local authorities would receive advance notice of operations. At that time, AREFWP 801 was stationed at the base together with AREFSP 801 and CAMSP 801. The first six BUFFs arrived on January 16, followed the next day by another four.

A BMWP 1708 B-52G, configured with Mk-82s, is taking off on January 2 from Jeddah. Being based so close to the battle field, BMWP 1708 flew a total of 823 combat sorties, 50% of all B-52G sorties. ***(USAF, TSgt Donald McMichael)***

Effective January 17, the Wing was re-designated as BMWP 801 and stayed attached to 8AF, with AREFSP 801 and CAMSP 801 being reassigned. On the same date, BMSP 801 was designated, activated, organized and assigned to the Wing, which was largely made up from elements of the 2nd BW. Its commander, Col Ron Marcotte, acted as BMWP 801's commander. Also, the Spanish approved to carry out offensive operations. The first four sorties were planned for the 18th, but cancelled for operational reasons. SECDEF Cheney authorized the deployment of another twelve B–52Gs after a U.S. request to station additional aircraft there to support DESERT STORM requirements had been approved on February 3. Morón B–52Gs flew the first combat sorties on Day 2, when three aircraft struck Scud facilities in northern Iraq. Another three BUFFs struck air defense, transportation, electrical and POL targets at Al Mawsil (Mosul) in cooperation with Incirlik F–111Es.

Because of a lack of facilities and ramp space in the AOR, a second location had to be found for intermediate-level maintenance once B–52Gs had arrived in-theater. Fairford was looked at (it still had an inactive maintenance capability), but the base was considered too far away from the AOR. Morón became the logical alternative as it was on the tanker air bridge and it was reasonably distanced from Fairford. Nineteen B–52G phase inspections were accomplished, twenty engine changes and nineteen BUFFs underwent wash and corrosion control.

Night off

Maj Kurt '2-Lips' Dittmer, 52nd TFW Deputy Chief of Wing Weapons and F–16C pilot, flew combat from Incirlik with the 23rd TFS. He collected his experiences and published them in 'Proven Force'. As to the Morón B–52Gs he recollected the following.

The BUFFs from Morón were still plugging away at their targets, even when we were trying to take a night off (to go party, but we told CENTCOM we needed to fix jets and rest our crews). So, night after night we ended up supporting them and keep them company—just like clock-work. Well, actually it wasn't 'clock-work', they wouldn't hit the targets at the times we wanted them to. In fact, they didn't hit many of their targets when they wanted to either! Okay, they were flying from a different time zone, their sorties were also ten hours long, and who really knows how long it takes their bombs to fall from as high as they were flying…?...

Restricted

Missions flown from Diego Garcia, Jeddah and Morón concentrated on the KTO with occasional runs into central Iraq. However, until mid-February Morón B–52Gs were restricted to flying missions in northern Iraq. They looked at JTF-PF at Incirlik for targets and support packages. With the arrival of the Computer Assisted Force Management System (CAFMS), Morón was able to receive ATOs from Riyadh. Without CAFMS, it was pretty unmanageable to include those BUFFs in the Saudi-based strike packages. At the time Morón received the CAFMS, the number of B–52Gs was twenty-two, of which eighteen flying combat and four undergoing intermediate level maintenance.

On February 8, six B–52Gs dropped nearly three hundred 750-pound bombs on Iraq's biggest oil refinery at Bayji on the Tigris, 100 miles south of Mosul. On the 14th, the Wing flew a mission against the missile production facility of the military research and development complex near the Tigris north of Mosul, when four JTF-PF F–111Es led four B–52Gs.

Of the 293 B–52G sorties flown, ninety were flown by the 524th BS. The B–52Gs departed for CONUS on March

21. The Wing and assigned units were inactivated effective May 15.

Fairford

On February 1, after the British government permitted conducting B–52G offensive operations from Fairford and the French government had opened its air space for those B–52s, the deployment of eight aircraft was directed on the 2nd. Personnel and equipment were assigned to BMWP 806, which was designated, activated, organized and attached to 8AF effective February 5. A similar process took place for BMSP 806 and CAMSP 806, with both being assigned to the Wing, which was primarily formed from elements of the 97th BW at Eaker AFB, Arkansas, and supported by four other Bomb Wings. The first BUFFS also arrived that day. Flying combat operations was initiated on the 9th with four sorties. The Fairford aircraft took over Morón's mission to strike targets in northern Iraq, as the base did not have CAFMS either. Aircraft were only scheduled to strike northern Iraq, when JTF-PF support aircraft were available. In general, a cell of four BUFFs shared the support package, which also supported the nightly strikes by F–111Es. Fairford and Morón B–52Gs flew 114 such sorties.

From February 9 through 27, except on the 22nd, four sorties per day were planned. However, the sorties on the 16th and 26th were not flown. B–52Gs flew sixty-three sorties from Fairford, of which forty-three were by 379th BW aircraft, and expended 3,008 bombs. Between March 1-9, the B–52Gs returned to CONUS. Inactivation of Wing and Squadrons was effective April 24.

Taji

Initially, war planners used B–52Gs for night strikes, employing the electro-optical viewing system, using FLIR and Low-Level Light Television (LLLTV) sensors to improve low-level night penetration. After the Coalition had gained air supremacy, the aircraft started operating around the clock. After B–52G 58-0248 was apparently hit by a SAM on a January 19 night mission (see later), low-altitude missions gave way to high-altitude missions (above 30,000 feet). B–52Gs, which generally flew in threes, were not fragged into the highest threat areas and always flew in conjunction with F–4G Wild Weasel and/or CAP aircraft in areas where a significant threat remained. Stratofortress crews flew four distinct missions, (1) against strategic fixed targets, (2) Scud hunting, (3) against Iraqi Army and Republican Guard targets, and (4) supporting breaching operations.

As to (1), one example was the Taji weapons manufacturing complex, fifteen miles north of downtown Baghdad, which sprawled over several square miles, and containing multiple complexes and facilities. The Jeddah-based B–52Gs took the lead in forming packages with the ones stationed at Diego Garcia and (after mid-February) Morón. Sixty-six sorties were flown in the February 10-27 period. Nearly 3,000 bombs were expended, inflicting widespread and severe damage (the B–52G could be configured with

A B–52G is being refueled by a KC–135A while the BUFF is returning to its temporary base after flying a combat sortie. ***(USAF, SrA Chris Putnam)***

up to fifty-one M-117 or Mk-82 bombs).

As to (2), tactical planners were driven to an increased emphasis on suppressive tactics due to difficulties in locating and striking individual mobile Scud targets. From February 19 through the end of DESERT STORM, dedicated B–52Gs, armed with CBU-58s made preemptive strikes in the Scud boxes. Aircrews dropped them at intervals from high altitude while on station. In this way the bomblets scattered over a wide area. Also, B–52Gs freed five Scud CAP F–15Es for other targets.

As to (4), CINCCENT confirmed on February 17 that 'battlefield preparations, including mine breaching by B–52s, would remain the primary focus of the air war.' In this way and by using dual-fuzed Mk-82s, B–52G efforts were devoted to opening lanes through Iraqi mine fields and other defensive systems like multi-strand concertina wire. An example was given on February 17 when eight B–52G strikes breached Iraqi defenses in southwest Kuwait. BUFFs were also used in psychological operations by dropping leaflets. Days before the start of the ground war, as many as eight aircraft were dedicated to this mission.

Strikes

B–52G aircrews participated in 616 strike packages, of which 174 against fixed targets and 442 as (B)AI. As to the latter, BMWP 1708's share was 377.

The largest number of sorties on a single day were flown on February 22, fifty-two. Twenty-eight originated from Jeddah, while no aircraft were launched from Fairford. The daily sortie rate for the aircraft exceeded the highest previously planned wartime rates. The 1,628 sorties flown (15,269 hours) encompassed 1,706 strikes (a strike was defined as the delivery of a weapon or weapons against a specific target. Therefore, the number of B–52G strikes was larger than the number of sorties): ninety-nine OCA strikes (for example radar installations and airfield-supporting infrastructure); 303 against strategic targets (for instance strategic and interdiction targets like industrial storage facilities, most of these were radar deliveries); forty-two 'other'; and 1,262 (B)AI. The majority of the latter

(1,175) were flown against the Republican Guard, armor and mechanized units and storage depots in primarily the 'kill boxes' in the KTO. After recognizing the impact of these sorties, General H. Norman Schwarzkopf, Jr., CENTCOM commander (CINCCENT), directed the BUFFs to focus on this mission. The result was a three-ship of B–52Gs, striking troops every three hours, twenty-four hours a day. Strikes began on Day 1 and continued throughout the campaign. The number in the major twenty-two boxes was 897. Most strikes, 229, were flown in Week 3, while kill box 'AF 7' underwent a total of 256 strikes. The BUFF's large area coverage and bomb load made it most effective in this role. For instance, on January 28, thirty-eight strike packages were flown. Ten, of which seven included B–52Gs, two additional B–52 strikes, and hundreds of separate ground-attack sorties pounded the Adnan Republican Guard Division around the clock. B–52 strikes against Iraqi's 20th Infantry Division were preceded by psychological propaganda broadcast EC–130E VOLANT SOLO operations with 'personalized' leaflets, warning personnel of the coming strikes. The EC–130Es were from the 193rd SOS of the Pennsylvania ANG (PAANG). On January 31, good weather permitted Coalition forces to fly thirty-three packages, including two PROVEN FORCE ones with 102 sorties. Seventeen packages struck the Republican Guard with focus on the Hammurabi Division. Five non-packaged B–52G strikes also hit Guard-related targets. With CINCENTAF Lt. Gen. Charles A. Horner's approval, two tactical air packages and one B–52 strike were diverted from Guard targets to ones near Khafji in southern Kuwait to support Coalition ground forces as Iraqi armor was moving to reinforce the initial Iraqi penetration.

BUFFs comprised only three percent of the Coalition combat aircraft, yet about thirty percent of all U.S. tonnage was expended from B–52Gs, 72,289 bombs for a total of 27,000 tons. As Iraqi prisoners reported, B–52 raids had a devastating effect on their morale.

Battle damage

General George L. Butler, SAC's commander, stated on February 6 that with sixty-six of his B–52Gs and 299 of his KC–10/KC–135s committed to DESERT STORM, additional tankers were scheduled to deploy to France and Greece by 'degrading' nine 'lines' from the CONUS strategic nuclear alert force.

In a White Paper 'USAF Performance in Desert Storm', it was stated that 'while fighters employed precision-guided munitions to destroy pinpoint targets, the B–52's successes demonstrated the need to preserve the large conventional bombers' ability to destroy large area targets'. It looks like the BUFF will be around for many more years to come!

The participating B–52Gs were procured in fiscal years 1957-1959, so were at least 32 years old. There were 143 aborts. Some cannibalization took place from non-tasked aircraft. The average mission-capable rate was 81.7 with Morón having the highest (91.0) and Fairford the lowest (71.4) rate.

Patch of the 596th Bombardment Squadron. ***(via André Wilderdijk)***

B–52Gs suffered no combat losses. However, 59-2593 (42nd BW/BMWP 4300) was lost on 02/2145Z Feb, while returning to Diego Garcia after flying a combat mission. It crashed into the Indian Ocean, some fifteen NM northwest of the island. Three survivors were rescued at 2334Z, while the other three crewmembers were lost. No battle damage had been reported. Seven B–52Gs were damaged, of which four battle damaged. On January 19, after striking the Uwayjah petroleum refineries, 42nd BW/BMWP 4300 B–52G 58-0248 was damaged by apparently a SAM (6' of tail, aft of the 1853 bulkhead), but the crew was able to return safely to Diego Garcia. It was repaired for a one-time flight to Andersen. Two BUFFs of BMWP 1708 received battle damage on January 26 while on an (B)AI mission. The fourth B–52G, 58-0253 of the 42nd BW/BMWP 4300, was damaged on February 27 by an infrared SAM, resulting in multiple holes below the left wing, left aft fuselage and under its tail. The crew was able to Return to Base (RTB) safely. It took 570 man-hours to repair the aircraft.

Secret Squirrel

An important task in the opening night of DESERT STORM was given to the 596th BS. Since its organization at Dow AFB, Maine, on February 1, 1963, it had been flying the G-version of the B–52. On April 15, 1968, the Squadron moved to Barksdale AFB and was assigned to the 2nd BW. It had a conventional and a nuclear mission.

The 596th was fragged to execute Operation SENIOR SURPRISE as part of a strike force with the mission to destroy Iraq's integrated air defense infrastructure and lines

B–52G aircrews of the 596th BS, including those of the seven aircraft that flew the SENIOR SURPRISE mission, but known as SECRET SQUIRREL to its participants. The B–52G is configured with CALCMs. ***(USAF, 2nd BW)***

of communications on Day 1. Seven B–52Gs were to be involved. They were scheduled to take off from Barksdale, fly to the target launch points, release their weapons and RTB. The distance was some 14,000 miles, which would normally take thirty-five hours to fly, resulting in the longest combat mission in history at the time. Because of the distance, the B–52Gs would be the very first aircraft to get involved in DESERT STORM. They would be configured with AGM-86C CALCMs, the only time this version was to be expended in the campaign. Its foundation was Boeing's nuclear AGM-86B Air-Launched Cruise Missile (ALCM), which was capable of autonomous navigation to targets deep into enemy territory. The development was initiated in June 1986 as a 'black' project. It was equipped with a modified guidance package with a GPS, a newly deployed space-based navigational aid, which was embedded in the terrain contour matching system. It gave the AGM-86C increased precision and the ability to strike from well outside enemy's defense systems. The Initial Operating Capability (IOC) was reached in January 1988. The Gs that were modified with an improved conventional capability, could carry a full range of conventional munitions, internally and externally, along with the AGM-86C.

According to 2nd BW information, Pres George Bush approved the mission after which CINCSAC, Gen. Chain, personally selected those officers who would form the leadership regarding planning and execution of the mission.

Secrecy

Preparations for SENIOR SURPRISE at Barksdale were initiated in early August 1990 with Lt Col Jay Beard, the Squadron commander, taking the lead. With three aircrew members the mission plan was written, establishing, among others, aircraft, personnel, and aerial refueling requirements, plus the execution of the mission. Seven primary and one reserve B–52 aircrews were selected after the plan had been completed, discussed and approved. The fifty-seven crewmembers were augmented by personnel from the 49th Test and Evaluation Squadron. They were given strict orders not to discuss the mission or any of its facets. This shroud of secrecy proved to be complete and created a great deal of curiosity at the base in the days leading up the mission's launch, especially with regard to the fact that the alert parking area showed so much activity. In the meantime, the eight aircrews were being trained and the aircraft maintained to the 'minutest' detail to guarantee mission success. New intelligence required constant updating of plans. Tuesday was mission study day and a randomly selected aircrew conducted a complete mission briefing and certification. Two days after each study day, preflight of the B–52Gs on the alert pad was accomplished, while the CALCMs were updated with the latest GPS information.

Engine trouble

As the January 15 deadline approached, the pace quickened. For instance, all seven aircraft were generated. On the 14th, all aircrews were restricted to the alert facility and assumed an alert status. This was also the time that relevant mission information could be shared with the aircrews.

Lt Col Beard received the 'Go order' the next day at 0300L. The aircrews were immediately awaken with 'All SIERRA crews report to the vault'. Forty-five minutes later they were told they would launch twelve hours prior to the beginning of DESERT STORM. The aircraft had been time-phased into the Strategic Air Campaign. At that time the destination, the highly classified weapons systems and the very existence of the aircraft was still classified at the highest level. People in headquarters referred to the mission as 'flight of the bad dogs', a reference to Dale Brown's book titled *Flight of the Old Dog*, about a modified B–52. Lt Gen Ellie Schuler, Eighth AF commander and Col Marcotte, Wing commander, were the execution authorities for the launch and command and control of the initial portion of the mission.

At dawn on a chilly and rainy January 16, the seven B–52Gs, carrying a total of 39 AGM-86Cs, initiated their MITO, Minimal Interval Take Off, the first aircraft at 0636L. They formed three cells, call signs Doom 31-37, with the first cell having three aircraft and cell two and three, two aircraft each. Lt Col Beard was the airborne mission commander in Doom 31. All aircraft, except Doom 36, had an eight-man crew, including an extra pilot and navigator. Doom 36 had two extra pilots. All aircraft, except Doom 32, carried artwork/nicknames.

During the mission, the BUFFs were refueled four times, twice outbound and twice inbound. The first outbound refueling was over the Azores, requiring two AREFWP 802 KC–135 Stratotankers per B–52G, offloading 140,000 pounds of fuel. At check-in after the refueling, Doom 34's aircraft commander, Capt Bernard Morgan, informed Beard 'he was working on something right now and that I'd be back to you'. Morgan did so about an hour later. At that moment, the formation had passed its point of no return. Beard was informed that the aircraft was experiencing engine trouble and that an engine had been shut

down due to fluctuating oil pressure. SOP (Standard Operating Procedures) in such a case called for the crew to abort the mission and land at the nearest friendly base. It certainly looks like that was not a real option for the crew on this important mission. The second refueling took place by Morón KC–10A Extenders over the central Mediterranean.

Doom 33

Two launch areas were established in northwestern Saudi Arabia, about 100 miles from its border with Iraq and beyond the range of Iraq's EW and GCI radars. Cell one flew to the northern launch area, while cell two and three continued to the southern area. Close to launch time, four CALCMs, carried by three different bombers, proved to have software problems, preventing their launch. The remaining thirty-five missiles were launched over a ten-minute period at the designated launch points. One missile crashed into Saudi Arabia shortly after launch. At least twenty-eight CALCMs hit their targets, while three might have impacted in the target area. The eight pre-determined targets, including the AI Musayyib Thermal Power Plant, were hit by multiple CALCMs. SAC intelligence estimated that six targets ceased functioning, one damaged, and one was missed.

After expending their missiles, the three cells reformed over Saudi Arabia to prepare for the third air refueling. This was accomplished by Extenders over the Eastern Mediterranean, offloading 200,000 pounds of fuel to each B–52G, 50,000 more than planned. Head winds that were 60-80 knots higher than anticipated, caused an increased fuel consumption and would ultimately add some seven flying hours to the schedule. Some of the bombers were also experiencing equipment malfunctions, including seized engines and fluctuating oil pressure readings. Lajes-based KC–135s took care of the fourth air refueling. Due to a refueling malfunction and fluctuating oil pressure, forcing the engine involved to be shut down, Doom 33 received 40,000 pounds less fuel than the other aircraft. Lt Col Beard determined that it needed additional fuel to reach Barksdale. He contacted Eighth 8AF's Command Post and requested assistance. Two KC–135Rs from Robins, GA were launched and offloaded enough fuel for Doom 33 to reach Barksdale. All aircrews were ultimately awarded the Air Medal.

Operation SENIOR SURPRISE remained classified until January 16, 1992, when USAF published News Release #90-001. It mentioned, among others, not only the existence but also the use of the AGM-86C CALCM in the opening hours of DESERT STORM.

Miss Fit II

Doom 35 was B–52G 58-0238 'Miss Fit II' with Crew E-81. Its Electronic Warfare Officer (EWO) was Capt Todd Mathes. I met Todd on November 2, 1992, the day before I flew on a B–1B Lancer training sortie from Dyess, TX, on which he was our OSO, Offensive Systems Operator. When I asked him about his background, he told me, among others, he had been part of SECRET SQUIRREL. Todd,

A couple of days after Iraq's invasion of Kuwait, the Squadron's eight most experienced aircrews (including one reserve crew) were briefed about the AGM-86C CALCM and its capabilities as preparation for a future mission against Iraqi targets. We would fly to pre-designated points to launch the missiles against eight strategic targets although these would remain unknown for the time being. The standard crew would be increased with a pilot and a navigator. In October, we started flying in the weekend to train the mission profile.

As it concerned an extremely secret mission, Barksdale soon called it 'Secret Squirrel' according to Todd. The aircrews then called themselves 'Secret Squirrels'. At launch, the BUFFs were at their maximum weight. Todd continued,

After takeoff we flew to New England where we initiated our Atlantic crossing. We flew in trail at a 1.5-mile interval. Via the Strait of Gibraltar we started crossing the Med from west to east at an altitude of 40,000 feet. During thirty minutes we were being tracked by surface-to-air missiles on Russian navy ships. Earlier it was agreed to not use defensive maneuvers and/or jamming, at least as long as we were not being attacked.

According to Todd, the Egyptian airspace was declared 'closed' for the BUFFs. Over Egypt they were also being tracked by radar. Via Saudi Arabia the mission continued towards Iraq. Before reaching the launch areas, the crews formed two cells, one with three and one with four aircraft, flying in trail as well. Some thirteen hours after takeoff from Barksdale, thirty-five CALCMs were expended in a coordinated action. Todd,

At each missile launch our aircraft shocked heavily. We carried six CALCMs and it took some ten minutes to expend them all. Through GPS signals the missiles were being directed to positions within sixty feet of the target, after which the final guidance was activated. While in the target area the Iraqis left us untouched. We then flew to a pre-designated rendezvous point to begin the flight home.

At 1800L on January 17, some 35 hours after takeoff, the BUFFs were back home. Each of the B–52Gs used one million pounds of fuel during the flight, 750,000 pounds through thirty-eight Lajes KC–135 tanker sorties and nineteen Morón KC–10 sorties. Todd once more,

When we took off I was actually stunned. On the one hand I realized we flew towards a war, but on the other hand I was proud I had been selected to get the job done. It was most encouraging to see that everything worked as advertised and that it was for a good cause.

On December 28-29, 1990, four KC–135As of the 917th AREFS (96th BW) arrived from Dyess at Incirlik. The photo shows 59-1502 'Lone Star'. ***(USAF)***

Wurtsmith

The seven Barksdale B–52Gs were not the only BUFFs flying a combat mission from home base. Early on January 18, twelve B–52Gs configured with M-117 bombs and CBUs, including two spares, launched from Wurtsmith to strike Republican Guard targets in the KTO and then land at their new home, Jeddah. Although all flown by 524th BS aircrews, only seven of the aircraft were assigned to the 379th BW with the others to the 93rd BW at March (three) and 42nd BW at Loring (two). The two 379th BW spares were not needed and RTB'd, flying a total of ten hours. Three aircraft each then formed the first and second cells and the third one had four aircraft. While on approach to the target area, the three aircrews of cell one aborted the mission for operational reasons and landed at Jeddah. Because of confusion and an additional air refueling, their total flying time was 18.4-18.9 hours. Cell 2 (flying time 15.8-16.1) and 3 (17.4-17.7) expended their weapons and also landed at Jeddah. The flying hours for the ten primary BUFFs totaled 175.

SAC B–52G Sortie Summary

Unit/Base/Number of Aircreft	Sorties Planned/ Flown/Targeted	Ground/Air Aborts
BMWP 4300/ Diego Garcia/20	436/430/414	6/16
BMWP 1708/Jeddah (New)/18	882/823/795	59/28
BMWP 801/Morón/22	303/295/287	8/8
BMWP 806/Fairford/8	72/63/57	9/6
2 BW/Barksdale	7/7/7	0/0
379 BW/Wurtsmith	10/10/7	0/3
Totals /68	1710/1628/1567	82/61

Incirlik

When Iraq invaded Kuwait, European Command (EUCOM) had fourteen F–111Es (79th TFS/20th TFW, RAF Upper Heyford), which arrived on August 1 for a Weapons Training Detachment (WTD), and four F–16Cs (612th TFS/401st TFW, Torrejón, Spain) on a NATO (SIOP, Single Integrated Operational Plan) commitment at Incirlik, Turkey. The 20th TFW deployed another eight F–111Es to the base, which was nicknamed the 'Lik,' but redeployed to Upper Heyford.

To participate in NATO exercise DISPLAY DETERMINATION 90, the 612th TFS, on September 18, deployed twenty additional F–16C/Ds and maintenance personnel. Nobody could have guessed then they would become part in January 1991 of what was to comprise Joint Task Force PROVEN FORCE.

The Honorable James Baker, U.S. Secretary of State, on August 8, offered the Turkish government increased military and intelligence cooperation in return for access to its air bases by DESERT SHIELD aircraft. On September 21, the Turkish Foreign Ministry expressed its intention to extend a defense pact, allowing the U.S. to use its military bases as launch sites for possible action against Iraq. However, a lot of water still had to flow through the Rhine before the Turks would not only actually permit an increased U.S. presence at Incirlik, but even allow unilateral combat operations.

Spangdahlem

The concept of opening a 'second front' was formulated in mid-August by a small cadre of aircrew members of Spangdahlem's 52nd TFW around the time the 561st TFS (35th TFW) deployed with its twenty-four F–4G Wild Weasel aircraft from George AFB, California to Shaikh Isa AB, Bahrain. Initially, the concept would focus on the disruption of the Iraqi integrated air defense network in the north of the country with the purpose to decrease the risk for allied operations in southern Iraq. However, while passing through the channels, the concept grew into a full-scale operation. Lt Col Edward 'Victor' Ballanco was the Wing's Chief, Weapons and Tactics Division, which had two F–4G pilots, two F–4G Electronic Warfare Officers (EWOs), and two F–16C pilots (the Wing was equipped with F–4Gs and F–16C/Ds). Victor,

We did not expect to get the call to deploy to the Gulf region as the 35th TFW at George had a second F–4G squadron assigned. I challenged the members of the Weapons Shop to determine how the Wing could get involved in what looked to be imminent military action. Maj Dittmer and Maj Rich 'Snooker' Snook, the Wing EWO, immediately picked up my glove. We first obtained the Iraqi SAM and fighter orders of battle and plotted them. We then developed an option to deploy to Incirlik to fight Iraq from there. We next ran the flight plans and determined we could stage out of Incirlik and even make it to Baghdad and back when called upon. This was to be followed by the most difficult step, selling our 'back door' option up the chain of command. By the way, about a week after we started planning, the Wing received a warning order to be ready to deploy personnel and twelve F–4Gs to the Gulf region, giving us our entry into the main operation.

The plan was first briefed to the Wing commander, Col Rudi Peskens. He then presented it to the 65th Air Division

(65AD), which was the parent headquarters for the Electronic Combat (EC) Triad, the F–4G, EF–111A and EC–130H. The second front option proved to be viable as it proceeded quickly through USAFE's chain of command. On September 4-5, USAFE's commander, General Robert C. Oaks, briefed General John R. Galvin, CINCEUCOM, on the concept. Galvin, in turn, discussed the plan with General Colin L. Powell, JCS Chairman. USAFE initiated a study on October 12 to determine if a deployment to Turkey could be supported by a number of its aircraft. As the Command expected a positive Turkish reaction to its request to retain its F–16Cs and F–111Es at Incirlik after completion of DISPLAY DETERMINATION 90, actions were postponed the next day to redeploy them to their home stations.

Proven Force

In the final months of 1990, the plan to operate from Turkey continued to be reviewed and refined. Maj Dittmer in the meantime had taken over the planning and coordination for the 52nd. On December 20, USAFE dispatched a logistics planner to Incirlik to lay the initial groundwork for the arrival of additional aircraft. EUCOM's Crisis Action Team was responsible to prepare the operations order (OPORD). On December 21, they telefaxed an advance copy to USAFE. Two days later, USCINCEUR issued this OPORD, establishing JTF-PF. Mission was to support multi-national forces in the CINCCENT AOR from Turkey (Generals Schwarzkopf and Galvin had earlier agreed that EUCOM was to maintain operational control, meaning the Command would organize JTF-PF and assign its tasks. However, CENTAF was to exercise tactical control, meaning it would provide data on the specific targets the JTF would strike. Gen Oaks was directed to appoint a commander in the rank of major general, establish a staff to support him, and to coordinate strike planning, mission execution activities and air refueling.)

Patch of Composite Wing Provisional, 7440. ***(Via Eric Bosch)***

The 552nd AWCW at Tinker did not only deploy E–3s to the Gulf Region, but also three to Incirlik to support JTF PROVEN FORCE. The January 11 photo shows E-3B 83-0008. ***(USAF)***

On December 27, Maj Gen James Jamerson, USAFE's Deputy Chief of Staff of Operations (DCO), was appointed as JTF commander. His staff consisted of Lt Col Tom Hanton as the J-3 Air, members of the USAFE Weapons Shop and several other 65AD members. Tom, in his job as 65AD/DO, which was not a command position, was responsible to integrate the training of the EC Triad. For instance, he set up monthly 'Regular Training Missions' in USAFE that brought together the Triad along with U.S. and allied strikers. These training missions proved to be very valuable in refining the SEAD campaign approach and working out some of the tactics employed against Iraqi targets. The SEAD campaign planning template was used to create the Air Campaign Plan used by JTF-PF. Tom Hanton,

My initial role was to set the JTF up and organize it with a team of ten people. This meant, among others, to choose building(s) at Incirlik to house the JTF, communications requirements, organizing the operational and intel support manning requirements, including personnel and skills, and to establish processes to execute the war. This took about fourteen days. As the J-3 Air, my role was to organize its operations staff, to develop the air campaign, and prepare the Daily Operations Order (DOO), which informed the Turkish government and military, CENTAF, the Joint Staff and off-station units what we were planning. The Wing used the DOO, a high-level, mission-type order that was approved by the JTF/CC, to develop their daily ATO. Its targets were matched to the Air Campaign Objective and based on the phase of the Campaign itself and progress made.

On January 1, 1991, Incirlik AB hosted forty-eight USAFE aircraft, 10/F–15C (had arrived on December 16 for a WTD), 24/F–16C and 14/F–111E. In addition, SAC

had deployed four KC–135s. The aircraft remained under control of their respective home units until Turkey would have authorized the JTF's activation.

Warning Order

On January 2, Jamerson, in company of Brig Gen Lee Downer, the prospective wing commander, and Hanton, flew to CENTAF Forward (CENTAF–F) in Riyadh to meet with its campaign planners. Tom,

We briefed each other about the concept of operations, coordinated ATO procedures and established operations areas to de-conflict targeting. CENTAF–F would receive our daily operations order. Although we were to choose targets in our AOR only, we were requested several times to hit targets in the CENTAF AOR. Direct phone lines would be set up between the two headquarters.

CENTAF's single ATO had aimed to avoid 'route packages', but in case of USAFE's JTF-PF, an exception was made. Although the Task Force was under Horner's operational control, geography dictated a de facto route package. Although the targets were assigned, often ones recommended by the JTF, Incirlik decided, for instance, when to attack and what the strike package composition would be. This information became part of CENTAF's daily Master Attack Plan. As long as JTF-PF stayed north of the 35th parallel, there was little need to communicate with anyone other than Morón's and Fairford's B–52Gs. Or when F–117As struck targets there, like in the case of the strike against the Kirkuk sector operations center. Their assistance was necessary because of JTF-PF's lack of stealth and precision. In mid-February, CENTAF started calling upon Incirlik to assist in striking targets below the 35th parallel.

After returning to Ramstein, JTF-PF was activated by Gen Jamerson at 7/0800Z Jan. The JTF was composed of four components, (1) air forces, composed of eleven different aircraft types, (2) combat search and rescue (CSAR), (3) psychological ops, and (4) a Patriot SAM battalion. Concurrent with the activation, the deployment of a small ADVON, Tom Hanton and a staff of nine, to Incirlik was authorized by the Turks. Jamerson arrived on the 17th.
Two days after a January 13 meeting between Turkish president Özal and Secretary of State Baker, the U.S. Ambassador in Ankara was formally informed that a 'temporary' deployment of additional aircraft to Incirlik had been approved. Hq USAFE staff, with support from the wings that were to deploy, already had a lot of planning accomplished and they were immediately given a JCS warning order to deploy. However, the approval did not encompass authorization to fly strike missions against Iraq.

On January 16, USAFE activated Composite Wing Provisional, 7440, (CWP 7440) at Incirlik as the JTF-PF's air component, with Brig Gen Downer as commander. The Wing, comparable to a Navy Carrier Air Wing, was the first such wing with a combat mission since World War II. It was believed that by putting more authority in the hands of fewer commanders, working in a composite wing would allow pre-war planning to be cut by sixty hours to as little as twelve hours. However, it proved not to be the only plus. Many of the aircrews liked working face to face with colleagues flying other types of aircraft instead of hoping that everyone from the various bases would rendezvous at the right time. Incirlik's 39th Tactical Group (TGp) was attached to the Wing. Airlift began with the arrival of two C–5 Galaxy transports. Personnel arriving included the first 39-man echelon of JTF-PF headquarters.

An F–4G and F–16C Block 30D on a wet Spangdahlem tarmac before deploying to Incirlik on January 17. The F–4G is configured with two AGM-88 HARMs and an ALQ-131 ECM pod, the F–16C carries two AIM-9 Sidewinders, two AIM-120 AMRAAMs and an ALQ-131. ***(USAF, 52nd TFW)***

Elusive Concept

In a 17/0001Z Jan message, 'Follow-up Execute Order-USCINCCENT OPORD 001 for Desert Storm', USCINCCENT/J-3 advised COMUSCENTAF to be ready to receive tactical control of JTF-PF tactical air and CSAR forces based in Turkey.

After the Turkish Parliament empowered its government on January 17 to employ the forces previously authorized, execution orders were given and within hours augmentation aircraft started to arrive at Incirlik with four F–111Es from Naval Air Station Sigonella, Sicily as the first aircraft. The remaining aircraft arrived by next morning. As EUCOM had sent all its F–111Fs to CENTCOM, no precision strike aircraft were available for deployment. Special Operations Forces also arrived, when Col Ben Josey, deputy vice commander of the 39th SOW at Rhein Main (FGR), deployed with a 52-man ADVON to the FOB, Forward Operating Base, at Incirlik. According to Tom Hanton the Wing fell under the umbrella of JTF-PF, but it was not controlled by them. All they could do was to request to conduct SAR operations if an airplane and crew(s) were lost. The special ops segment was called ELUSIVE CONCEPT. The Wing's vice commander, Col Eugene Ronsick, commanded the FOB, while Josey commanded the FOL at Batman, seventy-two miles from the Iraqi border. Four PAVE LOWs arrived at Batman on January 20 and were operational that night. The fifth MH–53J was kept

Two F-16C Block 30Ds of the 52nd TFW taxiing to last chance prior to taking off. ***(USAF, SSgt Marvin Preston)***

at Incirlik. By January 24, the 39th had grown to over 200 personnel.

Tornado Town

As authorization to use Incirlik for strikes against Iraq was received on January 17 only, it meant that JTF-PF entered the war on Day Two, January 18. Meanwhile, the 7440th was being reinforced with additional aircraft. The squadrons involved had prepared their deployment, while logistics personnel had worked hard to improve the Lik's capability to support expanded operations. After a January 13 Turkish approval to construct thirty 12-person tents at Incirlik, a PRIME BEEF Civil Engineering team constructed a tent city, dubbed 'Tornado Town'.

To maintain the variety of aircraft, seven Aircraft Maintenance Units were established, plus a combined component maintenance/equipment maintenance section, the 39th CAMS. In addition, a munitions branch was established from the 39th TGp and deployed units. As the majority of intermediate-level repair (all avionics except ECM and engine repair) was sourced out of European home stations, the Wing operated on a de facto two-level maintenance concept with Military Airlift Command (MAC) channel and special airlift providing lines of communication. This also applied to most of the units in the AOR, resulting in days that as many as 500 pieces of cargo required manual tracing.

Three waves

On 17/2350Z Jan, a 20-aircraft strike package, including twelve F–111Es, took off to initiate combat operations from Incirlik, only hours after Turkish authorization. With limited support, the F–111Es ingressed Iraqi airspace at low altitude, attacked the targets and returned. Targets were four EW sites in northern Iraq and relatively close to the border. All were destroyed. One F–111E received minor damage. Seventy-six sorties were flown that day, including ten air refueling and eight EW sorties.

As of January 18, 120 aircraft were stationed at Incirlik. By 1200Z, 104 of them were mission capable, while one F–111E was in battle damage repair. This enabled the Wing to fly 50-60 sorties a day in three waves, two daylight and one at night (with twelve F–111Es, increasing to sixteen after the arrival of four additional aircraft), against targets in generally northern Iraq to destroy centralized air defense command and control, biological and chemical weapons storage and production facilities, and to achieve air superiority. Two of the new F–111E arrivals had gone through the Avionics Modernization Program (AMP), including a GPS receiver to improve navigation, enabling them to act as pathfinder for other F–111Es. The bigger daylight waves would encompass as many as twenty F–16C strikers.

JTF-PF conducted two strike packages on January 22 with a total of ninety-six sorties. Due to weather, the first package with seventy-one aircraft was forced to air abort. The second package with twenty-five aircraft successfully struck Mosul Airfield.

A few days after the JTF-PF/B–52G strikes on February 8-9 against Bayji oil refinery, CENTAF told Incirlik to use F–111Es and F–16Cs to attack further south to help F–117As bomb central Iraq. The target was the Taji complex in the middle of CENTAF's 'territory'. During the final two weeks of DESERT STORM, Taji was struck by some 140 F–16C and F–111E aircraft, supported by CENTAF support packages. Not being able to cross Syria, the missions were a third longer for the Incirlik aircraft than necessary.

On February 25, support personnel and equipment arrived at Incirlik in preparation for the arrival of the PAANG EC–130E VOLANT SOLO which was requested earlier by JTF-PF. The aircraft arrived the next day. The first mission was planned for the 28th.

CWP 7440 Air Order of Battle on Jan. 1/Feb. 1, 1991

Sqdn/Wing	Home Station	Eqpt	Phase I*/II	Total
23TFS/52TFW	Spangdahlem	F–4G/ F–16C	-/13-12	25
32TFS/32TFG**	Soesterberg,	F–15C	-/5	5
42ECS/66ECW+	RAF Upper Heyford	EF–111E	-/6	6
43ECS/66ECW	Sembach	EC–130H	-/3	3
77TFS/20TFW++	RAF Upper Heyford	F–111E	14/-	14
79TFS/20TFW++	RAF Upper Heyford	F–111E	-/4	4
525TFS/36TFW	Bitburg	F–15C	10/9	19
612TFS/401TFW	Torrejón,	F–16C	24#/-	24
Total			48/52	100

* 'Phase I' involved the aircraft already at Incirlik prior to the augmentation.
** Aircrews and aircraft augmented the 525th TFS.
+ On January 25, reassigned to the 20th TFW.
++ F–111Es destroyed 423 targets, including, for example, signal intercept stations near the Tigris River in Mosul. Aircraft and the majority of personnel redeployed to Upper Heyford on March 9.
# including four aircraft on a NATO SIOP alert commitment.

Because, after all, there was a great need for BDA at Incirlik, the 26th TRW received notification to deploy after SECDEF's direction on February 1. Within thirty-six hours, six RF–4Cs, 168 personnel, a PPIF and maintenance support equipment deployed to Incirlik as CREEK STORM. Another latecomer was the F–4E, of which four arrived from Clark (Philippines) on February 23 to fly combat missions with PGMs. However, to do so, they needed their PAVE TACK pods. They did arrive, but after the Gulf War was over. ***(Tom Hanton)***

Later deployments:

Sqdn/Wing	Home Station	Eqpt	Total	Date
38TRS/26TRW*	Zweibrücken	RF–4C	6	Feb 6
77TFS/20TFW	RAF Upper Heyford	F–111E	4	Feb 25
Total			10	

* After PROVEN FORCE was initiated, it quickly became apparent that insufficient Bomb Damage Assessment (BDA) was received. In late January, the 26th TRW/CC was called and asked if the Wing still had the capability to provide intel collection. Bureaucracy worked quickly this time as on February 1, after SECDEF's direction, the 26th TRW received notification to deploy. Within thirty-six hours, six aircraft, 168 personnel, a Photo Processing Interpretation Facility (PPIF) and maintenance support equipment deployed to Incirlik as CREEK STORM. When this was taking place, the Wing was well into the closedown phase as it was slated for inactivation on March 31. The first combat sorties were flown on February 5. All sorties were flown in strike packages and at medium altitude. The average sortie duration was 2.6 hours. Redeployment was on March 11, followed by the inactivation of the 38th TRS on April 4 and of the Wing one day later.

Non-USAFE deployments

Sqdn/Wing	Home Station	Eqpt	Total
917ARS/96BW	Dyess AFB	KC–135	15*
552AWACW	Tinker AFB	E-3B	3
7SOS/39SOW	Rhein-Main	MC–130E	2
67SOS/39SOW	RAF Woodbridge	HC–130N/P	4
21SOS/39SOW	RAF Woodbridge	MH–53J	5**
7SOS/39SOW	Rhein-Main	C–130E	1
3TFS/3TFW	Clark AB, PI	F–4E	4+
61TAS/314TAW	Little Rock AFB	C–130E	8
37TAS/435TAW	Rhein-Main	C–130H	11
VQ-2++	Rota, Spain	EP-3E	2
Total			55

In addition, JTF-PF combat operations were supported by SAC B–52G, RC–135U/V/W, KC–10A and KC–135A/E/Q/R aircraft in France, Greece, Italy, Spain and the UK.

* assigned to AREFWP 804. Four 96th BW aircraft had arrived from Dyess on December 28-29, 1990. Additional aircraft first deployed to RAF Mildenhall, pending diplomatic clearance. SAC retained operational control with USAFE absorbing tactical control. This was the first time SAC tankers operated within a composite force. The tankers refueled 3,802 receivers, offloading 29.2 million pounds of fuel.

** two MH–53Js and three crews were from the 1st SOW.

+ Before JTF-PF was activated, all available USAFE precision attack aircraft, read F–111Fs, deployed from RAF Lakenheath to Taif, Saudi Arabia. The arrival at Incirlik as late as February 23 of four F–4E Phantoms must have been met by many with quite a bit of surprise. All non-recce F–4s had left USAFE's inventory and the only operational USAF F–4s, F–4Es, were assigned to the 3rd TFW at Clark. The aircraft arrived with a shortage of maintenance. The 52nd TFW leapt to the challenge and re-configured the aircraft to a combat configuration. Tom Hanton,

Initially there had not been a need for a PGM (Precision-Guided Munitions) capability based on early targeting and JTF-PF's purpose, preventing the Iraqi AF from having a sanctuary and safe rear supply system. These targets were easily destroyed by conventional bombing. However, a point in our campaign plan targeting strategy had been reached that only PGMs would be effective against certain targets, primarily weapon storage bunkers. Neither the F–111Es nor F–16Cs were PGM-capable. They were AGM-65 Maverick-capable, but none of their aircrews were currently qualified. The F–4G was Maverick-capable, their crews qualified and tasked on several occasions, but this was not really an option for sustained operations. This resulted in a USAF–wide (active and reserve forces) request by Gen Jamerson for aircrews that were current in employing PGMs and aircraft with laser designation pods. Both the USAF and ANG had F–4E units with PAVE TACK capability. Both PACAF and the 141st TFS of the New Jersey ANG at McGuire, NJ offered aircrews and aircraft. When I was asked which of the two units was wanted, my reply was the one that could get to Incirlik the quickest. This turned out to be PACAF's 3rd TFS. Crews and aircraft arrived safely, but the C–5 Galaxy with the PAVE TACK pods ran into maintenance problems en route.

The Westinghouse AN/AVQ-26 PAVE TACK pod was the first laser designation system to provide the capability to autonomously deliver PGMs at night. PAVE stood for Precision Avionics Vectoring Equipment. The size of the pod made it necessary to carry it on the F–4E's centerline, replacing the 600-gallon fuel tank. Due to the substantial drag, aircrews referred to the pod as PAVE DRAG. When the Clark aircrews arrived at Incirlik, they had to be checked out. As their pods had not yet arrived, part of the checkout included flying several combat sorties, dropping 'iron' bombs. Ten sorties were scheduled with six flown, for

Brig Gen Lee Downer, commander of the 7440th, is thanking the Wing's members for their dedication and hard work throughout the Gulf War before a flight line celebration with food and music. The four-star general on the right is Robert Oaks, USAFE/CC, with Col Gary Lorenz, 39th ABW/CC, standing with Oaks. ***(Tom Hanton)***

sixteen flying hours. The PAVE TACK pods must have arrived at Incirlik as in his 'How goes it' assessment as of March 14, the 20th TFW commander, Col Lawrence Stellmon, stated the following,

High altitude drops of laser-guided bombs were validated with ground lasers at Konya Range immediately before the end of the war. As its end was announced, our F–111Es were on the ramp, loaded with LGBs, ready to drop precision-guided munitions in formation with PAVE TACK F–4Es on high-value Iraqi targets.

++ Fleet Air Reconnaissance Squadron.

Mirage F–1

The Wing conducted 100 strike packages. Engaged were 108 targets, including, for example, twelve support, production and storage depots and twenty-two C3 facilities, against which 3,500 tons of ordnance were expended. In addition, psychological leaflets were dropped, including 900,000 on February 27 by four F–16Cs expanding four M-129 bombs each on Iraq's 2nd and 38th Divisions.

Although no combat losses were suffered, an F–16C (86-0329) of the 612th TFS was lost on February 21. The pilot, Capt Strom, experienced engine problems after in-flight refueling over Turkey, attempted to reach Diyarbakir AB, but was forced to eject. He did so safely and was recovered.

There were forty aircraft emergencies, thirty-four in the air and six on the ground. Two F–15C Eagle pilots were each credited on January 19 with an Iraqi Mirage F–1 kill, the first of five kills achieved by JTF-PF F–15C Eagles. The kills, with AIM-7Ms, were made when Iraqi aircraft responded to a JTF-PF strike package against targets at Kirkuk and Quayyarah.

The number of airlift sorties was 963, involving the transportation of 7,223 passengers and 7,862 tons of cargo. Of the 5,499 tons of ordnance received, 3,494 were used. A total of 1,867 missiles were assembled and checked out.

Sorties flown/fighters

Type	Sorties Sched	Sorties Flown	Flying Hours	MC Rate	Average Number
F–4E	10	6	16	54.4	4
F–4G	429	414	1247	68.0	13
RF–4C	109	109	286	79.5	6
F–15C	1088	1068	3540	79.9	27
Ibid-ZULU	*0*	*144**	*341*		
F–16C	1191	1108	3122	86.8	26
F–16C WW	580	577	1760	85.6	13
F–111E**	553	553	1583	74.8	18
EF–111A	250	250	702	68.8	6
Total	4210	4229	12597	75.3	113

* 72 alert scrambles.

** including 456 night sorties (1,328 flying hours).

Sorties flown/'heavies'

EC–130H	-	100	458	-	3
KC–135	-	526	1787	-	13
E-3B	-	89	483	-	3
Total	-	715	2728	-	19
Grand Total	-	4944	15325	-	132

Provide Comfort

Redeployment of aircraft from the Lik was initiated on March 9. Eleven days later, a USAFE F–15C downed an Iraqi SU-22 over northern Iraq. On the same day, the JTF-PF headquarters element redeployed from Incirlik. However, this did not mean the involvement in Iraq was over. To provide humanitarian relief and protect Kurdish refugees in northern Iraq, Incirlik hosted Combined Task Force PROVIDE COMFORT I, II and III. No-fly zones were initiated above the 36th parallel in Iraq.

Downer

In his article 'The Composite Wing in Combat' in the Winter 1991 issue of *Airpower Journal*, Brig Gen Lee Downer, commander of CWP 7440, stated that two persons were key in the PROVEN FORCE operation, the Chief of Combat Plans and the (package) mission commander. The former assisted JTF-PF/J-3, Air in developing the air campaign plan, consolidating the DOO and producing the ATO. Sometimes, CENTAF added special instructions and/or its priorities. The J-3 staff would then produce the DOO, providing campaign objectives for that day, the targets, Time-over-Target windows throughout the day, and other guidance. Next were the combat planners, who proposed an ops concept to the DOO after coordination with, among others, maintenance, the tactical squadrons and off-station supporting units. Subjects like force size, its composition and weapon configuration were essential. The plan, after the DCO's approval, would then be 'translated' by the J-3 staff into an ATO, a critical process, which was essentially a flying schedule for the combined force employment in time, space and purpose on a mission-by-mission basis. Next in line was the mission commander, who 'absorbed' the ATO. He was one of the most experienced flight leaders

Two members of USAFE's EC Triad, the F–4G/F–16C Block 30D and the EF–111A. Both the F–4G and F–16C are configured with an AGM-88 HARM and ALQ-131. In addition, the F–16C carries AIM-9s and the F–4G an AGM-65 Maverick. The third member, the EC–130H, also flew combat sorties from Incirlik. ***(Tom Hanton)***

in the lead attack squadron. His job was to put the package plan together, picking the route(s) to the target, assign specific duties to the supporting forces, like SAC ELINT (Electronic Intelligence) RC–135s from Hellenikon, and conduct the mass briefing. This resulted in flight, launch, tanker and, tactics and backup plans. After completion of the mission, he was responsible for the mass debrief. After it had become obvious a mission commander needed some (non-flying) help, the job of 'mission monitor' was born. He was a captain or major with extensive operational experience, would assist the mission commander and relieve him from some of his tasks. He was assigned to a package from the ATO's creation until the mission results had been reported. Ultimately, the Wing would have six MMs.

According to Downer, the efforts to get the 7440th into the war was a special success story. He answered his own question, 'Did the composite wing work in combat?' with 'Absolutely, with no reservations'. He stated that as to the composite wing concept there were no fundamental reasons why it could not succeed. With a future leaner, meaner force, being tasked with responding to a wider range of conflict, the composite wing would prove to be a most important capability, especially in the context of SECAF Donald Rice's vision of 'Global Reach—Global Power'.

USAFE Deployments

For Operations DESERT SHIELD, STORM, and PROVEN FORCE, USAFE deployed 297 aircraft from its 610 Primary Aircraft Authorized (PAA) aircraft. In Phase I, August 25-September 5, sixty-eight aircraft deployed to the Gulf region: 32/F–111F, 24/F–16C, and 12/F–4G. To support CENTCOM, USCINCEUR on November 19, ordered the Phase II deployment (November 8-December 31) of 114 additional USAFE aircraft (4/EF–111A, 32/F–111F, 24/F–16C, 18/A-10A, 12/F–4G and 24/F–15C), bringing the total to 182 (with 5,420 personnel). 110 aircraft were deployed to Incirlik (with 2,630 personnel, including some 450 aircrew members).

Of note is that the U.S. Government on September 7 approved the Foreign Military Sale (FMS) to Saudi Arabia of twenty-four USAFE F–15C/D Eagles (32nd TFG and 36th TFW) for delivery in September and October. The first six F–15Cs were delivered on September 20. ■

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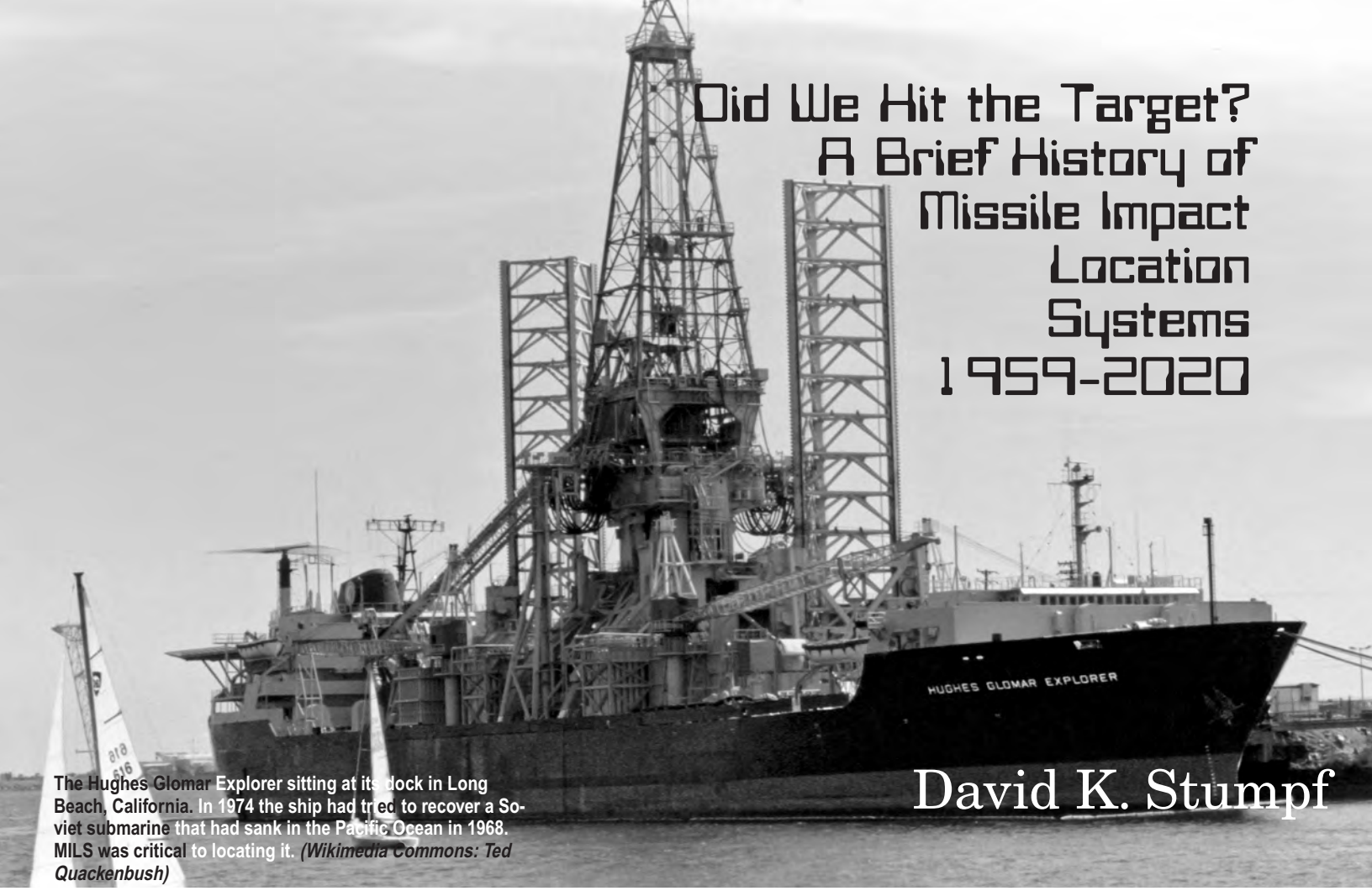
Did We Hit the Target? A Brief History of Missile Impact Location Systems 1959–2020



The Hughes Glomar Explorer sitting at its dock in Long Beach, California. In 1974 the ship had tried to recover a Soviet submarine that had sank in the Pacific Ocean in 1968. MILS was critical to locating it. *(Wikimedia Commons: Ted Quackenbush)*

David K. Stumpf

Along with the 1947 decision to locate the first U. S. long-range ballistic missile test range at Cape Canaveral, Florida, came the need to accurately determine reentry vehicle impact location in the open ocean. Tracking stations were to be located along the British West Indies Islands chain to monitor the boosted phase of missile flight for both performance and safety reasons.[1] They were, however, inadequate for determination of guidance system accuracy in the broad ocean area (BOA) targets. A similar problem arose with the decision in November 1956 to conduct the operational training and testing of IRBMs and ICBMs at Cooke Air Force Base, California. The IRBM target was a BOA 300 to 1500 nautical miles off the coast of Cooke AFB. Several of the ICBM targets were also BOAs, near Wake and Midway Islands, while others were near or within the lagoons at Eniwetok and Kwajalein Atolls (approximately 400 and 700 square statute miles respectfully).[2]

Fortunately, a solution was well into development. In 1941, a physicist at Woods Hole Oceanographic Institute, Massachusetts, Maurice Ewing, postulated the existence of what he called the deep sound channel. The confirmation of the existence of the channel in 1944 and the detailed evaluation of its properties led to the concept of the sound fixing and ranging system (SOFAR). SOFAR became a key part of the missile impact location system (MILS) for both the Eastern and Western Test Ranges. This article describes the SOFAR system and its application for the location of reentry vehicle impacts, recovery of data return capsules and locating Mercury spacecraft splashdowns. Photographic and radar systems are also briefly discussed.

The Deep Sound Channel

The long-range transmission of underwater sound was first suggested in 1934 by Karl Dyk and O. W. Swainson as a result of seismic experiments conducted by the U. S. Coast and Geodetic Survey off the coast of Southern California in 1933. Signals from the explosion of 0.5-pound charges of TNT were received at a distance of 50 nautical miles. The authors indicated that much greater ranges might be obtained.[3] The deep sound channel aspect of their research was not pursued further until 1941 when researchers Maurice Ewing, Columbus Iselin, Allyn Vine, Alfred Woodcock, and Lamar Worzel at Woods Hole Oceanographic Institute published "Sound Transmission in Seawater," a report sponsored by the National Defense Research Committee. Ewing postulated the existence of the deep sound channel, a layer of seawater approximately 4,000 feet deep in the Atlantic and similarly in the Pacific, though at a different depth, through which sound could travel remarkable distances.[4]

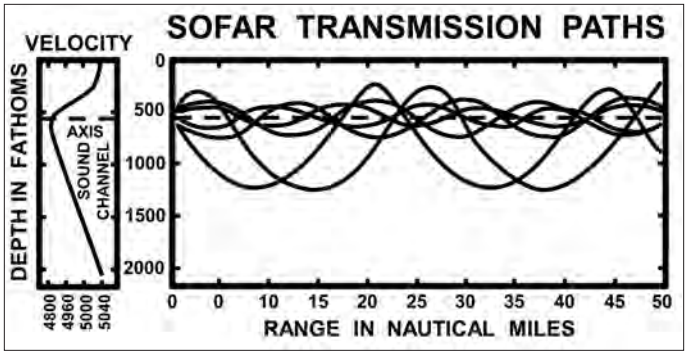


Figure 1. Left: speed of sound in seawater versus depth; Right: some of the many possible SOFAR ray paths simplified and exaggerated vertically. Counterintuitively, the longer ray paths arrive sooner at the receiver due to the higher speed of sound in the region they are traveling. ***(Long-Range Sound Transmission Interim Report 1)***

In deep ocean water the temperature normally decreases gradually with increasing depth, reaching a minimum slightly above zero at approximately 700 fathoms (4,200 feet), in the Atlantic, after which the temperature gradually rises until reaching the ocean floor. The sound speed follows a similar pattern, reaching a minimum at a depth of 4,200 feet, then increasing near the ocean floor to a greater speed than at the surface. The increase in velocity is due to a pressure effect. If an omnidirectional signal source is placed at the depth of minimal velocity, the axis of the sound channel, signals that start at an angle of 12 degrees above or 15 degrees below the axis of the channel are repeatedly reflected downward or upward, respectively, within the channel until absorbed or blocked by an obstruction (**Figure 1**).

Ewing and coworkers noted that signals in the deep sound channel had these qualities:

1. Extremely long-range transmission (probably 10,000 miles).
2. Signal was positively identifiable.
3. Abrupt termination of the signal allows the arrival time to be read with an accuracy better than 1/20th of a second. This permits location of the source to better than a mile, if the signal is received at three suitably located stations.
4. The signal duration is related in such a way to the distance that the distance may be estimated to 3 nautical miles in 1,000 from reception at a single station.

David K. Stumpf, Ph.D., is a retired plant biochemist living with his wife, Susan, in Tucson Arizona. He has written three nuclear weapon histories, Regulus the Forgotten Weapon*, a history of the Navy's Regulus I and II cruise missiles;* Titan II: A History of a Cold War Missile System *and* Minuteman: a Technical History of the Missile that defined American Nuclear Warfare*, published February 2021. Dr. Stumpf volunteered at the Titan Missile Museum, Sahuarita, Arizona, as an historian and as a tour guide for 15 years. He was instrumental in the effort to gain National Historic Landmark status for the museum.*

The limitations were:

1. It is required that the great circle path which the sound follows between source and receiver be entirely deep water (probably at least 1,000 fathoms).
2. Sound travels in water at a speed of roughly 1 mile per second so that the interval between the origin of the signal and its reception become sufficiently great to be a handicap for some uses.[5]

In July 1943, Ewing filed a report with the Navy Bureau of Ships describing the use of the deep sound channel for coded transmissions to submarines. Somewhat to his surprise, his report was met with little enthusiasm.[6] Undeterred, from March 1944 to January 1945, Ewing and coworkers undertook to more fully characterize the deep sound channel. The results clearly showed that three or more stations equipped with hydrophones located in the deep sound channel could be used to triangulate a signal from a downed aircraft, life raft or ships in distress to within 1 nautical mile. Since all of the receiving stations in the experiment had been hydrophones suspended from ships, a station with one hydrophone located on the ocean floor in the deep sound channel was established on Eleuthera Island to complete the investigation. Signals were detected out to 450 nautical miles, after which the hydrophone cable broke.[7]

To the casual observer, it would seem difficult to isolate the signal generated by a relatively small explosion from the background noise in the ocean, but this proved not to be the case. The received signal consists of a series of impulses corresponding to the possible propagation paths. Paths within the deep sound channel are the slowest and also most numerous. The first sound to arrive is weak. Though coming over the longest path, i.e., reflections from the surface and ocean floor, it arrives first by virtue of the higher velocities encountered along this path. The last, strongest, signal to arrive comes via the shortest path, along the axis of the deep sound channel, which is the path of minimum velocity. Sound from a source located on the axis will follow paths which are refracted toward the axis. Therefore, a large portion of the signal will be confined more or less to the plane of the velocity minimum and not encounter reflection off the surface and bottom. As a result, losses are relatively low and very long ranges are possible.[8]

The longer the distance from the source, the greater the time differential between the first and last arrivals (**Figure 2**).[9] The abrupt cutoff represented the signal

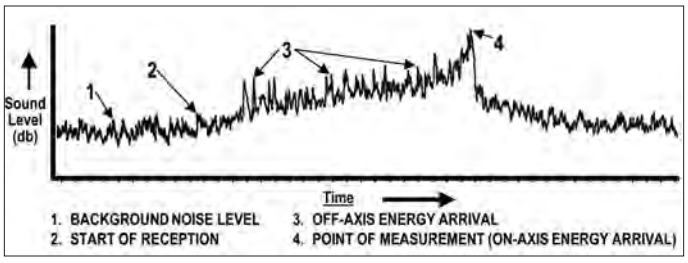


Figure 2. Typical SOFAR signal trace. Normally the SOFAR channel signal was this clearly indicated. ***(AF Western Test Range Instrumentation Handbook)***

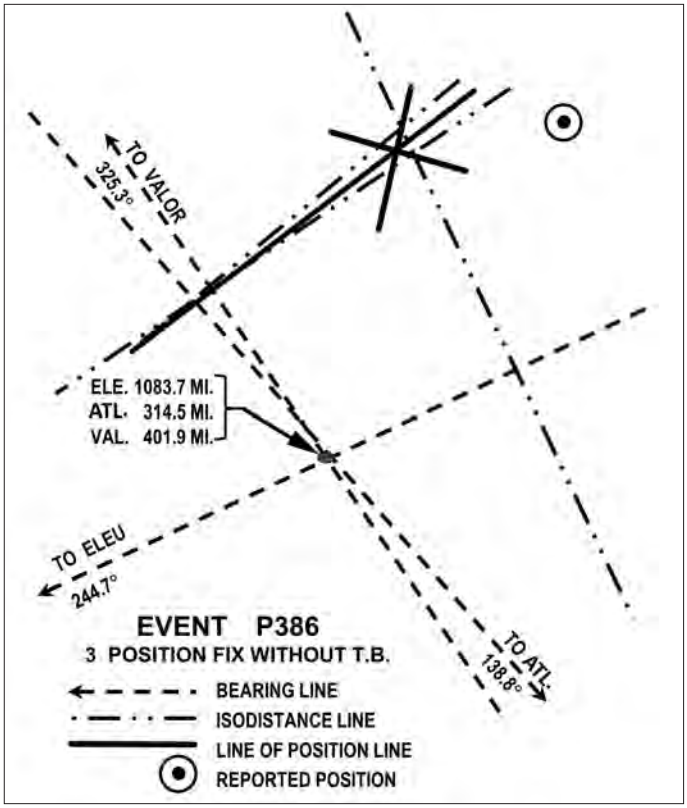


Figure 3. Example of a triangulation plot. Large cross indicates where the isodistance lines from Eleuthera, USCG Valor and USRV Atlantis coincided. *(Long-Range Sound Transmission Report Number Three)*

transmitted by the deep sound channel. This characteristic pattern made signals that originated at or near the axis of the sound channel easily recognized. The maximum signal range during the cruise was 900 nautical miles due to the limitations imposed by the Navy on the use of the *USS Buckley* (DE-51). Work completed after the cruise resulted in reception of a signal from detonation of a 6-pound TNT charge at a range of 3,100 nautical miles.[10]

In 1959, Ewing and coworkers proposed that SOFAR be used to "connect the geodetic networks of all continents and islands into a single unit." The major obstacle to establishing the many international ties required for a global geodetic system was the difficulty of making geodetic measurements at sea. Such a survey would be coupled with a gravimetric survey to determine the shape of the earth. They proposed methods for the establishment of benchmarks in the ocean, measuring the distances using the SOFAR technique with an accuracy of one part in 200,000. This work would facilitate the accurate navigation of spacecraft and targeting of ballistic missiles.[11]

SOFAR Begets MILS

Regardless of the skepticism of the Navy for the use of the deep sound channel for submarine communications, work progressed at Woods Hole on the design and production of explosive charges called SOFAR bombs. The Navy did see the potential of the SOFAR bomb concept for experimental use as air-sea rescue aids. The bombs varied in design from simple demolition blocks with detonators to cast charges of TNT, in pressure proof cases, fired by a preset pressure sensitive mechanism. Since the depth of the deep sound channel was variable, the charges had to have easily adjustable detonators for both experimental work and as rescue aids.[12]

In the summer of 1945, after seven months of testing the bomb design, a two-week cruise involving three ships, several aircraft and the repaired shore station at Eleuthera, successfully evaluated SOFAR triangulation techniques using bombs ranging from 1 to 48.5 pounds and one 300-pound Mark 6 depth charge (**Figure 3**). Crucial to the SOFAR concept was the use of the correct axial sound speed value. The average value for the northern Atlantic was 4,888 feet/second. In the Pacific, the value was 4,845 feet/second off California and 4,852 feet/second off Hawaii. Calculations using the appropriate average value for each ocean proved sufficiently accurate to delineate a relatively small air-sea rescue search area.[13]

The utility of the SOFAR concept was demonstrated in 1953 during a month-long experiment using two hydrophones separated by 16 miles off the southeast coast of Bermuda. The *USS San Pablo* (ADP-30) fired 234 0.5-pound TNT shots at a depth of 50 feet in an arc between 34- and 221-degrees true bearing, 120 nautical miles off of Bermuda:

The SOFAR signals received by the Bermuda instruments do not have the characteristic sharp cut off nor are the signals identical on both instruments. This is caused by the location in different depths of water, both being shallower than the sound channel. It is also caused by their location on dissimilar morphological features along the southeast Bermuda island slope. In general, their SOFAR signals start with staccato bursts and end with a confused reverberation. Relative timing between signals at both instruments is done by comparing their overall signal envelope.

The results indicated that bearing accuracies of 1.5 degrees were possible. The fact that the signals were not as clear as those found in similar experiments on the West Coast demonstrated the efficacy of the system under less-than-ideal conditions.[14]

While tracking radar could be used for visual display of booster or reentry vehicle impact prediction for range safety issues, it was insufficient at the time for determination of impact locations in the BOA targets of the Air Force Eastern Test Range (AFETR).[15] SOFAR was the solution in the form of stations with groups of hydrophones around the periphery of the North and Mid-Atlantic. These were not part of the sound surveillance system (SOSUS), which operated at a different frequency and utilized a much larger number of hydrophones. Reentry vehicles, data capsules and spacecraft would release SOFAR bombs as location aids. The system was named the Missile Impact Locating System.

Sound Channel Axis Velocity Experiments

The Polaris flight test program presented the problem of accurately locating the reentry body (the Navy term for

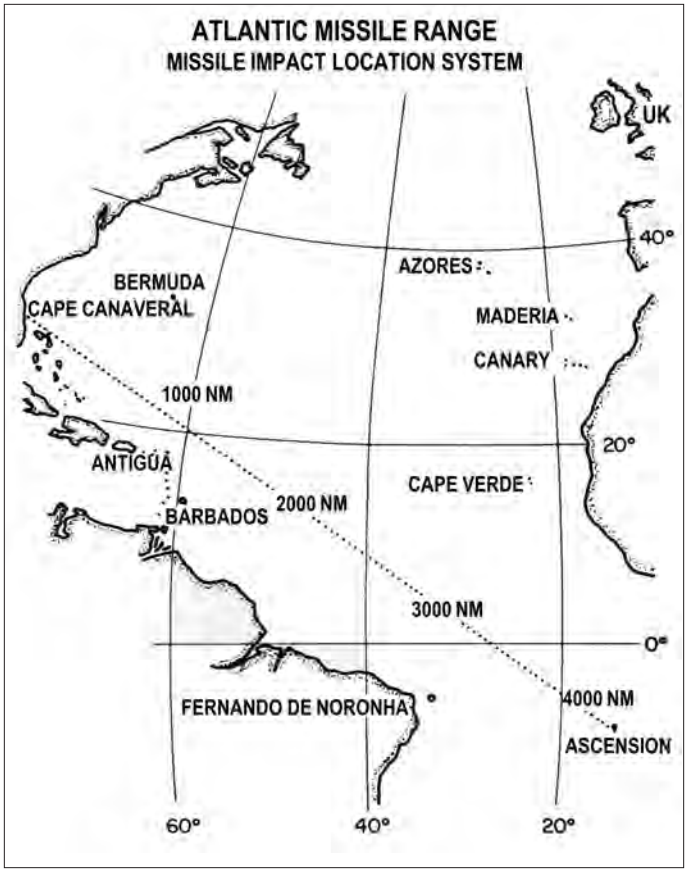


Figure 4. Portion of the Atlantic covered by the Sound Channel Axis Velocity Experiments. Signals were detected by SOFAR and MILS stations at Ascension, Barbados, Bermuda, Canary Islands, Eleuthera, Fernando de Noronha. ***(Time Variations of Sound Speed over Long Paths in the Ocean)***

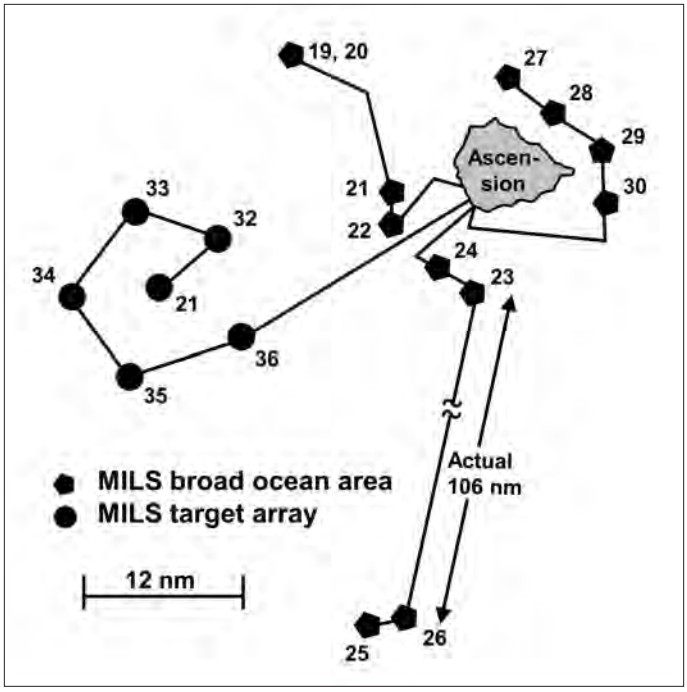


Figure 5. Approximate location of hydrophones at Ascension Island for target array and broad ocean area signal detection. ***(Sonobuoy MILS)***

reentry vehicle) SOFAR detonation in the mid-Atlantic. Sound-Channel Axis Velocity Experiments (SCAVE) were conducted from 1961 to 1964 to evaluate solutions to the problem. SCAVE was a series of precisely located and timed SOFAR charges detonated off the island of Antigua and detected by the MILS and SOFAR stations at Ascension, Barbados, Bermuda, Eleuthera, Fernando de Noronha, with additional hydrophones installed at the Canary Islands to balance the unknown bias from the existing hydrophones to the south and west (**Figure 4**). The seasonal and short-term variability of the axial sound speed of the deep sound channel were evaluated as possible sources of error.[16]

The first year's experiments, utilizing two hydrophones at Bermuda and three at Eleuthera, demonstrated sound channel axial speed was not constant, although there were times when it remained steady for a month or two. The results after two and half years of experiments demonstrated it was not feasible to try to predict the axis sound speed due to time of year.

The solution was to calibrate shortly before the predicted impact and again afterwards. An eight-day test revealed that while the axial sound speed did vary, the change was small in this short a period of time. The method adopted was calibration before and after the flight test by firing 10 SOFAR charges in the vicinity of the proposed reentry body impact area over bottom transponders that had been geodetically located.[17]

Acoustic-Based Missile Impact Locating Systems

Initially, there were two acoustic-based systems used for impact location determination, the missile impact locating system (MILS) and the sonobuoy missile impact location system (SMILS). MILS was subdivided into the target array, also known as the splash detection system, and BOA array.[18]

Missile Impact Locating System

Target Array (Splash Detection System)

A target array consisted of six hydrophones, five of which were placed on the ocean floor in a regular pentagon configuration, 5-24 nautical miles across depending on sea floor topography, with the sixth located in the middle (**Figure 5**). The pentagonal shape was used so that at least four hydrophones were at a range less than the refraction limit, thereby enabling them to pick up the sound of impact by a direct transmission path instead of bottom and surface reflection paths. Accuracy with this design was ±30 feet when impact was within the confines of an array at least 10 nautical miles across.[19]

BOA Array

A BOA array was used when flight test requirements dictated impact locations away from established target arrays as was necessary for the later Polaris flight test program. Shore stations were connected to individual hydrophones or groups of hydrophones. The stations were

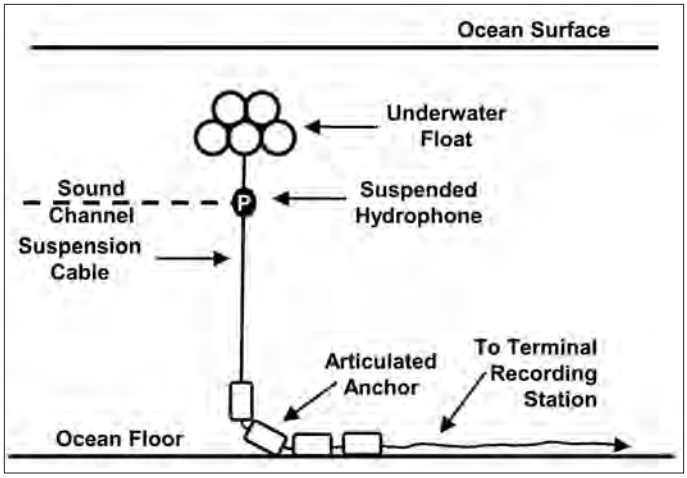


Figure 6. Typical broad ocean area hydrophone installation. It was critical to have them positioned accurately in the sound channel. ***(Air Force Western Test Range Instrumentation Handbook)***

separated by several hundred to 1,000 nautical miles or more. Where the installation was a group of hydrophones, they were placed in a plane-hyperbolic array, located as close as possible to the deep sound channel axis (**Figure 6**). With at least three stations receiving the SOFAR bomb signal, the impact location was determined by triangulation. The calibration of the BOA array hydrophones consisted of a ship releasing several SOFAR bombs at the same time the ship's position was being accurately determined by the Acoustic Ship Positioning System via geodetically surveyed bottom transponders in the impact area.[20]

Sonobuoy Missile Impact Locating System

By the late 1960s, the capability of the MILS system, deployed in 1958-1960, was no longer sufficient. Accurately monitoring the impact of the 6 to 14 reentry bodies carried by the Poseidon SLBM was not feasible. Installation of additional stations was expensive and, in many cases, politically difficult. SMILS developed by adapting already existing antisubmarine warfare sonobuoy detection system equipment.

The SMILS concept was evaluated by monitoring the water impact of finned Martlet rounds fired from 5-inch, 7-inch and 16-inch smooth-bore cannon during the High-Altitude Research Project (HARP,1962-1967).[21] For SMILS, projectiles were launched from Barbados, West Indies, to altitudes approaching 300,000 to 400,000 feet, splashing down in the nearby ocean at a speed sufficient to mimic reentry vehicle impacts. The projectiles were spin-stablished by canting the fins 3 degrees, resulting in an impact dispersion of less than one mile.[22]

SMILS was deployed by aircraft just prior to the flight test. There were four basic components:

1. The Acoustic Ship Positioning System (ASPS) deep ocean transponders on the ocean floor. These were geodetically surveyed using the Navy's Transit satellites and served as reference points for the sonobuoys. The batteries for the transponders lasted between 2 to 3 years and replacement units could be located with accuracies approaching 50 feet in the 1969 timeframe. The transponders were energized by a 16 kHz interrogator signal and each responded on a different frequency at 0.5 kHz intervals from 7.5 to 12 kHz.[23]

2. Specially equipped Navy P–3 Orion Lockheed Electra antisubmarine warfare aircraft modified to receive and record up to 32 sonobuoy signals. A precision timing system was also installed as well as the ability to monitor and provide a quick-look recording capability.

3. The standard Navy aircraft-deployed AN/SSQ-41 sonobuoy was modified, extending the battery life and providing the ability to receive the ASPS transponders interrogation and reply signals.

4. Unlike the MILS system, SMILS used the well-mixed surface isothermal layer. Projectile splash signals from the HARP experiments had been received up to 20 nautical miles distance. A bathythermograph sonobuoy dropped by the aircraft was used to determine the presence and depth of the surface mixed layer prior to the flight test. Without this layer the splash signal propagation paths were by ocean bottom bounce rather than the surface duct, degrading the SMILS performance.[24] This information, combined with the expected reentry vehicle impact footprint, was used to configure the sonobuoy pattern for the particular test. The typical pattern for a single reentry vehicle impact footprint consisted of four sonobuoy rings approximately three nautical miles apart with a total outside diameter of 20 nautical miles. This involved as many as 30 sonobuoys including the interrogator sonobuoy.[25]

The transponders were energized by the interrogator sonobuoy and served to locate the pinger sonobuoys relative to the transponder. The signals from these pinger sonobuoys propagated through the surface duct and were received by the circular array sonobuoys. The splash position relative to these sonobuoys and the time at which the splash occurred could then be determined.[26] The estimated accuracy for the system was 0.1 nautical mile as originally deployed, but early improvements brought the accuracy down to 0.05 nautical miles (**Figure 7,** following page).[27]

Portable Impact Locating System 1

The Portable Impact Locating System (PILS) represented an example of the ultimate evolution of the acoustical-based impact detection system. The Navy began development in 1994, expanding on the research conducted for the Air Force in 1983-84 before cancellation in 1986.[28] The deep ocean transponders of the SMILS were replaced with sonobuoys equipped with NAVSTAR Global Positioning System receivers. This eliminated the costly positioning and upkeep of deep ocean transducers and made flight test targeting much more flexible.

Operationally, the system was a simplified version of SMILS, utilizing two concentric rings, 10 and 14 nautical miles in diameter, each with six sonobuoys. The ring dimensions were chosen to allow for sonobuoy drift during possible launch holds. The sonobuoys were deployed from the P–3 Orion aircraft approximately 90 minutes prior to

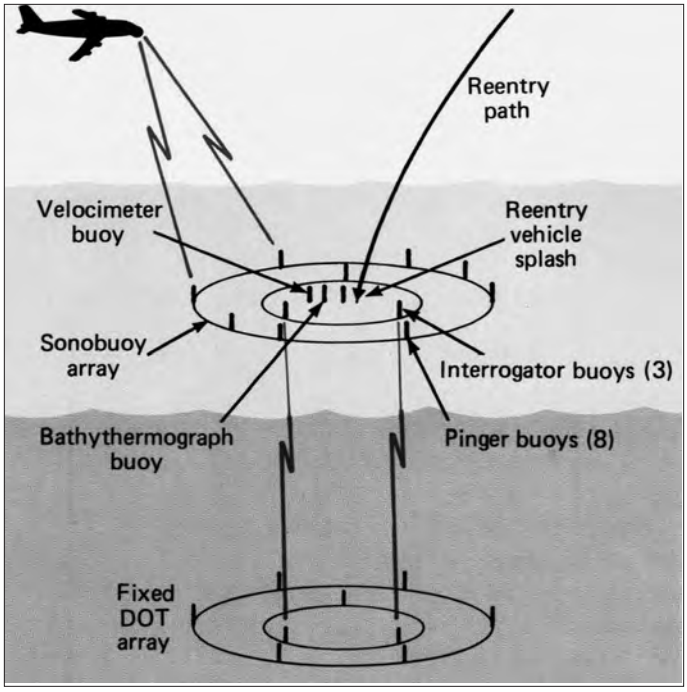


Figure 7. Overview of the DOT/SMILS. Each sonobuoy is equipped with an acoustic transmitter and receiver. The acoustic information picked up by the sonobuoys is transmitted to the aircraft via a VHF radio link. The fixed deep ocean transponder (DOT) array, previously placed on the ocean bottom, is used to determine the position of sonobuoys. The velocimeter buoy measures the velocity of sound in the water, while the bathythermograph buoy measures the temperature of the water as a function of depth. Interrogator buoys are equipped with sonic transmitters that send commands to the DOT, the DOTs respond to the interrogations by generating an acoustic signal, different for each transducer. The pinger buoys propagate the signal through the surface duct which are received by the circular array buoys. ***(Copyright 1984 John Hopkins University applied Physics Laboratory, LLC. All Rights Reserved)***

programmed flight test vehicle launch. Typical impact position accuracies were 15 feet, with impact time accuracies approaching 3 milliseconds. The system was declared fully operational in October 1996.[29]

Portable Impact Locating System 2

The current PILS 2 differs from PILS 1 in three respects: the sonobuoys are deployed from a ship carrying the Navy Mobile Information System (NMIS); they are designed to maintain position after deployment and only nine sonobuoys are used, eight in a six nautical mile diameter circle with the ninth in the center (**Figure 8**).[30] The date of deployment has proven elusive.

Over-the-Horizon Buoy

Trident II flight test safety rules can require that the NMIS ship be over-the-horizon from the deployed PILS 2 sonobuoys. An over-the-horizon (OTH) buoy system was developed for the Navy by Johns Hopkins University Applied Physics Laboratory and the University of Texas, Austin, Applied Research Laboratory, to provide satellite communications capability between the ship and the buoys. The test operator onboard the ship programs the

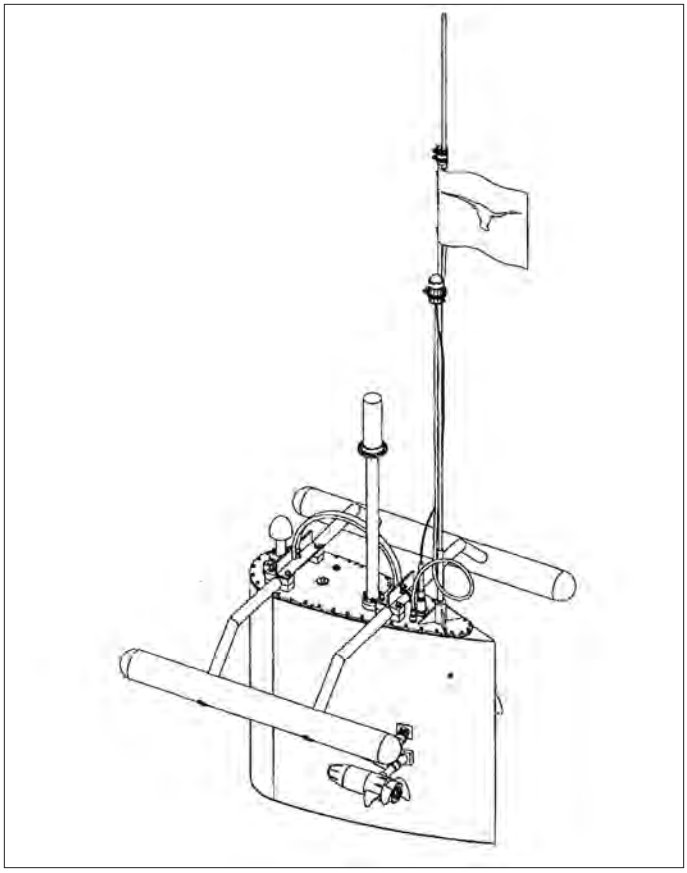


Figure 8. PILS 2 self-propelled sonobuoy. (*Adapted from United States Patent 6,854,406B2)*

buoys with telemetry recording start and stop times. The multiple reentry body impact timing must be at least 12 seconds apart, permitting 10 seconds of data recording and two seconds to change the settings for the next reentry body impact. When the test is complete, the buoys are recovered and the data extracted. The OTH buoys are modified PILS 2 buoys.[31]

Air Force Eastern Test Range

Missile Impact Locating System

Target Arrays (Splash Detection System)

Target arrays were located at Antigua, Ascension and Grand Turk. The dimensions of the three target arrays, as of 1976, are listed in **Table 1**. Polaris A-1 and A-2 reentry body impacts in the Antigua and Grand Turk target arrays could be located within 0.05 nautical miles.[32]

Table 1. AFETR Target Array Location and Description.

Location	Description	Distance from Cape Canaveral
Antigua	130 nm northeast, at a depth of 3 miles, 5 nm across	1230 nm
Ascension Island	35 nm west-northwest, at a depth of 2 miles, 12 nm across	4370 nm
Grand Turk Island	75 nm north , at a depth of 3 miles, 24 nm across	660 nm

AFETR Range Instrumentation Handbook, September 1971

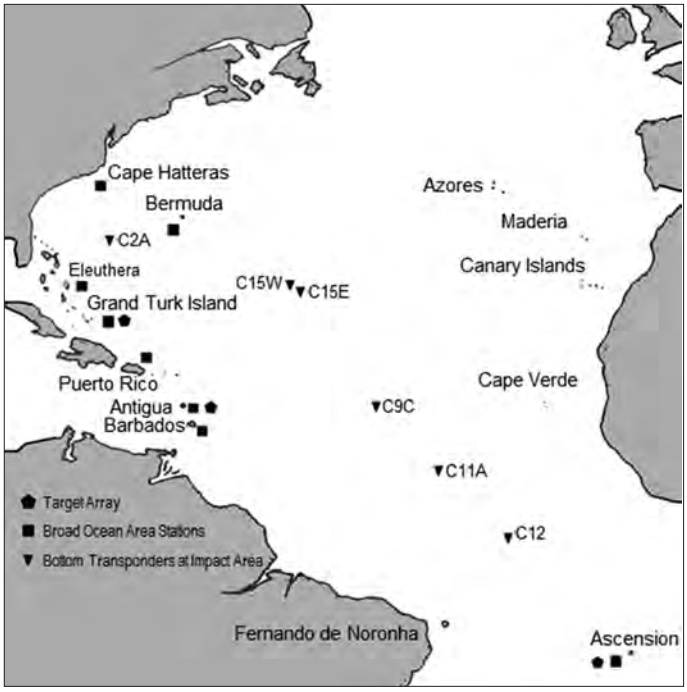


Figure 9. Location of unclassified MILS components of the AFETR, July 1, 1976. There was at least one additional MILS station in the eastern Atlantic. The Canary Island SCAVE installation was temporary. ***(AFETR Range Instrumentation Handbook)***

BOA Arrays

BOA arrays and receiving stations unclassified locations, as of 1976, were: Antigua, Ascension, Barbados, Bermuda, Cape Hatteras, Grand Turk, Eleuthera, Fernando de Noronha and Puerto Rico (**Figure 9**).

In May 1958, the Thor IRBM research and development program began at Cape Canaveral with the Series III flight tests to determine the performance of the Mark 2 reentry vehicle and continue evaluation of all the missile subsystems. Earlier work with the X–17 reentry vehicle research rocket had demonstrated that telemetry transmission through the ionized air flow around the reentry vehicle during reentry was intermittent at best. General Electric, manufacturer of the Mark 2 reentry vehicle, developed a recoverable data capsule that housed a tape recorder for recording telemetry, power supply, radio antenna, dye pack and SOFAR bomb.

The capsule was an 18-inch-diameter sphere made of polyurethane foam and fabricated as two hollow hemispheres. The bottom half contained a data tape recorder, battery pack, dye packs and SOFAR bomb. The top half contained the radio beacon and antennas. There was an opening for the ejection of the SOFAR bomb as well as to detect contact with saltwater, activating the radio beacon, releasing the dye packs and ejecting the SOFAR bomb. The two hemispheres were cemented together and enclosed in an ablative outer shell that shattered on impact with the water surface. The capsule was ejected from the reentry vehicle by a small rocket motor (**Figure 10**).[33] The first successful recovery of a data capsule took place on 13 June 1958 after the flight of Thor FTM 122.[34]

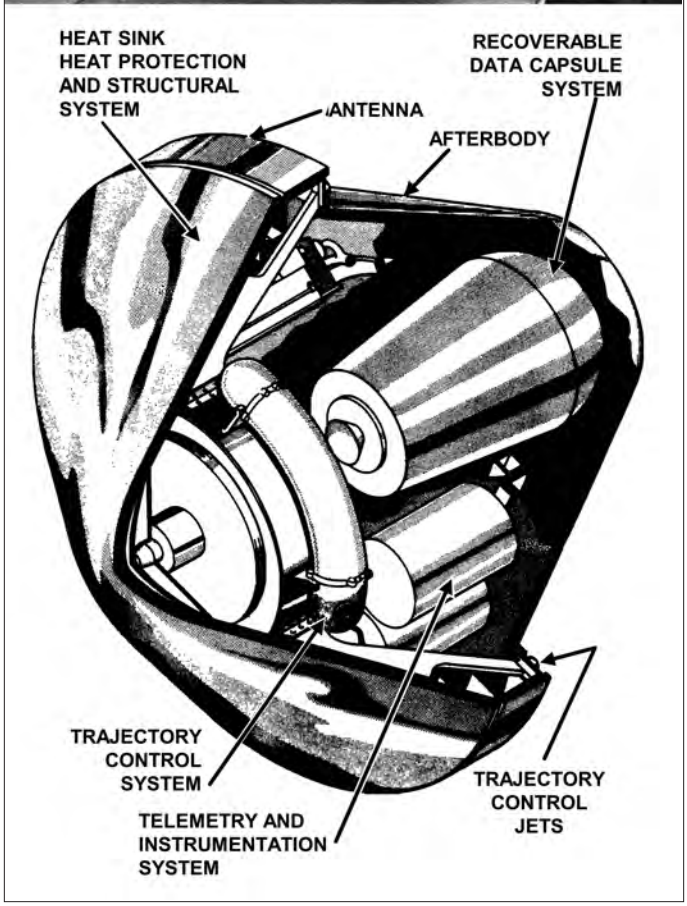


Figure 10. Top: General Electric recoverable data capsule system. The technician is assembling the two hemispheres of the recoverable capsule. The hemisphere on the left contains two dye packs and the data recorder as well as the SOFAR bomb, the large cylindrical object in the center In the background is the fully assembled system including the separation rocket. (USAF); Bottom: Mark 2 development reentry vehicle general layout. (General Electric)

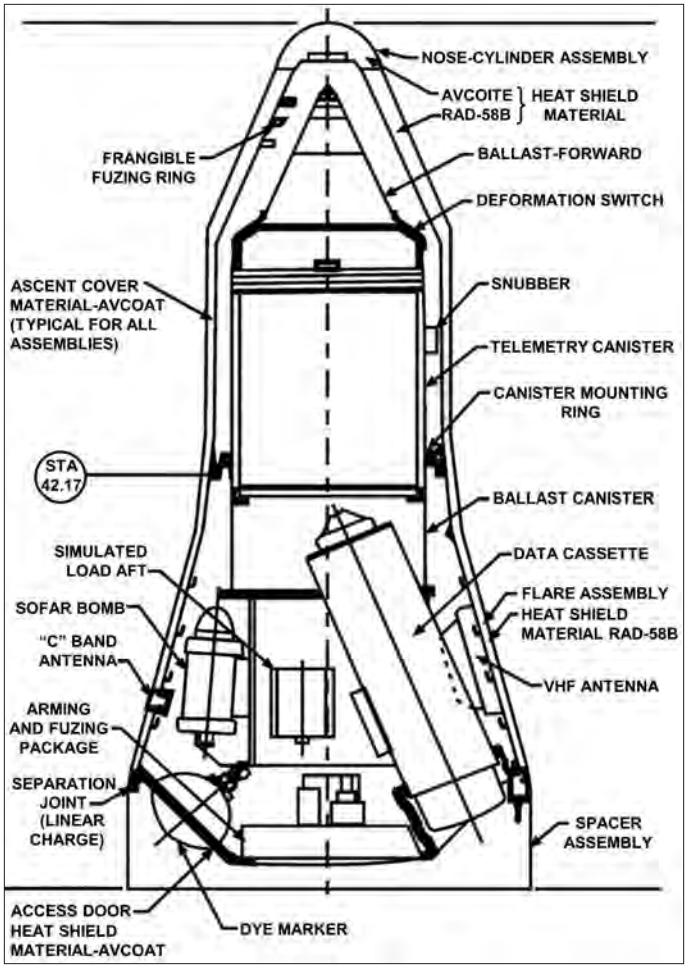


Figure 11. Minuteman Mark 5 development reentry vehicle. Telemetry was transmitted therefore there was no need for a recoverable data capsule. The SOFAR bomb is located on the left side of the illustration. *(USAF)*

Details of the developmental flight testing of Atlas, Titan I and II reentry vehicles are scarce. The Mark 3 and 4 series reentry vehicles (Atlas E, Atlas F and Titan I respectively) could be equipped with SOFAR bombs and data capsules, but not all flights carried the systems.[35]

The Minuteman ICBM flight test program at the AFETR began in 1961. The program consisted of minimum-range flights of 3,000 nautical miles and to the target array and BOA target located at 4,300 nautical miles near Ascension Island. Both the Minuteman IA Mark 5 and Minuteman IB Mark 11 reentry vehicles could be equipped with SOFAR bombs that would explode at the pre-set depth regardless of whether they were ejected from the reentry vehicle (**Figure 11**).

Manned Spacecraft

The Mercury Program included SOFAR bombs as part of the recovery package on several of the developmental flights, beginning with a suborbital heatshield test in September 1959. Only two of the manned flights, MA-6 and MA-8, carried SOFAR recovery aids.[36] The Gemini and Apollo spacecraft did not carry SOFAR bombs.

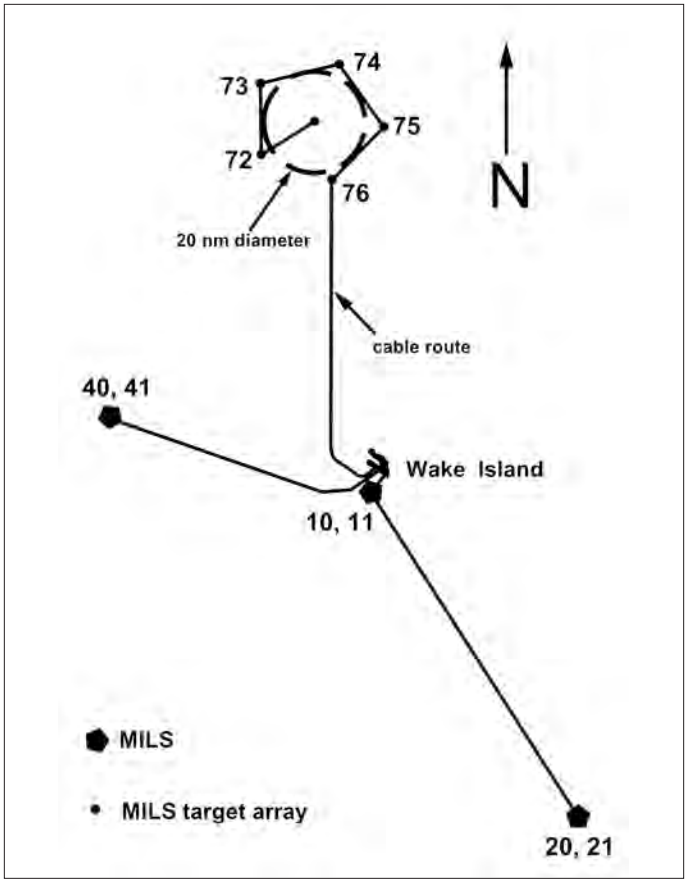


Figure 12. Wake Island MILS hydrophone installations. The target array north of the island was installed first followed several years later with the six-hydrophone broad ocean array west and south of the island.(USAF)

Sonobuoy Missile Impact Locating System

The system was used exclusively by the Navy with the Polaris A-1, A-2 and A-3 SLBM flight test programs.[37]

Portable Impact Locating System

The system was used exclusively by the Navy for the Poseidon and Trident I and II flight test programs.[38]

Pacific Missile Range/Air Force Western Test Range

Like the AFETR, the Navy's Pacific Missile Range was faced with the dilemma of accurately scoring reentry vehicle impacts in the open ocean (the name was changed to Air Force Western Test Range, AFWTR, on May 15, 1964).[39] The solution over the years was the evolution of the SOFAR/MILS techniques.

Missile Impact Locating System

Target Arrays (Splash Detection System)

One target array was approximately 60 miles northwest of Wake Island (**Figure 12**). Initially the use of the Eniwetok and Kwajalein lagoons as targets obviated the

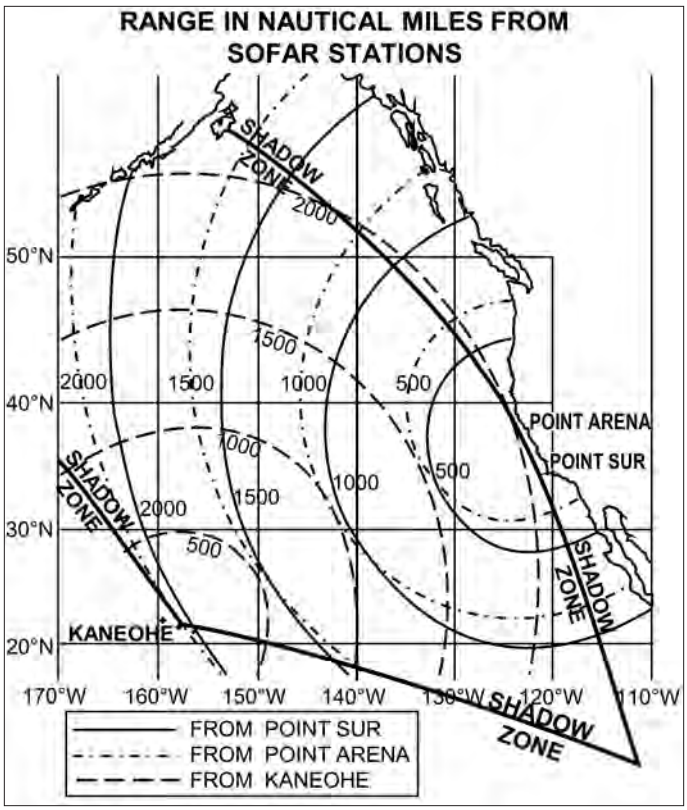


Figure 13. Northeast Pacific SOFAR network coverage 1948. The system was incorporated into the Pacific Missile Range MILS in the 1958-1960 timeframe. *(USN)*

need for target arrays near those islands. On September 9, 1959, the Wake Island array successfully detected and scored the impact of the Mark 2 reentry vehicle carried by first Atlas ICBM (12D) launched from Vandenberg Air Force Base.[40]

BOA Arrays

In late 1945, the Navy Department decided to install a SOFAR network in the eastern North Pacific for air-sea rescue purposes. The network consisted of three stations: Kaneohe, Oahu in Hawaii and two stations on California's central coast separated by 180 nautical miles—the U.S. Coast Guard Station, Point Sur and the U.S. Coast Guard Lifeboat Station, Point Arena. The system became operational for evaluation in September 1948 (**Figure 13**).

Accuracy varied from 10 to 20 nautical miles in the southeasterly portion of the network to 20 to 100 nautical miles in the northeasterly section. Between the West Coast and the Hawaiian Islands, the accuracy was much better, on the order of 3 nautical miles. Due to the more complicated topography of the Pacific Ocean bottom, the signals were not as clear as those found in the Atlantic. Nonetheless, in the spring of 1951, signals from SOFAR charges dropped off the coast of Japan were easily detected 4,340 nautical miles away at the California stations. While the concept worked well, by 1956 budget constraints resulted in the stations being closed, but the hydrophones and equipment were left in place.[41] Reactivated in the 1958–

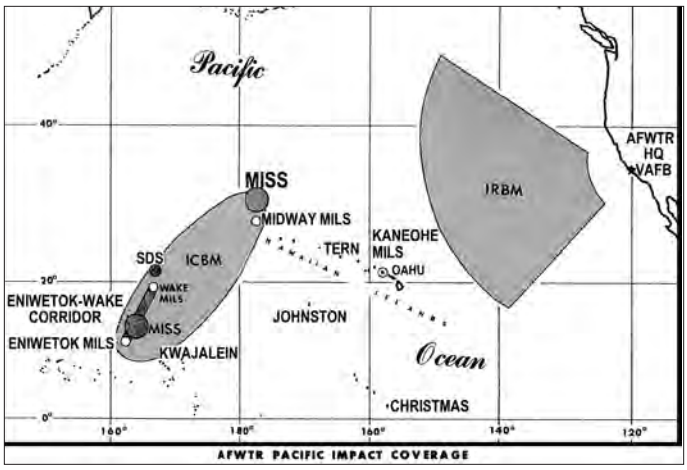


Figure 14. AFWTR Pacific Ocean MILS coverage 1966. *(USAF)*

1960-time frame, the Northeast Pacific SOFAR stations became part of the Pacific Missile Range MILS.[42]

The Pacific Missile Range BOA array locations started with the IRBM sector between Vandenberg and Hawaii, extending 300 to 1500 nautical miles off the California coast.[43] The IRBM range became active in October 1958 with the completion of the signal receiver building at the Marine Corps Air Station, Kaneohe Bay, Oahu, Hawaii. The first use of the range took place on December 16, 1958 with the first launch of a Thor IRBM (DM-18A, 58-2262, *Tune Up*) from Vandenberg.[44]

Plans to extend the Pacific Missile Range MILS to support ICBM operations were finalized in December 1958 with expansion to include Eniwetok, Midway and Wake (in addition to the target array at Wake). The MILS system had two additional hydrophones installed between Wake Island and Eniwetok. The installation was completed in March 1961(**Figure 14**).[45]

Sonobuoy Missile Impact Locating System

Until the early 1980s, there had been no need for the SMILS capability as part of the Western Test Range. This changed with the flight test programs for the Peacekeeper (MX) ICBM and Trident SLBM scheduled to begin in 1982-1983. The range safety instantaneous impact prediction system in use at the time for the Kwajalein terminal area precluded Peacekeeper or Trident flights to the Kwajalein lagoon. Additionally, many of the flights needed to be conducted at distances beyond Kwajalein at ranges of 6,000 to 7,400 nautical miles depending on the number of reentry vehicles carried.[46] The solution was to develop BOA targets in the vicinity of Guam and north of the Mariana Islands for the long-distance flights and north and east of Kwajalein for the shorter-range tests. This involved positioning and maintaining deep ocean transponders at the new sites.[47] Already existing facilities at Wake, Phoenix and Oeno Islands were also available.

Initial SMILS support utilized Navy P–3C assets operating from the Pacific Missile Test Center, Point Mugu, California. The 4950th Test Wing, Wright-Patterson AFB, assumed management of the program in 1986. To econo-

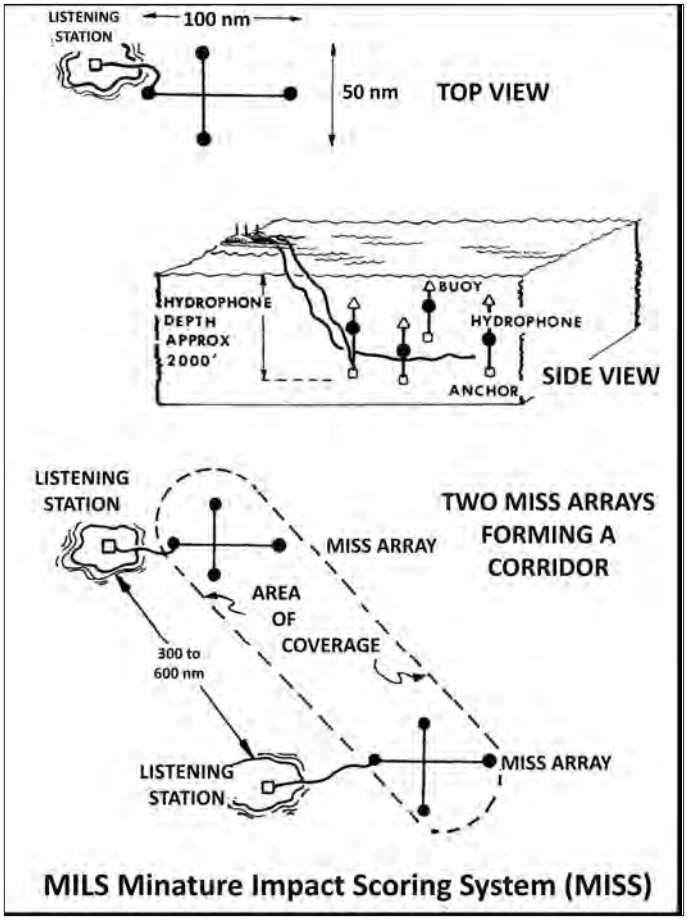


Figure 15. Miniature Impact Scoring System configuration. ***(USAF)***

mize, SMILS capability was added to the EC–18 Advanced Range Instrumentation Aircraft (ARIA). Now a single aircraft could both track the reentry vehicles and record telemetry as well as deploy sonobuoys and determine the impact locations. One of the original requirements had been that Global Positioning Satellite capability be added to the sonobuoys and eliminate the need for the placement of deep ocean transponders. Research proved this to be feasible but in late 1986, the Office of the Secretary of Defense canceled the requirement due to budgetary restraints. After flying 13 ARIA missions as backup, the 4950 TW assumed the primary scoring mission in 1993.[48]

Portable Impact Locating System

The Pacific Ocean extended-range flight test program for Navy's Trident II SLBM utilizes PILS 2. The system was successfully tested on 21 November 2006 during the FCET dual launch exercise of the *USS Maryland* (SSBN-738). The NMIS ship was not located over the horizon but the capabilities of the new buoys to record the data was verified.[49]

Miniature Impact Scoring System

The miniature impact scoring system (MISS) was a special case of the BOA array installation. Four pairs of hydrophones were arranged in a crossed-dipole pattern, separated by 30 to 60 nautical miles. Two pairs of hydrophones were suspended from seamounts at depths of 450 to 520 fathoms. Two pairs were bottom mounted on the insular slope of the atoll. The first MISS array was completed at Eniwetok in March 1961, off Japtan Island, followed by an installation at Midway and eventually at Kwajalein forming a MILS corridor (the hydrophone arrangement was different at Kwajalein and referred to as the KMISS, see below).[50] Most signals originating from the North Pacific Ocean could be detected at the Eniwetok installation. Impact in the open ocean area 20 nautical miles northeast of Eniwetok was also monitored by the MISS installation.

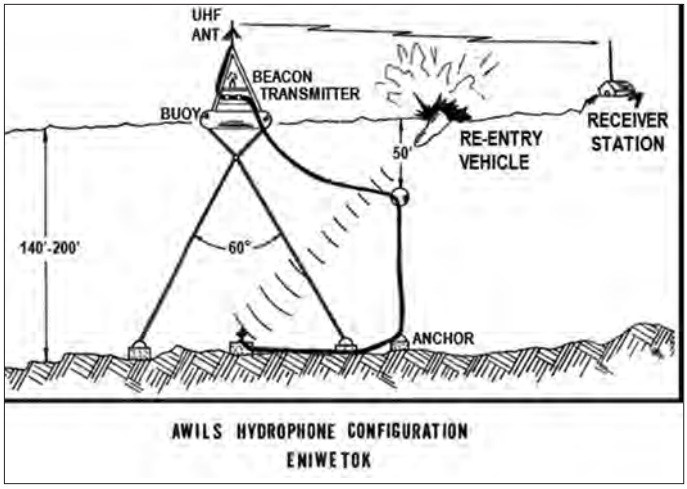


Figure 16. All Weather Impact Location System (AWILS), Eniwetok Lagoon. ***(USAF)***

Sand Island, part of the Midway Atoll, was the termination point for 10 hydrophones. Four pairs of hydrophones were installed north of the island in the MISS configuration (**Figure 15**). There was excellent coverage over an angle of 120 degrees on both sides of true North and indefinite coverage in other directions. The exceptions were signals blocked by the Hawaiian Archipelago. To the southeast, signals were often blocked by various island groups, and in the southwest, signals were blocked by the Eniwetok Atoll.[51]

All Weather Impact Location System

On February 1, 1965, the Air Force accepted operational control of the Pacific Missile Range facilities from the Navy. At that time there was only one reentry vehicle impact scoring system at Eniwetok Atoll for scoring impacts in the lagoon target area—the optical-photographic system which could only be used during daytime and in good weather to score surface or air burst options. The Air Force rectified this situation with completion of the installation of the all-weather impact location system (AWILS) and the splash detection radar scoring system (see below).

The Navy had studied the concept of the AWILS in 1963 and determined it was feasible. AWILS was a modification of the MILS target array. Instead of undersea cable connections to the receiving station, the seven bottom

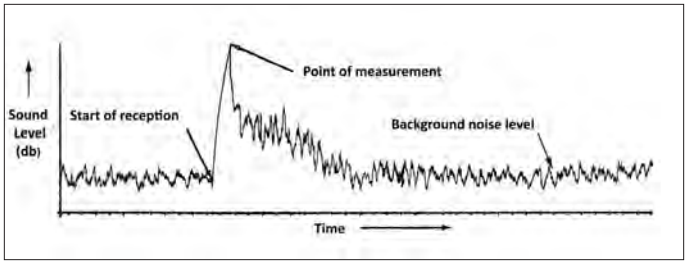


Figure 17. Reentry vehicle splash signal. The target arrays and AWILS hydrophones picked up a distinctly different signal than that detected by the broad ocean area hydrophones. The first peak was a direct signal from the impact of the reentry vehicle with the water. No SOFAR bomb was necessary. ***(USAF)***

mounted hydrophones, distributed in a hexagonal configuration with one hydrophone in the middle, were connected to surface buoys that housed a battery supply and transmitter (**Figures 16, 17**). The reentry vehicle splash signal from the hydrophones was transmitted via radio to the MILS building at Site David on Japtan Island. The prototype system was installed in April 1964. Initial operation was unsatisfactory so the diameter of the 7-hydrophone array was decreased from 10 to 6 nautical miles. The first test of the system took place on 30 July 1964 with the successful scoring of the impact of a Mark 6 reentry vehicle launched from Vandenberg on Titan II B-28.[52]

The Air Force upgraded the system in April 1965 and the system was calibrated with a series of explosions in the impact area on April 10, 1965. The system was successfully used on 14 April 1965, Eniwetok time, to score the impact of two Minuteman IB Mark 11 reentry vehicles—*Sea Point* at 2109:57.856 and *Yellow Light* at 2124:51.6—"ripple" launched from Vandenberg Air Force Base on April 13, 1965.[53] The final flight report scored the two reentry vehicle impacts using the optical-photographic system, but the AWILS was in close agreement.[54] The accuracy of the optical photographic system was ± 100 feet and, with AWILS, ±150 feet.[55]

Bottom Mounted Impact Location System

In 1968, the bottom mounted impact location system (BMILS) replaced the AWILS buoys with hardwired, bottom-mounted hydrophones in the same hexagonal configuration. In 1969, the BMILS system at Eniwetok was dismantled due to the decision to fly to Kwajalein (see below).[56]

Kwajalein Missile Impact Scoring System

Kwajalein did not have a MILS-type scoring system installation until the addition of the overlapping hexagonal, 10-hydrophone Kwajalein Missile Impact Scoring System (KMISS) in 1996 off Gagan Island (**Figure 18**). Upgraded in 2014, as presently deployed the refurbished KMISS covers 39.5 square nautical miles (approximately 1/8 the area of metropolitan Tucson, Arizona) providing an accuracy of ±18 feet within the boundary of the array. The relatively small target area exemplifies the accuracy of the Minuteman III guidance system.[57]

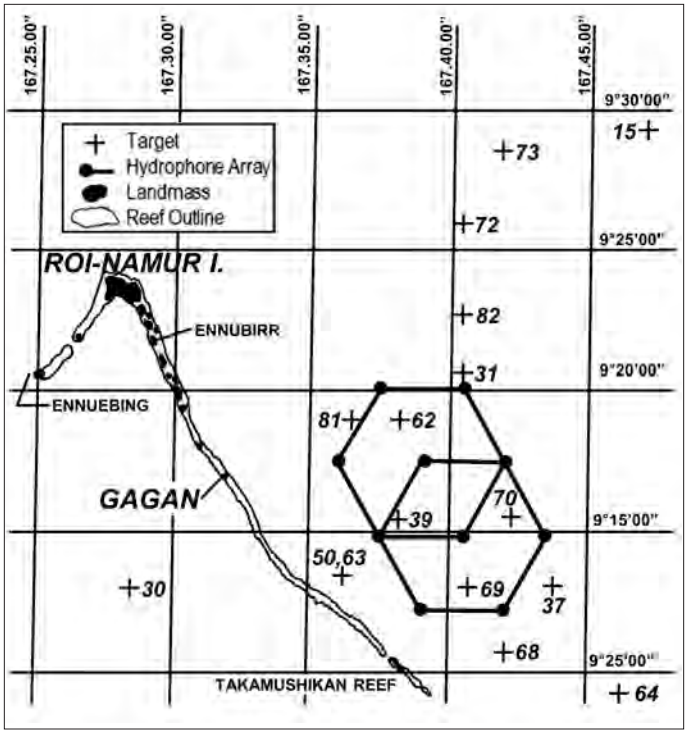


Figure 18. Original Kwajalein Missile Impact Scoring System (KMISS) configuration east of Gagan Island. The 49 mi.² system was installed in 1996 and upgraded in 2014. ***(USN)***

Minuteman III reentry vehicles are now targeted to either the KMISS or Illeginni Islet impact zones. If targeting the KMISS, the reentry vehicles land at least 3 nautical miles to the east of Gagan Islet where the ocean waters are between 6,900 to 12,000 feet deep. Those targeting the ocean area off of Illeginni Islet impact about 0.4 nautical miles southwest of the island in water about 1,000 feet deep. Typically, one reentry vehicle each year is used for conducting an airburst test above either zone though the majority of the tests are done southwest of Illeginni Islet.[58]

Flights on October 30, 2017 (FE-1) and March 20, 2020 (FE-2), tests of the Navy's Intermediate Range Glide Body (IRGB) concept for the Conventional Prompt Strike system used both the KMISS and a deep-water ocean area approximately 18 nautical miles southwest of Illeginni Islet as target options (**Figure 19**, following page).[59]

Hydroacoustic Impact Timing System

The splash detection radar system (see below) could only determine reentry vehicle impact timing to within 1.5 seconds. Because Minuteman II and III development required accuracy to within 100 milliseconds or better, three hydrophones were installed in the Kwajalein lagoon to improve timing accuracy to within 10 to 20 milliseconds. The system is no longer operative.[60]

Livermore Independent Diagnostic Scoring System

The SMILS concept has evolved into the Livermore Independent Diagnostic Scoring System (LIDSS) developed at Lawrence Livermore National Laboratory. Similar to the

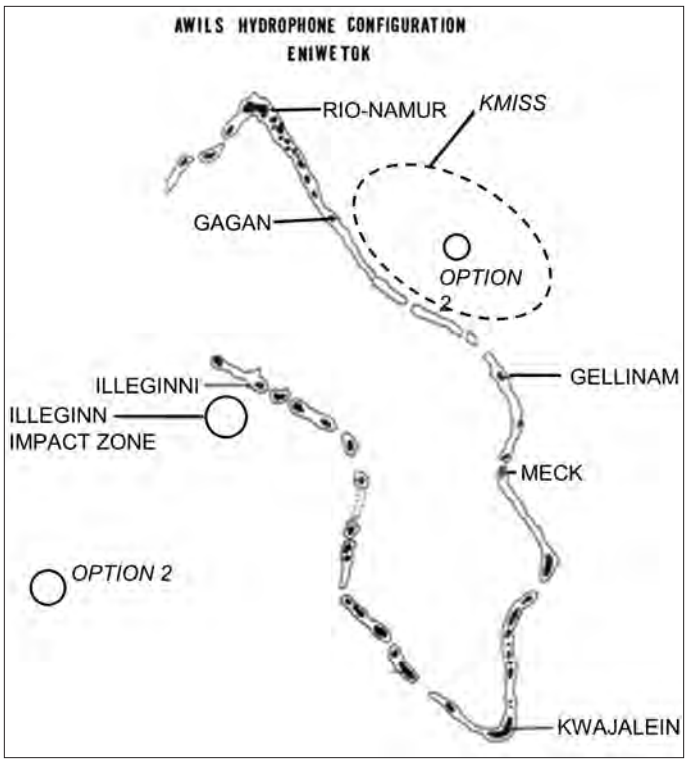


Figure 19. Target options for the Navy's Intermediate Range Glide Body concept test for the proposed Conventional Prompt Strike system. ***(USN)***

PILS 2 concept and developed in the same timeframe, LIDSS rafts are equipped with high-speed, streak, and high-definition video cameras as well as neutron detectors, hydrophones and microphones. On-board telemetry equipment records data for air burst or ocean impact missions. The rafts maintain their position in the water using GPS-based controls and trolling motors. Within two hours of reentry vehicle impact, "quick look" data can be supplied concerning reentry vehicle-warhead performance. Detailed analysis takes place back at Lawrence Livermore Laboratory. As many as 17 of these rafts can be deployed in the deep water off Illeginni Island (for example the FE-1 and 2 tests) or in BOAs such as targets near Guam or Saipan as is necessary (**Figure 20**).[61]

Other Scoring Systems

Optical

Manned Optical and Photographic Systems

In 1961, impact location in the Eniwetok lagoon, or impacts sufficiently close but outside to the east, were determined by triangulation using angular data from manned optical instruments and camera equipment platforms on three towers positioned along the eastern periphery of the atoll. Runit Island (Site Yvonne) had a 196 ft² cab on a tower approximately 85 feet above the lagoon. Site Yvonne was chosen because it was nearly directly underneath the reentry vehicle trajectory to the lagoon. Parry Island (Site Elmer) was the central location, with a 270 ft² cab atop a 300-foot tower (**Figures 21 & 22**). Eniwetok Island (Site

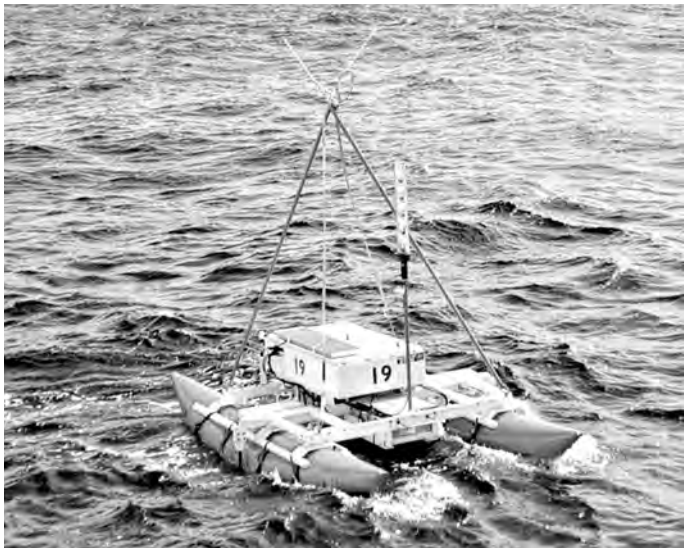


Figure 20. Livermore Independent Diagnostic Scoring System (LIDSS) instrument raft. (Courtesy Lawrence Livermore National Laboratory)

Fred) had a 273 ft² cab built on top of the 50-foot water tower. Each of the tower cabs were equipped with surveyor's transits, motion picture cameras and aircraft reconnaissance cameras.[62]

LA-24 Tracking Telescopes/Askania Cinetheodolites

The original Kwajalein tracking equipment was designed to track launches of missiles associated with development of the Nike-Zeus antiballistic missile system. There were two LA-24 Tracking Telescopes, one each on Ennylabegan and Kwajalein Islands.

In 1963, three Askania Cinetheodolites, along with three Mobile Optical Tracking Units, were added to the system, one each on Gugeegue, Ennylabegan and Kwajalein Islands, forming a triangle with a nine-mile base for point-of-impact triangulation.[63]

Recording Automatic Digital Optical Tracker (RADOT)

In the late 1960s, Kwajalein was the test site for Spartan and Sprint anti-ballistic missile developmental launches against incoming reentry vehicles from Vandenberg. RADOT cine-sextants were deployed to provide maximum coverage of the Sprint and Spartan launches from Meck Island and Spartan launches from Kwajalein Island. By December 1969, a total of eight RADOTs were deployed on Kwajalein, Gugeegue, Ennylabegan, Legan and Gellinam.[64]

Optical Scoring System

The system was established in 1966 to facilitate optical coverage of impacting reentry vehicles in the Kwajalein lagoon. Composed of stations on Legan, Gellinam and Eniwetak which were equidistant from the established target area, the result was a triangle 11 nautical miles across. Daylight optical determination of impact location was provided with an accuracy of ± 50 feet.

Figure 21. 300-foot instrumentation tower, Parry Island (Site Elmer) 1961. *(USAF)*

Ballistic Impact Locating System

The ballistic impact locating system consisted of four mobile ballistic cameras with a wide field of view. There were seven surveyed camera locations on Kwajalein Atoll. The system could be used for both air burst and surface impact missions.[65]

Radar

Splash Detection Radar

On April 1, 1965, Bendix engineers began installing the first splash detection radar system at Eniwetok. This system provided all-weather reentry vehicle splash detection, day or night. The SPN-8A radar was modified to provide a system pulse repetition frequency of 4,000 pulses per second versus the standard 2,200 pulses per second. While the SPN-8A range was reduced to 20 nautical miles, the increased pulse rate greatly enhanced the splash detection capability. The antennas were mounted on 100-foot towers and could detect a splash of 27 feet minimum height and three second minimum duration at ranges up to 20 nautical miles. The accuracy was ±10 feet with a detection probability of at least 95 percent.[66]

The system was successfully evaluated against optical scoring with a series of sand-ballasted oil drums dropped from a C–54 aircraft flying a base leg from the Elmer Island tower to the Mack Island tower. The system successfully detected the two impacts of Minuteman IB Mark 11 reentry vehicles "ripple" launched from Vandenberg AFB on April 13, 1965 (see above). To further enhance system accuracy, five radar reflectors were placed at various locations in the target area to serve as calibration points.[67] The SDR system at Eniwetok was removed in 1969.

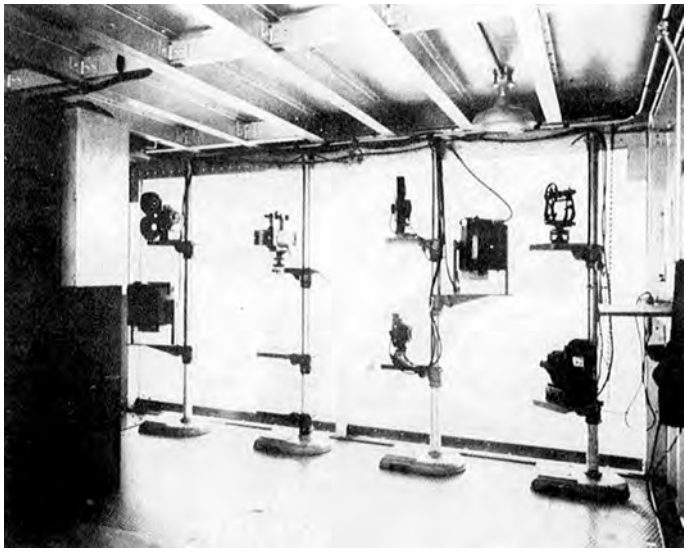


Figure 22. Optical and photographic instrumentation room, Runit Island (Site Yvonne) 1961. *(USAF)*

At Kwajalein, one SPN-8A splash detection radar was installed on Eniwetak Island in May 1966. The system could detect a splash of 30 feet or higher but also needed the splash to be a minimum of two seconds in duration.[68] A month later, the system was successful in determining the lagoon impact point of a Mark 11A reentry vehicle delivered by a Minuteman II, *Fox Trap*, launched on 24 June 1966 at 2310 hrs.[69] A second unit was installed on Gagan Island in Fiscal Year 1969. The system covered not only the lagoon but also BOA targets 20 nautical miles to the east and west of the atoll.[70] By late 1989 the system had exceeded its life expectancy with no source of major repair parts.[71]

The Phoenix Islands Terminal Complex Area of the Western Test Range was formed as part of the Minuteman III flight test and operational test program. Splash detection radars were deployed on Canton, Endenbury and Hull Islands in 1971.[72]

Broad Ocean Scoring System

The broad ocean scoring system (BOSS) was used to detect and locate impacts of reentry vehicles at remote island sites or in the open ocean, thereby augmenting the results of the MILS. The system was similar to that of the splash detection radar but was mounted on the Range Instrumentation Ship *USNS Huntsville* (T-AGM-7). The system operated in one of two modes: reflector or navigation. In the reflector mode, the ship and the reentry vehicle impact had to be within 20 nautical miles of an island on which there were two geodetically surveyed radar reflec-

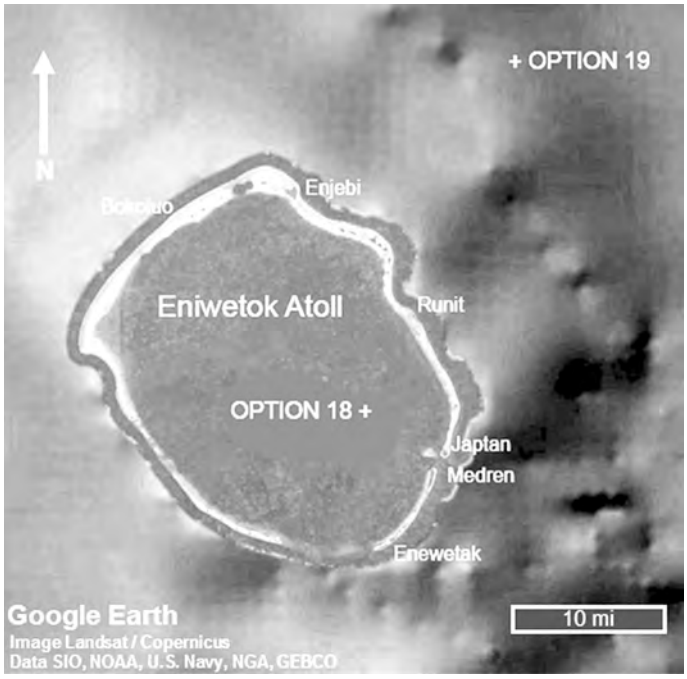


Figure 23. Minuteman I target locations, Eniwetok Atoll, 1962-1969.

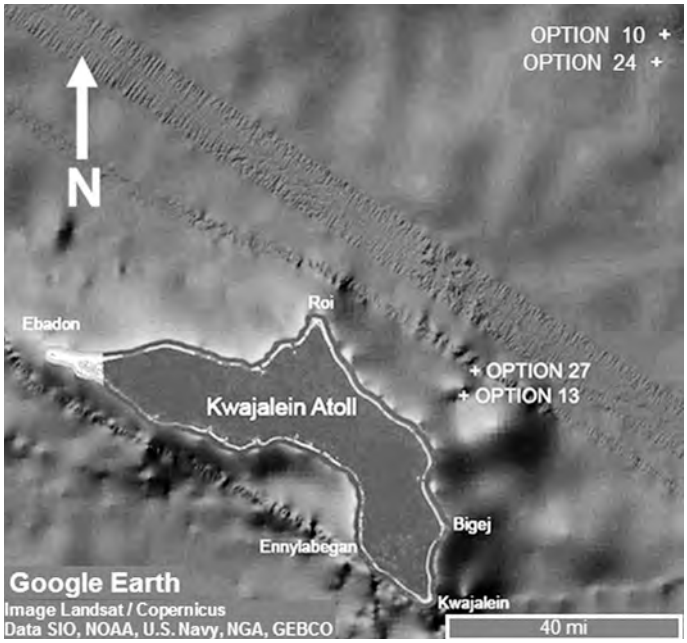


Figure 24. Minuteman I target locations, Kwajalein Atoll, 1965-1971.

tors. In the navigation mode, the ship's navigation system, such as a Ships Inertial Navigation System or Acoustical Ships Positioning System, provided the geodetic reference.[73]

Targets

The most complete information on targets is from the Minuteman I program. Between 1962-1969, the majority of the flights were to Eniwetok Target Options 18 (in the lagoon) and 19 (20 nautical miles northeast, **Figure 23**). Option 18 made use of the cine-theodolites, the most accurate (± 100 feet) scoring system which was limited to daylight. Option 19 made use of the MISS equipment (± 360 feet). The small percentage of flights against the Kwajalein anti-ballistic missile radars utilized Target Option 24, which was 68 nautical miles northeast of the lagoon and was scored by the BOA MILS network (**Figure 24**).[74]

Summary

MILS was the first-generation reentry vehicle impact detection technology. As is often the case with first-generation technology, more famous examples of its use, such as SOSUS for detection and tracking of Soviet and Chinese submarines, overshadowed details of other applications of the deep sound channel phenomenon.

The MILS BOA techniques were developed for the AFETR IRBM and ICBM test programs and further refined for use in the IRBM and ICBM operational test programs at the PMR/AFWTR.

They were used in the Atlantic Ocean until 1992, presumably similarly for the Pacific Ocean.[75] The equipment was not completely abandoned and is now used for a variety of civilian marine-life and geophysical investigations.

Technology and cost savings forced the demise of the AWILS and its variant, BMILS, at the end of 1969. While the modification to the BMILS had proven highly successful, the system was expensive to maintain and impact missions were now being flown to Kwajalein or to a new target, the Phoenix Islands. The SDR equipment was removed for transfer to the Phoenix Islands group for use with Minuteman III flight testing. If scoring capability was needed at Eniwetok, a BOSS-equipped ship would be brought into the lagoon on a temporary basis. If land impact was desired, an acoustic array could be constructed specifically for land impact missions.[76]

In 1968, the MILS stations at Midway, Wake, Kanoehe, Hawaii and Eniwetok provided crucial data used to locate the position of the sunken Soviet submarine K-129. Combined with the data from the SOSUS stations at Adak, Alaska; Point Sur, Centerville Beach, California; Coos Head, Oregon and Pacific Beach, Washington, the Navy was able to locate the site of the accident within two nautical miles of 40.1 North Latitude and 179.9 degrees East Longitude.[77]

The PILS, KMISS and LIDSS technology represent the ultimate evolution of acoustic-based reentry vehicle impact detection. ■

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Robert Manning Gray

Robert Manning Gray in the cockpit of a fighter.

Mervyn Roberts

On February 6, 1951, Robert Manning Gray was interred at Killeen, Texas nearly ten years after the crash that took his life. As the *Killeen Reporter* headlined it that week, "Bob Gray Back Home with Loved Ones." During the intervening decade his hometown, and indeed the world, had been transformed by the war in which he played such a critical early role. The son of James and Della Gray, Bob grew up with his sister and brother in a home the family owned at Tenth Street in Killeen, near the Quality Hardware they ran on 6th (now Gray) Street. Bob had graduated from Killeen High School in 1937, before attending Tarleton College. Prior to his leaving, Killeen was a village of 1,300 souls and everyone knew the precocious Bob Gray. By the time he returned, the town bloomed to nearly 8,000, not including the sizable force at the new Fort Hood.[1]

As war clouds gathered, Robert Gray enlisted in the U.S. Army Air Force as a Flying Cadet on June 29, 1940 at Dallas. Seven months later he graduated as a Second Lieutenant pilot at Kelly Field, Texas and was assigned to the Ninety-fifth Bomb Squadron, at McChord Field, Washington in February 1941. Gray promptly volunteered for an unidentified mission and spent the spring training for and participating in then-Lieutenant Colonel James Doolittle's bombing raid on Tokyo.[2] Exactly six months later, "while flying blind high over the mountains of Burma in heavy fog…his engines failed and he and his crew crash landed to their deaths on a high mountain."[3] The path that led there started with the Doolittle raid on Tokyo.

Robert Gray's B–25, nicknamed *Whiskey Pete*, had not so much launched, but rather separated from the USS *Hornet* while the bow crashed into a violent trough. The plane, named for his favorite horse, strained off the deck of the ship on Gray's first carrier take-off. In fact, his was only the third B–25 in history to do so, following the previous two by mere moments. The raid launched 200 miles early, after the flotilla was sighted by a Japanese ship. Bob later wrote his parents, who later recalled the "difficulty getting his heavily loaded plane off of the carrier but with a prayer on his lips and steel in his heart a few short hours later he and his crew were returning the blows to Japanese installations."[4] The lonely aircraft struggled above the waves, grinding towards Tokyo to target a steel mill, a chemical factory, and a gas company, all in a thickly populated factory district. Receiving ineffective anti-aircraft fire on approach, the 23-year-old Gray felt the concussion of the unseen bomb blast at the steel works, followed by direct hits on the two other targets, prior to scattering incendiary bombs and machine gunning a barracks complex on the way out.[5]

Due to the premature launch from the USS *Hornet*, Gray knew they could not reach the pre-arranged landing strip in China and directed the crew to prepare to bail out. As the fuel touched critical, Gray ordered the men to jump. After ensuring everyone was ready, he switched to auto-pilot and from 6,200 feet, was the last man out of the crippled plane.

Robert M Gray in dress uniform. ***(Photo courtesy of the author.)***

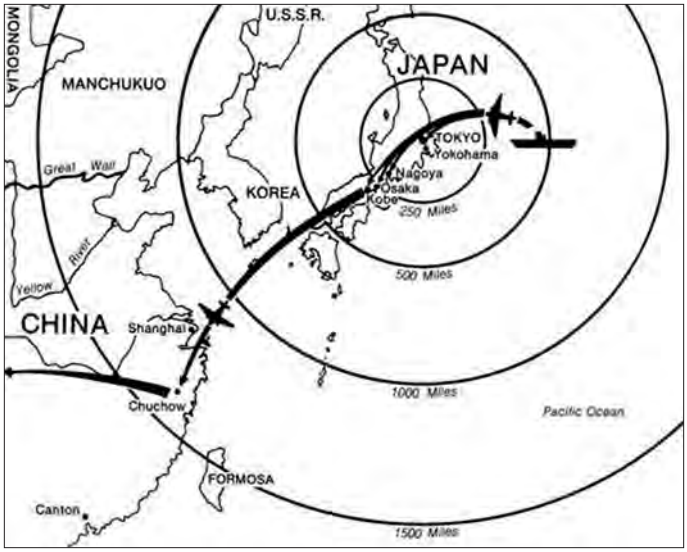
From the alarming chaos of the doomed craft, Gray, likely in his first parachute jump, slipped into the silent, inky calm beneath the rustling white silk chute and into the yawning jaws of dread.[6]

In an after-action report, Lieutenant Gray described his arrival in China. "The next morning, I looked for other personnel but could not find them. Walked all day and came to village where I stayed that night. Was directed in wrong direction for six miles and ended up where I started from that morning." Gray encountered bombardier Sergeant Aden Jones that night and the next morning they rode in Chinese palanquins to a river. That evening they found co-pilot Lieutenant Jack Manch and the group loaded a small boat, traveling two days to Chuchow, followed by train and bus travel to Hengyen and a flight to Chungking.[7] Engineer Gunner Corporal Leland Faktor died as a result of the jump, and was buried in Wan Tseun in Sui Chang Province, China by colorful missionary John Birch. Birch also aided the escape of Richard Joyce, pilot of plane ten, and later was commissioned in the Army by General Claire Chennault. Birch then served as an OSS officer before being killed by Communist Chinese.[8]

Mervyn Roberts holds a PhD degree in history from the University of North Texas and teaches United States, Texas, and Persian history at Central Texas College in Killeen. His published works include The Psychological War for Vietnam, 1960-1968*, and two articles for the* Journal of Iranian Studies*. Additionally, he served two tours in Afghanistan, as well as in Desert Storm and peace-keeping efforts in Somalia.*

On April 18, 1942, airmen of the U.S. Army Air Forces, led by Lt. Col. James H.(Jimmy) Doolittle, carried the battle of the Pacific to the heart of the Japanese Empire with a surprising and daring raid on military targets in Japan itself. ***(USAAF photos via Fold3.)***

Doolittle Raiders in Chinese Palanquin. ***(USAAF photo via Fold3.)***



Map of the Doolittle Raid.

News of the Tokyo bombing plan was kept strictly secret. At a press conference three days after the attack, President Franklin D. Roosevelt coyly surmised that the bombers had come from "our new secret base at Shangri-La."[9] A month later, only after the crews were safely out of Japanese controlled areas, the War Department at last released details on the raid. Newspapers across America then led with banner headlines about the strike and discussed the raid details. In Texas, the papers radiated pride over the states' fourteen native sons, not least of all Robert Gray, who had taken part in the raid. "Texas Fliers in Major Role" beamed the Goose Creek, Texas *Daily Sun* on May 20, 1942. The author wrote, "Killeen practically went on parade when it heard about Lt Robert M. Gray being on the raid."[10]

The following day the *Borger Daily Herald* glowed that Gray, "a star tackle on the Killeen high school football team and a letterman two-year at John Tarleton College," was now dropping bombs.[11] The *Texas Mohair Weekly* quoted Killeen High School football coach Leo Buckley as saying, "Whatever the job was, no matter how tough, if they gave it to Bob, he'd get it done." The story reiterated that "the Killeen folks held a camp meeting in the streets to celebrate for Bob."[12] Later, the Fort Worth *Star Telegram* reported on Colonel Doolittle's return to America. The story noted that he was the only raider to have returned home by that point. The raid leader said, "The others are still out of the country…But most of them are well and happy, I can assure you."[13]

Like the other pilots, First Lieutenants Richard Joyce and Robert Gray had been awarded the Distinguished Flying Cross as pilots on the Tokyo raid.[14] The *Georgetown Sun* later remarked that Gray had also gotten a "Message of Thanks From Madam Chiang." Della Gray received the medal, which Madam Chiang Kai-Shek had presented to her son, along with a letter that read: [15]

To the Valiant Airmen who bombed Japan: It is is with mixed feelings that I write these words. We have for five years suffered the inhumanities and barbarties of the Japanese military, not only on land and seas, but also from the skies….The entire Chinese people are grateful to you and to him for your brave deeds…I was glad of the opportunity to thank you on behalf of my compatriots. The Generalissimo and I both were happy to see you…. May you continue to vindicate freedom and justice so that by your efforts a happier and more unselfish world society will evolve when victory is ours.

Madame Chiang awards Airmen, Lt Col Doolittle third from left. ***(USAAF photo via Fold3.)***

Like many of the other Raiders, Lieutenant Gray remained in Asia after the raid.

Even as this morale boosting attack was underway, U.S. leaders struggled to plan for the larger war needed to actually defeat Japan. Critical to this goal was keeping China, riven by civil war and struggling against the Japanese assault, in the fight. As Madam Chiang described, this was a dark period for the nation. The Soviets had provided military aid and training prior to 1941, until the Soviet-Japan pact was signed. The German invasion of Russia, further crippled "Soviet aid to China and dried up the Silk Road supply route, with Stalin seeking to avoid a war with Japan until his war against Germany was finished."[16]

As a result, the Americans stepped in to fill the gap, using the Burma road to transfer Lend-Lease aid. Limited Lend-Lease support to China had begun in the summer of 1941. Additionally, the American Volunteer Group (Flying Tigers) had unofficially provided air cover for the past year, but American leaders knew more was needed. President Roosevelt prodded the Joint Chiefs of Staff to create the China, Burma, India (CBI) Theater to lead the resupply effort and stage a bombing campaign to support Chiang Kai Shek's forces. This could also provide a stable base from which to strike Japan in earnest. However, Germany was the main effort and America needed to achieve its goals in China "at small cost," depending on the British and the Chinese "to carry the main burden of ground conflict." Additionally, the CBI was an economy of force effort and never rated as high as the other theaters for men and matériel. This 'European First' strategy relied on sustaining the Chinese to continue their four-year war with Japan until such time as the full force of American power could be brought to bear. However, the Allies "conflicting national objectives" further hamstrung the endeavor.[17] Americans had a long

Dinjan, India airfield tower. ***(USAAF photo via Fold3.)***

history of support to China against territorial aggression, creating an emotional connection for many. For his part, Roosevelt looked past the war and saw "China through eyes that blended romantic and pragmatic elements." The goals did not necessarily match the British and Chinese.[18]

Lieutenant General Joseph W. Stilwell arrived in the region in early 1942 to command American forces, and "to serve as chief of staff and principal advisor of Nationalist China." However, the Japanese conquest of Burma later that year, "cut the last overland supply route to China," frustrating Stilwell's plans. As the Japanese advanced into Burma, the Chinese 38th Division, along with British and Indian forces withdrew towards Assam, India. The force had suffered 13,000 casualties and the "exhausted and malarious survivors" were in no shape to defend India.[19] General Stillwell, now American commander in the CBI, had also narrowly escaped Burma by land, taking a "dinky trolly train to Dinjan" and ending his 30-day trek in New Delhi.[20]

The supply line now depended on a long and difficult airlift over the high peaks of the Himalayas [AKA the Hump] from northeast India to the main logistical base at Kunming in southwestern China. Thus, the Hump airlift became "materially and symbolically" central to the strategy in the CBI. The U.S. Army Air Force began to take up the Flying Tigers operations out of Kunming, while simultaneously creating the airbridge from whole cloth.[21]

By the spring of 1942, policy makers understood that an air ferry system to China "must be established." Despite the difficulties of a supply line running from the United States, uninterrupted operations were essential. Airlift from Dinjan began in April "with a handful of airplanes and aircrews…composed largely of Pan Am pilots," to help after the expected arrival of the Doolittle Raid planes. The original plan was to fly supplies from Dinjan to Kunming via Myitkyina, necessitating the construction of three air fields around Dinjan to make the system work. Ten million dollars were budgeted to begin the program of airfield construction in the Dinjan, India area, which was seen as the ideal launching point due to location and proximity to rail lines. With the looming summer monsoons, completion of the base expansion was not expected until November.[22]

Dinjan is located in Assam, India and formed the western leg of the ferry route over the hump to China. "Existing airfields were few, and the prospects of using local labor in India to build more were being hurt by Mahatma Gandhi's nationalist 'Quit India' campaign; though directed at the British, their alliance with the United States made for the perception that both were to be resisted, diminishing the pool of available local labor."[23] Work on the Dinjan-area fields began in February using 2,600 native women to manually crush, "the eleven million cubic feet of stone necessary to lay the runway." Furthermore, local laborers refueled aircraft" by hand and loaded the cargo.[24]

The austere airstrip sat at the end of among the longest logistical trails in military history. As noted, the Hump became the only route to China after the Japanese closed the Burma road and later captured Myitkyina. All supplies and equipment were shipped from the United States' east coast, braving the Atlantic U-boat packs and rounding the treacherous Cape of Good Hope, on a 13,000-mile voyage to the port of Karachi in present day Pakistan. At times, more than 200 ships waited in the harbor to be unloaded. As General Clayton Bissel, Tenth Air Force commander remarked, "From the base port at Karachi to the combat units in China is a distance greater than from San Francisco to New York." From Karachi, supplies traveled by railroad, "a distance about as far as from San Francisco to Kansas City." Bissel described the need to transship the material several times due to rail gauge changes over the ensuing 250 miles, before being loaded on to boats, cruising "down the Ganges and up the Brahmaputra." From there, the material was conveyed to Dinjan to fly over the Himalayas to Kunming, China, "a distance greater than from Pittsburg to Boston." After landing, the supplies went "by air, truck, rail, bullock cart, coolie and river" to sustain operations. Bissel noted that sabotage, and the political situation in India, presented additional "difficulties."[25] Robert Gray arrived in the midst of this tumultuous commotion.

After the raid on Tokyo, Bob Gray was technically assigned to the South Carolina based 376th Bomb Squadron through September 1942. The War Department had originally ordered this squadron to China, so it seems the Army assigned Lieutenant Gray to the unit in anticipation of the its arrival in theater. However, the Japanese advances in China and Rommel's success in North Africa forced a reallocation of forces. The squadron, then traversing Africa via the Southern ferry route, was diverted to support the European Theater and it seems that Gray never actually served with the 376th Bomb Squadron.[26]

The initial CBI theater development witnessed ad hoc organizations cobbling together a few airplanes and crews,

Chinese airfield construction. Manpower substituted for modern machinery ***(Photo courtesy of the author.)***

and a "catch-as-catch-can" attitude. Individual pilots chose who to fly with, and which route to take.[27] Gray operated as a freelance at Dinjan Airfield after his arrival on 1 June, initially flying P–40s on reconnaissance missions over Burma, though not officially assigned to a unit there. Others from the Doolittle Raid assigned at Dinjan included pilots Richard Cole and Richard Joyce, and gunner George E. Larken. Eventually, the Kunming, China based Eleventh Bomb Squadron, 341st Bomb Group assigned two B–25s to form a detachment at Dinjan. Gray joined that detachment and began flying bombing missions. A unit history noted Gray and fellow Raider Richard Joyce "were of great assistance because of their previous reconnaissance missions."[28]

B-25 guarded by Sikh Soldier. ***(USAAF photo via Fold3.)***

The danger of flying the 'Hump' under these circumstances cannot be understated. For instance, the 341st Bomb Group history noted that on June 3, 1942, six B–25s departed Dinjan for transfer to Kunming, disregarding adverse weather reports. Three of the ships followed each other into a mountain, one was shot down, one ran out of gas, and only one made it to Kunming. The treacherous, cloud-socked mountains were often more deadly than the Japanese.[29]

Despite living among verdant tea plantations and shimmering green rice paddies in the shadow of the looming Himalayas, this remained a war zone. Against the tranquil backdrop, the constant threat of Japanese air attack, the approaching battle lines, and political instability in India, kept airmen ever alert. Although it is likely that a year prior, none of the Americans gave Indian independence even a second thought, they were thrust into the center of a cauldron of political intrigue. To top it off, Gray arrived with the monsoon, which inundated an average of thirteen inches of rain per month, for three straight months.[30]

Support facilities at the remote, spartan, base suffered as a result of these myriad challenges. Soldiers dealt with

CBI troops being entertained by travelling USO troupe in India. ***(USAAF photo via Fold3.)***

"a complete lack of mail for many months…[an] absence of newspapers and books," substandard housing conditions, and organizational equipment that often failed to arrive with the troops. The men slept in a jumble of rickety bamboo huts and tents, washed in buckets and slept under mosquito nets. Lack of cigarettes and pay contributed to morale issues at Dinjan. Most did their own laundry, rather than trust the "tender mercies" of the "rock-wallop system" washing method used by the locals.[31] To make matters worse, the 341 Bomb Group received "no spare parts" in June, necessitating cannibalization of damaged planes.[32] "Are they squawking? Sure!" wrote the theater newspaper *CBI Roundup*, while trying to downplay the problems.[33]

In July, the detachment flew eleven bombing missions and two reconnaissance missions in the vicinity of the Japanese held Myitkyina airfield, but it is unclear which of these Gray was involved in.[34] The Brownwood *Bulletin* that month contained a story in which Gray discussed these operations. While he was on R&R at the Tenth Air Force base in Calcutta, Gray told UPI reporter Darrell Barrigan about the six-days of attacks on river bridges. According to Barrigan, "the stocky, slow-spoken, drawling," pilot described how the operations may have halted rail traffic along the strategic Myitkyina line. According to Gray, "We understood from intelligence reports that the Japanese were moving plenty of troops up to Myitkyina." He continued, "The railway was their only means of troop transport since the rains had swollen the rivers and flooded the roads. We determined that destruction of the river bridge about 45 miles southwest of Myitkyina was the best way to halt communications." On the last mission of the series, Gray said "We flew at about 1,500 feet below a heavy overcast" to attack a rail bridge. He described how, "A .30-caliber bullet tore a two-inch hole in the right wing of my plane. Another punctured a tire and the landing gear hydraulic line (providing power for lifting and lowering the wheels) of Joyce's plane. We got back okay, though Joyce pumped down his wheels by hand and made a beautiful landing."[35] The repair to the hydraulic line may have contributed to a later incident critical to the story.

The *Roundup* described life at Dinjan by October 1942 as improved, but the base remained a hard, remote post. A story, headlined "The Assam Lads Are Now Cooking with Gas," describes a barren existence for airmen "at the easternmost American air base in India." At last, though, the airmen could eat prepared chow in "a neat mess hall full of tables." Despite the challenge's airmen faced, operations could not stop; "the vital aerial supply line to China" must continue. Men worked from before dawn to after dark, all cross-training jobs, due to the shortage of personnel. As the *Roundup* put it, "until recently [they] went without movies or PX supplies" and they "have no baseball equipment and no time to use it if they had."[36]

As noted, the Eleventh Bomb Squadron suffered a personnel shortage, meaning all crew members helped in loading bombs and flight preparation. Men could be called "at any hour of the day or night," to prepare, plan and conduct combat missions lasting up to 15-hours duration. Often the crews had nothing to eat between breakfast at 0430 and an evening meal. Clearly the effects of all of these shortages hit Bob. The *Taylor Daily News* in October reported Taylor native Malcom Conoley, who spent time with Gray in Dinjan, was relaying letters from Gray's parents since the direct mail system did not work for him. They had re-

Bridge bombing in Burma. ***(USAAF photo via Fold3.)***

peatedly sent letters that were undelivered to Gray. In letters home, he sounded philosophical about his chances. Writing his Uncle Fred Page that month, Gray commented that, "If I do not come back, have no fear or regrets for I will be with Him I know." The tone of the letter shows the worry his family had over his safety. Also, Gray told his uncle he had been belatedly promoted to Captain, another of the sore spots among those in the CBI, as they watched their peers in other theaters rapidly promoted. Indeed, morale at Assam was rated as lowest in the theater. The CBI continued to have the least priority for everything, and many of the problems were not corrected until after Gray's death, if ever.[37]

The Dinjan detachment flew another fourteen missions over Burma during August, and three over China.[38] The *Sweetwater Reporter* in a August 14, story discussed this campaign, noting they had "interrupted service on a 125-mile stretch of the vital Mandalay railroad and heavily bombed Japan's three greatest bases in northern Burma in a two week offensive," including the critical Japanese air base at Myitkyina.[39]

By September the Eleventh Bomb Squadron at Kunming consisted of 43 officers and 70 men. The small detachment at Dinjan, comprised of seven officers and seventeen enlisted men, was enough for two complete crews with one relief pilot.[40] On September 15, 1942, the Eleventh Bomb Squadron was transferred from the Seventh Bombardment Group to the Three Hundred Forty-First Bombardment Group, and re-designated as a medium bomb squadron, reflecting the B–25s the unit flew. It was at this time that Gray was transferred officially to the unit he had flown with for the previous three months.[41]

The Dinjan detachment added fifteen bombing missions that month, as well as "five badly needed maintenance men." On September 9, the detachment had attacked Myitkyina Field with a mix of 100 and 500-pound bombs. The following week they attacked the Katha rail yard, and on September 16, one plane attacked the Mogaung Bridge. The strategic railway bridge linking Myitkyina with Katha was finally destroyed. Two days later the detachment hit Tinghe [Tinka] field and a large suspension bridge. Between September 24 and 30, they carried out missions to hit Myitkyina air field, and the rail bridge and former Chinese airplane factory at Loiwing. At Katha, the detachment struck the bridge and an oil barge north of the town. The B–25s strafed two small river boats, and a large steamer, forcing the latter ashore. On October 1, another mission against Katha destroyed 200 yards of track and later the two B–25s attacked barracks, bridges and warehouses. The relentless tempo, interrupted only by the torrential monsoons, ensured the Japanese could not advance on India at this critical time.[42]

Brigadier General Clayton L. Bissell, commanding general of all air units in this theater, announced the formation of the China and the India Air Task Forces in early October. Finally, organization emerged out of chaos. As a result, the Eleventh Squadron now fell under the China Air Task Force. This is likely why Gray was preparing to transfer to Kunming later that month, and, may help account for the mail problems he encountered. For the time being though, Gray fell into an awkward bureaucratic purgatory. He was based at an India Air Task Force base, but assigned to a unit of the China Air Task Force. Mail in austere theaters typically is distributed through unit chains down to the soldier. It is possible, his mail went over the hump to Kunming, never to return.[43]

The Dinjan detachment conducted eight missions in October before transferring to Kunming to take part in series of raids scheduled for the latter part of the month. Lieutenant Joyce was at the field hospital in Dinjan on the eighteenth when his plane was ordered to bomb a Japanese convoy at Hong Kong. In need of a pilot, Gray volunteered for the job.[44] About thirty minutes out of Dinjan both of Gray's plane engines quit simultaneously. Along with Captain Gray, co-pilot Max F. West, bombardier co-pilot Richard A. Walter, Gunners Herbert F. Cromwell and George A. Larkin (who had flown the Doolittle Raid as a gunner with Lieutenant Joyce), and passenger Private Russell D. Juggers were all killed instantly.[45]

Staff Sergeant Jack Price, an observer with the 51st Fighter Control Squadron based in the Naga Hills on the Burmese border, recovered the bodies. Price reported that while covered with the thick overcast normal to that region at their camp at 7,000 foot, they "heard the B25 and were tracking it when the engines quit. A moment later we heard the crash north of us." Two days of searching the jungle clad mountains proved unsuccessful. At last, a child came to alert them to the location, and Price found the plane "in a deep gully in a low valley."[46] An apparent second observer quoted in the accident report, Ujan-based Lieutenant Donald Harburg, stated the plane was directly over-

head at about 100 feet. "Suddenly the engines sputtered a few times then quit completely. A few minutes later a muffled crash was heard in a westerly direction."[47] According to the Tenth Air Force operational diary, a radio lookout, likely observer 2, "reported an unidentified plane with apparent motor trouble, approximately 16 miles to the south of Margherita at 1402 hours." Ten minutes later, the observer reported "definitely hearing a crash" but visual confirmation was impossible due to cloud cover reaching the ground level. An accident report filed in November noted the plane took off at 1:40 pm and crashed 30 minutes later, in a fog lined valley.[48]

Fellow Doolittle Raider, Richard Cole, heard one of the two Eleventh Bomb Squadron B–25s taking off from Dinjan that afternoon. Cole watched the plane lift off, he "assumed with a full load of bombs." Shortly after, he departed for China in a C–47 delivering aviation fuel. As Cole approached the Burma border at ten thousand feet, he saw "a plume of black smoke" to his right. The thin column of dense, oily smoke, scattered by seven thousand feet. He knew "it was either a plane crash or a bomb strike on a fuel depot." As they flew over the remote jungle area, they saw it was a plane, and with no parachutes visible, knew there could be no survivors. "Cole radioed Dinjan to report the crash…[and, after returning to Dinjan] he heard the news of Gray's death. Cole himself had flown the same B–25 plane the day prior on a mission, and Gray was "considered an excellent pilot" with over 550 hours in the B–25. The suspicious circumstances led to scuttlebutt at Dinjan, and according to Cole, "many of the pilots suspected sabotage."[49]

A number of factors likely contributed to this belief. The accident report listed the crash as "forced landing, engine failure," but obvious causes eluded those at Dinjan. Weather appeared to not be a factor. On October 18, the average high temperature in Dinjan was 86 degrees and the April to October monsoon had just ended. The Tenth Airforce operational diary for that day noted that the visibility and ceiling at Dinjan was "unlimited locally, with heavy coverage over the mountains" at 15,000 to 26,000 feet. The altitude in the area of the crash was about 6,000 feet, easily outmatched by the B–25's 24,000-foot ceiling. Gray's aircraft, a B–25D (tail number 41-29730) had come off the North American Aviation's Kansas City production line just eight months prior and was rated as "new," along with the recently overhauled engines.[50]

Interestingly, another B–25 (tail number 41-29744, and likely produced within days of Gray's plane), crashed on landing at Dinjan earlier the same day. Hours before Gray departed on his final mission, Clark Johnston piloted the detachment's other B–25 on a check flight for a newly installed propeller governor. On approach to Dinjan he became aware of a hydraulic fluid leak, causing loss of flaps and landing gear control. Engineer George Larkin managed to manually drop the nose and left landing gears and work the flaps. On landing, the left gear collapsed, causing the plane to careen at a 45-degree angle. Clark, Larkin, and co-pilot Lieutenant Max West all escaped successfully. Subsequent investigation determined that an "improper flaring of hydraulic pressure line connections" was the cause of the failure. This may have been caused by an unsuitable repair from the incident in July. However, given the crash hours later of Gray's plane, which included Larkin and West in that crew, it is easy to see how many airmen might assume a sabotage cause.[51] Therefore, the charge Dick Cole made of sabotage cannot be discounted, though the evidence to support it is circumstantial.

Reports across Texas that Fall covered the rising Indian unrest in detail. In one such story on August 15, the *Sweetwater Reporter* noted the looming "Non-Violent Revolution" in India. Gandhi had declared that the price of accepting allied soldiers in India was the "immediate end of British rule in India." He threatened to form "a mass movement" if the demands were not met. The following week, an editorial originally published in the New York *Herald* attacked Gandhi's move as "unreasonable" and hinted that the Congress Party planned to allow Axis agents into the country. The Fort Worth *Star Telegram* that month reported that the All-India Congress meeting recommended that Gandhi receive "full powers to lead a civil disobedience movement," in response to British rejection of demands "for Indian independence." The *Quit India Movement* was formed in the following days to manage the effort. Ten days later, the *Star Telegram* reported that Britain was considering "severe penalties for Indians" involved in the resulting wave of violence. The story noted "wilful damage to railroad property and telegraph lines" led to the threat. In Dacca police fired on a crowd, killing five.[52] On August 14, a report from Bombay titled "Rioting Continues in 5 Indian Areas," noted the death toll there at forty.[53] The following week, the *Clifton Record* carried a story that "Indian Riots Molest U.S. Troops There." On September 20, the *Sweetwater Reporter* noted "the anti-British disturbances" were "worse than censorship has told us."[54]

Security troubles abounded in the 'wild west' environment of the China-Burma-India Theater. Indicating the British Air Headquarters, India level of concern, they conducted a surprise inspection of an airfield in September 1942 in which British undercover investigators accessed the base with impunity. In one case, "Two men dressed as soldiers…inspected aircraft in the hangers" and later that night, "they reentered the aerodrome with a bag of 'bombs'." [55]

Dinjan had similar security lapses which could have enabled access, and the base had no effective perimeter fence and used local labor on base. Local laborers refueled aircraft, often by hand with five-gallon cans, and loaded and unloaded cargo, providing them access to critical areas of the aircraft.[56] Unit members also hired 'bearers' and launderers, as was standard in the British Indian Army, who had no background checks performed on. The bases had no method, even by 1944, to check visitors via a pass system. Given the political instability Bissel alluded to, this was a problem.[57]

As early as December 1942, investigations noted unit manpower shortages at the widely dispersed Assam airfields contributed to security complications. According to a message from General Bissell, "Minor incidents of arson and sabotage are still occurring daily in many parts of

Robert M Gray burial site at Barrackpore, India. ***(USAAF photo via Fold3.)***

India." The bombers in eastern India each needed "individual guarding" but personnel shortages precluded this. The following month British Commander in India, General Alexander, reiterated the shortage of guards, noting only one Gurkha battalion for all the air bases in Assam, but expressed, "no sabotage has been reported to date."[58] It is likely the situation was far worse in the fall of 1942. But beyond the fears and rising political maelstrom, additional challenges at Dinjan made the sabotage charge plausible.

One October story from the *Roundup* announced, "Jap Spy Caught." The story appears to come from China, but documents show that a security problem existed. The report stated two U.S. airmen "saw a suspicious stranger loitering about the [Air] Operations Office." Suspicious the individual was a spy, "they noted that the stranger was able to make his way to the control tower and with little difficulty." When the man tried to leave, he "was taken into custody by them and questioned by the officers." After an investigation and a trial, he was "shot as a Japanese spy."[59]

Several other reports supported the sabotage theory. The monsoon had broken by the time of the crash, which conversely enabled a Japanese air attack on Dinjan the following week. A report on that October 25, attack stated that, "three telephones were unusable after the first raid" and personnel suspected sabotage. "Investigation proved, strangely enough, that three demolition bombs had neatly severed the wires of each phone where it left the buildings in which the instruments were located." The fact that the question of sabotage arose indicates a generalized fear that it could happen.[60]

Meanwhile, under the leadership of Indian leader Subhas Chandra Bose, Japan set up an army of Indian POWs known as the Indian National Army (INA), which fought against the British. The INA also formed the *Bahadur Group* on September 1, 1942 specifically to sabotage allied operations in India. Bose, with the assistance of Germany, later formed the Indian Legion from Indian students in Axis occupied Europe and Indian Army prisoners of war. The group tried to form a military alliance with Germany or Japan to gain independence. By the end of 1942, the British had become aware of trained Indian espionage agents who had infiltrated into India for the purpose of collecting intelligence, subversion of the army and the subversion of civilian loyalty. A bomb blast on 10 October 1942 derailed a military train at Sarupatrar, killing many British soldiers. The movement reportedly also formed death squads to carry out acts of sabotage, and a Gohpur police station was bombed. These were about 150 miles southwest of Dinjan.[61]

Weeks prior to Gray's crash, the *Fort Worth Star Telegram* reported, on October 4, about Japanese sabotage in India, conducted by "a traitorous network of spies, agitators and saboteurs who brazenly admit taking their orders and inspiration from Tokyo." The story claims that the level of sabotage "cannot be revealed for reasons of military security." But, according to the reporter, a propaganda newspaper that was available throughout India, "Do or Die", as well as Japanese radio broadcasts, urged Indians "to attack civil authorities, to steal arms, and above all, to sabotage the telegraph and railway lines."[62]

Bases in general still had no control over local nationals working on bases, and connected with a high turn-over rate, created a situation ripe for exploitation by the Japanese. A counter intelligence report on a nearby airfield in late 1944 stated though few demonstrations had taken place, "many instances of a suspicious nature" had occurred, including suspected sabotage incidents. Another counter intelligence survey of Dinjan that year noted the wide variety of units and civilian air freight companies, as well as Chinese National Aviation Corporation planes,

meant that it was nearly impossible to maintain control over the airfield. The understaffed American units were tasked with providing aircraft guards, while a small 50-man Military Police detachment ran patrols. The report noted that while the local villages seemed cooperative, one village eight miles away was "friendly to the Japanese." The statement closed, saying that "A general tightening up of security…will also help reduce the risk of loss due to accident or sabotage."[63]

The Tenth Air Force Security Office, issued a memo alerting units to potential problems, which noted aircraft and vehicle tires slashes that could cause failure. More disconcerting was the report of a German who reportedly "spent the day on a large American airfield in India." He got on the base without being checked, wandered around for some period, "climbed in and out of planes parked on the runways" and visited the Operations Room.[64] Another noted a "series of sabotage incidents occurred throughout India," in early 1943. In April 1944, Tenth Air Force reported, "a probable sabotage attempt on a B–25" in which the bomb bay doors were tampered with.[65]

After recovery of the crew's bodies, Robert Gray was interred in Barrackpore, a British air base north of Calcutta, and home to a U.S. General Hospital and the Seventh Bomb Group.[66] All across Texas communities reacted with sympanthy over the news of Gray's crash. The *Taylor Daily News* on October 29, 1942 announced Gray's death and recalled he had "participated in the raid over Tokyo" along with Taylor native Captain Ross Wilder. The November 5, Coleman, Texas *Democratic Voice* noted Gray's cousin lived in the town. Meanwhile the following day, the Olney *Enterprise* noted "Robert Gray is Missing in Action." According to the story, "Mrs. Fred Page and children left last Saturday morning for Killeen after receiveing word that Robert Gray is now considered missing in action in India by the War Department. Gray, whose family lives in Killeen, was well known here and had visited here many times."[67] Clearly much of Texas felt a connection to this loss.

Through the haze of 80 years, it is unlikely a case one way or the other on the cause of crash can be proved. As noted above, the personnel at Dinjan had clear reason to suspect sabotage, given the political and security context. The airmen clearly would have heard some of these details, and given the suspicious circumstances surrounding the crash, seized on sabotage as a likely cause. Regardless of the reason, his death was not in vain. The bombing raids carried out by Gray and the Dinjan based crews undoubtedly blunted the Japanese advance at a critical moment. They stood in the gap under austere, ad hoc conditions. Had the airfields in Assam fallen to the Japanese onslaught, it is questionable whether China could have remained in the fight. The resulting shift of one-million Japanese troops to the Pacific region might have extended the war considerably. ■

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Images of War: The Hawker Hunter. Martin W. Bowman. Yorkshire UK: Pen & Sword, 2020. Photographs. Illustrations. Pp. 119. $29.95 paperback. ISBN: 978-1-52670- 560-0

One jet that exemplifies Britain's Cold War military is the Hawker Hunter. When jet fighters often lasted a mere decade in service, the Hunter remained in service for over three decades with the RAF and over 50 years in other countries around the globe.

Beginning in 1946, Britain issued a series of specifications to procure jet fighters. A year later, Hawker received a contract to build a single-seat, swept-wing fighter equipped with the Rolls-Royce Avon engine. The primary mission of Hawker's first swept-wing fighter would be that of a day interceptor. The Hawker Hunter flew for the first time on July 20, 1951, and, from the start, proved itself to be a very capable aircraft. Before the Hunter became operational in 1954, the Hunter set a jet-aircraft speed record of 727 mph. Equipped with four 30mm cannon (the only jet aircraft so equipped), the Hunter quickly replaced the RAF's de Havilland Venom and Gloster Meteor fighters.

Ultimately, Hawker produced 1972 Hunters that served 21 countries. The last Hunter left service in 2014. The aircraft would prove its combat capabilities in a number of conflicts. Today, 70 years after its first flight, there are about 100 potentially airworthy Hawker Hunters scattered around the globe.

The book is divided into five chapters, each telling the story from a key part of the Hunter's history. Bowman kept each chapter's text brief in order to provide more space for the strength and focus of the book: the images.

Bowman did an excellent job of selecting and documenting over 100 high-quality images to tell the story of the Hawker Hunter. However, only black-and-white images are included, and most of these were not taken during war. All of the images are sharp and have detailed captions that not only explain the image but also place it in historical context. Fans of tracking aircraft tail numbers will appreciate how, when he could, Bowman included aircraft tail numbers in the caption. Including some color images would have been nice. Certainly, with an aircraft whose primary service period was the 1950s - 1970s, readers would expect that most of the images would be black-and-white; but a small selection of color images would have enhanced the book.

Beginning in the introduction, Bowman does not hide the fact that he is a fan of the Hunter, which he describes as "one of the world's greatest aircraft" and a "real pilot's airplane." The book's images make both points hard to disagree with. The aircraft's longevity is a testament to both assertions.

Fans of British Cold War military aviation will certainly find this book to be a must-have read. Strap yourself into the cockpit of a Hawker Hunter and take a flight through the early years of military jet-fighter history. You won't be disappointed.

Lt Col Daniel J. Simonsen, USAF (Ret), Alexandria VA

Rocky Boyer's War: An Unvarnished History of the Air Blitz that Won the War in the Southwest Pacific. By Allen D. Boyer. Annapolis MD: Naval Institute Press, 2017. Maps. Photographs. Notes. Bibliography. Index. Pp. xii, 426. $29.95. ISBN: 978-1-68247-096-1

In addition to this obvious labor of love about his father's World War II experiences, Boyer, a retired attorney, has published four other books unrelated to modern military history. Holding a doctorate from the University of St. Andrews, he has demonstrated solid research skills in this work. In fact, he uses his father's diary to provide the backdrop for Fifth Air Force operations from November 1943 until the end of the war in the summer of 1945. In doing so, he makes good use of official histories and the reminiscences of generals George Kenney and Ennis Whitehead, among other sources.

The elder Boyer, a lieutenant trained as a communications specialist, deployed to New Guinea with the 71st Photo Reconnaissance Group, a unit composed of three squadrons initially equipped with Bell P–39 Airacobras and North American B–25 Mitchells. The group would upgrade later to Curtiss P–40s and, eventually, North American F–6s. William Shomo of the group's 82nd Tactical Reconnaissance Squadron was awarded the Medal of Honor for shooting down seven Japanese aircraft over the Philippines on a single mission.

Military regulations prohibited maintaining a journal or diary in operational areas. Letters home, of course, were closely censored. Typically, published combat accounts have been based on post-war memories and official records. When reading excerpts from Boyer's diary, it's easy to understand why commanders did their best to discourage the creation of such documents. Certain themes reappear throughout the entries: poor living conditions for the enlisted troops and, conversely, favored treatment for the "brass" in the form of extravagant housing and Australian women commissioned as officers to enable them to serve the commanders; absence of sex; limited access to alcohol; and, probably most important in many instances, a lack of leadership.

Despite what Boyer and his peers considered to be the relatively poor quality of their bosses (there were a few exceptions), the pilots and ground crew appear to have performed in a highly professional and, in some instances, extremely courageous fashion.

Starting in Port Moresby on New Guinea's south coast, the 71st and other Fifth Air Force units moved northwesterly in support of General Douglas MacArthur's approach

to the Philippines. Boyer, who would temporarily serve with other units during his time in the southwest Pacific, moved first to Nadzab, a huge airfield complex in the Markham Valley near the north coast of New Guinea. Other stops included the island of Biak just northwest of New Guinea, the Philippines. and finally the Ryukyu Islands.

This book is highly recommended for anyone with an interest in tactical operations, especially in the southwest Pacific. The irreverent tone reminds this reviewer of Joseph Heller's novel, *Catch-22,* or the television series *M*A*S*H*.

Steven D. Ellis, Lt Col, USAFR (Ret), docent, Museum of Flight, Seattle

The Tonkin Gulf Yacht Club: Naval Aviation in the Vietnam War. By Thomas McKelvey Cleaver. New York: Osprey, 2021. Maps. Photographs. Glossary. Bibliography. Pp. 400. $30.00. ISBN: 978-1-47284595-5

Since the end of the Vietnam War, the published memoirs, war diaries, and monographs delving into the role of carrier aviation in that war have grown to many dozens. Among the most definitive accounts is Nichols' and Tillman's 1987 *On Yankee Station* that catalogues orders of battle, tactics, threats, and aviator attitudes and morale mainly through the observations of F–8 Crusader pilot Nichols. Now, Cleaver's thoroughly engaging and accurate exposition may be the most comprehensive history to date of naval aviation's involvement over North Vietnam.

The book opens with the Tonkin Gulf Incident. The riveting detail follows the trail of message traffic and dispatches among commanders on the scene and interpreters and policy makers in Washington, all ultimately filtered to serve a prevailing political agenda in an election year. Cleaver closes with a chapter describing naval aviation's part in 1975's poorly executed action to recover the *Mayaguez* crewmen from their Cambodian captors, an "appropriate epitaph for a war that began in confusion and misinformation." Through his opening and closing chapters, he presents events in a way that leaves no doubt as to his disdain for the decision makers and their motivations in pushing the country into a decade-long war of attrition.

In between the opening and closing chapters, Cleaver takes the reader along on most of the major engagements of the initial air campaign, Operation Rolling Thunder, through the final air campaigns of Operation Linebacker. His descriptions of aerial encounters and bombing attacks have an immediacy and authenticity that is gripping. One feels as if they are in the cockpit in some detached out-of-body experience, the sum of which is a sense of high regard for the professionalism, fortitude, and commitment of the naval aviators involved. The style here is reminiscent of other Cleaver works, notably *Fabled Fifteen*, which goes into stirring detail of the aerial engagements of naval aviator and World War II ace, David McCampbell. To a degree not seen in other books on this topic, Cleaver also shows the view from the enemy cockpit as well, providing insight into the tactics and attitudes of the North Vietnamese pilots facing clearly superior US air forces. Throughout, he details the air wing's aircraft on the flight deck and also delineates the performance specifics of series changes in the aircraft and the impact technology updates had on tactics as they evolved through the different air campaigns.

As noted in reviews of prior Cleaver works, the realistic depictions of cockpit action are the main and the strongest attribute of this book as well. Very few inaccuracies were noted. A helpful addition for researchers or anyone interested in further substantiating documentation would have been notations and references for the Tonkin Gulf message traffic, for instance. It is curious to note as well that none of the referenced 21 primary interviews occurred after 1976. For anyone looking for a naval aviator's perspective that encompasses the entirety of the Vietnam War, this is a fast and highly enjoyable read that brings to light the experiences of a generation of naval aviators who remained faithful to their calling.

Ernest Snowden, Captain, USNR (Ret)

The Secret Horsepower Race: Western Front Fighter Engine Development. By Calum E. Douglas. Horncastle UK: Tempest Books, 2020. Photographs. Tables. Illustrations. Notes. Appendix. Index. Pp. 480. $65.00. ISBN: 978-1-91165850-4

Douglas is a British mechanical engineer who has worked on auto racing engines. This book was the result of his passion for older aircraft. He discusses the development and design of the more famous engines used by the British, Germans, Italians, and Americans in fighters during World War II. As readers hear about the crankcases, valves, pistons, bearings, manifolds, and superchargers, they can visualize how the gears, oil, fuel, and spark all came together as designed by the engineers. Douglas has done a fantastic job of gathering transcripts of numerous meetings of engineers and department heads to show what went on between the politicians and the engineers.

Douglas brings out a great deal of information about engine development:

- Early in the war, there were discussions about how German engines were fuel injected and did not suffer the effects of inverted flight that carbureted engines did. It turns out that the Germans developed fuel injection because it was one technology not prohibited by the Versailles Treaty that had limited the German ability to develop powerful engines.
- Before the war, engineers of all major firms maintained professional relationships and actually visited each other's

factories. This, of course, stopped after hostilities began.

- Each side in the war desperately wanted engines from enemy aircraft wrecks in order to examine what the other side was building. One interesting story involved the first BMW 801 that was decent enough to send over to the US. It, unfortunately, encountered souvenir collectors along the way and arrived with components missing. Finally, upon taking Sicily in 1943, the US did find nine brand-new BMW 801 power eggs.
- It took the British a while before they discovered that the extra tanks in German fighters contained nitrous oxide to boost performance.
- In chapter 6, Douglas comments about fitting the Mustang with the Merlin: "The British had correctly projected that the Mustang's top speed would rise from 370mph to nearly 430mph by removing the Allison . . . and installing a Merlin . . ." This change surpassed even the Spitfire Mk. IX's performance of 405mph.
- German engineers had to contend with a lack of natural resources, primarily nickel, while dealing with a fanatical bureaucracy.
- Daimler-Benz drew criticism when leading ace Hans-Joachim Marseille (158 kills) was killed as he bailed out of his smoking Bf 109 whose engine was on fire. The air ministry stated that it contributed to his death by not thoroughly testing the DB 605 engines.

My only criticism of the book is that many graphs had to be reduced in size to fit on a page, thus making some very difficult to read. Overall, however, the book drew me into the guts of the engines. I highly recommend this book for the "gearheads" who enjoy the mechanical aspects of these piston engines, and how the engineers of this era collected and tested their ideas to build the fighter engines that performed so well over Europe.

Tony Kambic, volunteer, National Air & Space Museum, Fairfax VA

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Luftwaffe Special Weapons: 1942-45. By Robert Forsyth. Oxford UK: Osprey, 2021. Maps. Photographs. Illustrations. Bibliography. Pp. 272. $50.00. ISBN: 978-1-47283982-4

Since their inception in the late 1960s, Osprey has published over 2,300 titles. Most of their product focuses on military history, and many consider them as pre-eminent in the field. Their stable of authors produces outstanding work. Research is collaborative and meticulous. Illustrations, photographs, drawings, and charts are detailed and always directly support the narrative. The books themselves are solid with quality paper and binding. Having read a number of these Osprey books, I was fairly certain that Forsyth would provide a quality reading experience. I wasn't disappointed.

Most aviation historians focus on aircraft, people, or events. Forsyth asks readers to follow him as he explores what was carried on Luftwaffe aircraft and employed by Luftwaffe personnel during World War II. His story explains how the Luftwaffe attempted to squeeze every drop of efficiency from its hardware by exploring innovative and interesting weapons to equip the aircraft. A couple of examples should suffice to demonstrate what the book offers.

Most Second World War historians are familiar with the Fi 103, better known as the V-1. A pulsejet-powered cruise missile carrying a 2,000-pound warhead, the V-1 changed the nature of surface-to-surface weapons. Fewer historians are aware that Germany tested launching the V-1 from aircraft. Fewer still know that a dedicated Luftwaffe unit was established to conduct a campaign against the UK from June-December 1944 when over 1,300 V-1s were air launched against London and Manchester. While the air-launched V-1s were just as inaccurate and unreliable as their surface-launched brethren, it was 1947 before the US began exploring the idea of air-launched cruise missiles with its V-1 clone "Loon" cruise missile.

Many aviation enthusiasts look with awe at the 50mm and 75mm weapons mounted on Luftwaffe aircraft. These large weapons were designed to break up bomber formations or "pulks," degrade defensive firepower, and render the Fortresses and Liberators more vulnerable to conventional machine-gun and cannon fire. Forsyth spends some time exploring the Luftwaffe's attempts to field these weapons. I kept expecting him to draw analogies with the USAAF B–25 modification where a 75mm weapon was installed and used in an anti-shipping mission, but he chose not to elaborate on the similarities.

In fact, that leads to my only criticism of the book. Forsyth establishes his expertise; and I, for one, have great confidence in his mastery of the material. That confidence never waivers. But he never offers a summary or conclusion. He never shares his opinion on the efficacy of the German programs. He never compares or contrasts the Luftwaffe "selbstopferung—self-sacrifice" programs with their Japanese Kamikaze counterparts. The book simply ends. That abrupt conclusion was a disappointing end to a superb piece of writing and research.

Gary Connor, docent, Smithsonian National Air and Space Museum's Udvar Hazy Center

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The Bomber Mafia: A Dream, a Temptation, and the Longest Night of the Second World War. By Malcolm Gladwell. New York: Little, Brown and Company, 2021. Photographs. Notes. Index. Pp. 240. $27.00. ISBN 978-0-316-29662-8

This book is a study of the switch from daylight preci-

sion to night area incendiary bombing during the B–29 bomber campaign against Japan in 1945. Written as a follow-on to the author's podcast Revisionist History, *The Bomber Mafia* explores the origins of precision bombing theory, the role of the Air Corps Tactical School, and the emergence of a key group of leaders, including Haywood Hansell, so firmly wedded to that doctrine—the Bomber Mafia—that they were blind to alternative strategies. After precision bombing efforts over Japan proved less than successful, the book views Hansell's hesitation at adopting area incendiary bombing was a key factor in his replacement with Curtis LeMay as head of XXI Bomber Command.

The Bomber Mafia reviews the challenges—atrocious weather and high winds among them—that the B–29s faced in aiming bombs with accuracy over Japan. Concluding that the change to area incendiary bombing was inevitable, it states that along with nuclear weapons, the area bombing campaign over Japan helped end the war without a costly ground invasion. The key factor enabling that change was the replacement Hansell, a commander so devoted to precision strategic bombing doctrine that he never would have moved to area incendiary bombing. The link between Hansell's replacement and area incendiary bombing is not as direct as Gladwell would have it. LeMay persisted in precision attacks for some time after assuming command of XXI BC. He switched to area bombing after concluding that conditions prevented any meaningful amount of precision bombing over Japan.

Although it considers the familiar arguments, this book's conclusion offers little not already found in numerous studies of this topic. Seasoned airpower readers will find the focus on Hansell and LeMay confining; many others contributed to the US strategic airpower effort. Most glaring is the absence of the significant role of General Hap Arnold in the patient, steady development of a strategic airpower organization, the building of a massive global bomber force, and his role in Hansell's replacement. Puzzlingly, Hansell's 1986 memoirs, *The Strategic Air War Against Germany and Japan*, are not mentioned; although Charles Griffith's biography of General Hansell, *The Quest* (1999) is cited frequently. Gladwell's account of the development of precision strategic bombardment doctrine would have profited from reference to Futrell's *Ideas, Concepts, Doctrine* (1971) and Greer's *Development of Air Doctrine* (1985). As a study of how bombardment doctrine grew to dominate the minds of military leaders, it is not as convincing or thorough as Sherry's seminal *The Rise of American Air Power* (1989) or Schaffer's *The Wings of Judgement* (1985).

Gladwell's social psychology background lends itself to colorful descriptions of people and events, related in a jaunty, conversational style that makes for easy reading. Previously unplumbed oral histories and interviews with prominent airpower historians and USAF leaders give the book a freshness and an immediacy lacking in some older works. The occasional fact is skewed to fit the thesis: the Air Corps Tactical School refined and formalized, but did not create the concept of precision strategic bombardment; General Eaker was not a "charter member" of the Bomber Mafia. As a popular history, however, *The Bomber Mafia* is recommended reading as a lively and refreshing narrative account of this well-known airpower topic.

Steve Agoratus, Hamilton NJ

Storms over the Mekong: Major Battles of the Vietnam War. By William Head. College Station TX: Texas A&M Press, 2020. Maps. Photographs. Notes. Bibliography. Index. Pp. 464. $30.00. ISBN: 978-1-62349835-1

This is a carefully constructed "roadmap" of the Vietnam War using seven iconic battles. It is not an unconnected collection of significant battles but, rather, an explanation of how Vietnam became the "American War" and, then, how it was fought and lost.

The first chapter, 1963's Battle of Ap Bac, highlights major failures of the South Vietnamese campaign against the Viet Cong and why, without American intervention, it was lost.

Chapter two covers "Rolling Thunder," the misguided attempt to use air power to intimidate North Vietnam, that was driven by an ill-conceived doctrine of gradualism micromanaged by would-be tacticians comfortably residing in Washington. The price for their hubris (800 aircrew lost and 1,000 aircraft destroyed) was paid for by the aviators who flew highly dangerous missions against targets of marginal value. It was also borne by the North Vietnamese people who willingly endured endless sacrifice in order to unify the country. To the end, Washington's "wise men" remained unable to grasp what they were inflicting on Vietnam, both north and south, without hope of victory.

Head then moves to the seminal battle that foretold the price to be paid by Americans if a ground war was pursued. Once again, results were misinterpreted by senior leadership to justify a massive buildup of American forces and a willingness to accept the losses that would follow. The battle in the Ia Drang Valley, fought in November 1965 by the 1st Air Cavalry Division, cost 240 Americans killed and 247 wounded—many of those from just one battalion. It was briefed as a resounding victory and a model for subsequent operations against the North. In the aftermath, however, Secretary of Defense McNamara acknowledged to President Johnson that the likely consequence of an American war would be a military stalemate fought at a high level of violence with high casualties.

The next chapters center on the 1968 Tet Offensive, in particular the battles for Khe Sanh, Hue, and Saigon. Head does an excellent job examining the biggest question that came out of the siege of Khe Sanh: did General Giap intend to capture the base or use it as a diversion for the attacks on the cities? For the North, Tet was a military defeat but a

political victory. The ultimate withdrawal of American forces can be measured from that outcome. Hue's mass executions also revealed a glimpse of what the North planned with victory.

A chapter on the 1969 battle of Hamburger Hill, a tactical victory, illustrates the excessive loss of American lives in senseless combat of no lasting value. The significance of the battle is that its high casualties led to an end of major ground combat for American troops.

The chapter on the 1972 Easter Offensive again demonstrated that, if not for US airpower and a handful of first-rate South Vietnamese units, the war was lost.

The final battle is one fought by Vietnamese units on both sides. Aside from a heroic stand at Xuan Loc in April 1975, it was a rout for the South leading to rapid capitulation and defeat.

While not a history of the Vietnam War, this book is easily as effective as one. In seven battles, it neatly captures the war's essence and its loss. Kudos to Head for providing a very readable and informative work.

John Cirafici, Milford DE

Above the Reich: Deadly Dogfights, Blistering Bombing Raids, and Other War Stories from the Greatest American Air Heroes of World War II, in Their Own Words. By Colin Heaton and Anne-Marie Lewis. New York: Penguin Random House, 2021. Photographs. Notes. Appendices. Index. Pp. 406. $25.00. ISBN: 978-0-59318388-5

Above the Reich is a collection of five oral histories that present the memories of notable aviators Robert Johnson, Jimmy Doolittle, Curtis LeMay, Robin Olds (better known for his Vietnam-era activities than combat missions above the Reich), and the lesser-known Buddy Haydon. Heaton is a disciple and student of the controversial historian Trevor Constable; this book shows elements of Constable's style.

The oral histories were compiled from interviews conducted decades ago that sometimes covered days, months, or years. They are written as if the subject were speaking in the first person, although it is clear the editors have touched up the speaker's words to some extent. The stories are well known to the serious aviation or military historian, so this is not a book that is going to reveal new information. But the stories are presented as the principals told them. Their personalities shine through brightly. That clarity is the book's great strength and weakness.

To their credit, the authors present the oral histories with little sugar coating. Humble, polite, self-deprecating, and quietly heroic men reflect those characteristics in their stories. Men who were loud, crude, profane, self-centered, and self-promoting reflect those characteristics as well. The reader has the option of deciding how they like their heroes. Since all these aviators were also leaders, the book becomes a case study for effective leadership. The major traits that these leaders shared were their reputations for competency, responsibility and leading from the front. While only one of the aviators actively reviles "armchair generals," it is clear they all believe that combat leaders lead from the front.

Oddly, the book has a surprisingly large section of notes and an extensive bibliography. Oral histories are generally assembled from the speaker's memories "warts and all." The occasional instances where a personal memory differs from "accepted" history is what brings this type of work to life. Memories burnished by time are the true reward provided by oral histories and personal journals. I am not sure if the author's bibliography was used for the purpose of preparing for the interviews or post-interview fact-checking.

Above the Reich is a solid effort and a comfortable recreational read that I recommend without reservation. The narrative is occasionally clunky as the authors try to smooth the speaker's words without changing their meaning. The characters selected to be included are heroic icons for a reason. However, this raises an interesting question. This book tells the story of successful combat leaders, a small percentage of the men and women who labored, fought, and perhaps died for the same cause. What historian is going to tell the story of the pilot who flew 100 missions and never fired his guns? Or the cook who prepared the last meal for aircrews who would never return? Who tells their story?

Gary Connor, docent, Smithsonian's National Air and Space Museum Udvar-Hazy Center

The Tornado Years: More Adventures of a Cold War Fast-Jet Navigator. By Wing Commander David Herriot. Yorkshire UK: Air World; 2019. Photographs. Glossary. Pp. 246. $49.95. ISBN: 978-1-52675-8-941

Herriot's final book picks up his career story where his previous *Adventures of a Cold War Fast-Jet Navigator* ended. It follows him as he transitions into the new Tornado GR1, serves as a Tornado navigator, and then moves from flying to staff assignments in the final years of his RAF service. Throughout the narrative, Herriot conveys his intense enjoyment and the professional challenges of flying fast jets in the RAF and the trials and tribulations he experienced during his career.

Herriot spent twelve years flying the Buccaneer with two front-line squadrons and as an instructor at the Buccaneer conversion unit before converting to the Tornado in 1985 following an assignment at the Ministry of Defense. He describes in detail the intensive training he underwent learning the Tornado's advanced digital navigation and radar systems, which were far superior to the analog systems in the Buccaneer. Herriot spent four years flying the Tornado, first on No. 17 Squadron in Germany and then as

Standards and Evaluation officer in the Brüggen Tornado Wing. He describes life in a squadron and the constant training Tornado crews undertook to reach and maintain the highest professional standards. Herriot participated in ultra-low-level flying training in Canada, Red Flag exercises in the US, dissimilar air combat training, and regular exercises in Europe. He just missed the First Gulf War. Having trained twelve crews in preparation for the war, much to his frustration he received a posting to the Ministry of Defence at the last minute.

A self-confessed late bloomer, Herriot spent thirteen years as a flight lieutenant before being promoted to squadron leader. After twenty years of flying and six squadron tours on the Buccaneer and Tornado, he attended the RAF Staff College and then held staff positions for the remainder of his career. He developed an ability to manage complex projects, which served him well. His most enjoyable assignment was as head of the Department of Initial Officer Training at RAF Cranwell. His book documents how an RAF officer moves from being an active flyer to becoming a participant in the management of a complex military service. Herriot retired after 38 years of service and over 3,000 hours in fast jets. Sadly, he passed away in September 2020.

The book is an enjoyable read, with readers quickly drawn into the fast pace of squadron life and the thrill of flying the Tornado at low level. It provides an interesting study of how an individual progresses in a career in a large organization and the choices that ability and chance present along the way, a path that will be familiar to serving officers and professional managers. Of the two aircraft he flew on squadron service, Herriot's heart is with the Buccaneer. He was one of the founding members of the Buccaneer Aircrew Association and served as the Association's secretary for many years.

Edward M. Young, PhD, volunteer, Museum of Flight, Seattle WA

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World War II Fighter Planes Spotter's Guide. By Tony Holmes. Oxford UK: Osprey, 2021. Illustrations. Pp. 288. $12.00 paperback. ISBN: 978-1-4728-4851-2

My first reaction to this book when I received it was, "You have to be kidding"! What use is something like this to readers of *Air Power History*? However, after thinking about it for a while, it hit me that this sort of book is still very useful in a limited way.

What are we talking about here? The book is exactly what the title says it is—a guide to World War II fighter aircraft. It is in typical "spotter guide" or "recognition handbook" format: only 5 inches tall, but 7-1/2 inches wide. There are 88 entries varying from two to four pages in length. Each lays out the bare essentials of one of the major fighters used during the war years: a data block with essential specifications, a side profile illustration (all used in previous Osprey books on specific aircraft types or aerial campaigns), a short narrative about the aircraft development and use, and specific information about the aircraft shown in the profile view. Some of the more prolific aircraft, such as the Messerschmitt Bf 109, have multiple entries (e.g., Bf 109E, F, and G/K; Mitsubishi A6M2/3 and 5/7) because of the big differences in models.

C an a book like this still be useful in the days of Wiki and the vast resources of the internet? My answer is yes. There is no question that any Wiki article contains more information about any of the aircraft types presented in this guide than what is contained in the book. But one has to know what one is looking for in Wiki. Suppose you are someone who knows absolutely nothing about what fighter aircraft did in the war or what they looked like. A book such as this, arranged as it is in alphabetical order, can provide the bare-bones information needed at an airshow featuring a lot of warbirds or at a museum. After you get all excited about seeing a Zero or a Mustang flying or sitting behind a barrier, then you can go home and consult Wiki or any of hundreds of books for more detailed information.

As a youngster, I would have been thrilled to get a book such as this for a birthday or at Christmas. Despite all the other information easily available to kids these days, I think this would still be something that a fledgling fighter-pilot-to-be would love to peruse.

Col Scott A. Willey, USAF (Ret), Book Review Editor, and Docent, NASM's Udvar-Hazy Center

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Arado Flugzeugwerke: Aircraft and Development History. By Volker Koos. Stroud UK: Fonthill Media, 2021. Photographs. Drawings. Pp. 192. $40.00. ISBN: 978-1-78155-671-9

Aircraft from the Arado Flugzeugewerke may not be as well-known as their Messerschmitt, Focke-Wulf, Junkers, and Heinkel cousins; but Koos' book provides a wealth of reasons to stir the aviation historian to learn more about this family of aircraft.

Arado was founded in June 1912 by Count Brandenstein-Zeppelin with the intent of focusing on seaplane design and production. The end of the war saw them turn their attention to small boats and yachts to stay in business, and it wasn't until the mid-1920s that resources were found to support a return to aviation. The company focused on small training and sport aircraft for German and a small number of foreign customers. By limiting their design efforts to this market, Arado did not contribute designs that participated in the massive European air battles of World War II. That is not to say that the company didn't make any contributions. Arado facilities built a dizzying array of combatants including Ju 88s, He 177s, Bf 109s, and Fw 190s.

Koos takes the reader through every Arado design, providing details of the requirement and a technical description with detailed specification and performance information. He self-identifies "holes" in the narrative, noting areas where his research could not complete the narrative.

One area that goes without explanation is how a company whose history was focused on light and sport aircraft suddenly produced the unique Ar 232 Combat Zone Transport or the seminal Ar 234 family of jet-powered bomber/reconnaissance aircraft. The Ar 232 contained many innovative features, such as the *wanderguerruder* flap system and adjustable landing gear designed to facilitate operations on unimproved surfaces. The Ar 234 rapidly evolved into an unstoppable reconnaissance platform that demonstrated the ability to outmaneuver the Me 262 in flight-test mock dogfights. Only the lack of reliable engines and a stable fuel supply limited its operational effectiveness.

Koos' emphasis on technical and statistical descriptions creates a very sterile and lifeless narrative. There are no aircrew stories or anecdotes to bring the book to life. There is no explanation of how Arado coped with supply-chain disruptions, work-force issues, the use of forced labor, or fiscal problems. There is no discussion of design challenges created by the leap from fabric-covered trainers to all-metal jet bombers. While the book contains a wealth of information, the reader is left wondering what wasn't said and what stories weren't told.

The book itself is a quality product. Printed on heavy paper, it shows pictures and drawings in detail. The translation from the German language is very readable. The style of the narrative limited the opportunities to fall into grammar and syntax traps.

Gary Connor, docent, Smithsonian's National Air and Space Museum Udvar-Hazy Center

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The Schneider Trophy Air Races: The Development of Flight from 1909 to the Spitfire. By Jerry Murland. South Yorkshire, UK: Pen & Sword Aviation, 2021. Photographs. Appendix. Bibliography. Index. Pp. xxiii, 186. $34.95. ISBN: 978-152677-001-1

This is Jerry Murland's first venture into aviation writing, although he's written or co-authored a number of books relating to land battles during both World Wars. A large part of his motivation was that his father flew Spitfires in 74 Squadron from 1943-45.

Unfortunately, that lack of aviation background shows in miscaptioned photos and erroneous reports. He identifies Eugene Lefebvre as the first victim of an air crash, 10 months after Lt. Selfridge died at Fort Myers; a photo of Billy Mitchell is captioned as of him in "a SPAD XIII during the battle of Saint-Mihiel," while a cursory Google search turned up the photo with a caption, written on the negative, that it was a Thomas-Morse Scout. Eddie Rickenbacker is shown with his "SPAD XIII," which is clearly a Nieuport 28.

I wouldn't recommend this book as a resource for anything beyond the basics on the Schneider Trophy races, although Murland tries to cover everything from the coming of age of flight (according to him, in 1909; the Wright brothers' previous accomplishments are only nodded to) through to the Spitfire his father flew. What he calls his primary references (I'd be more inclined to call them "principal," since none is contemporary) go back no further than 1934. Most of them are post-1960. This book may give you a sense of what the Schneider Races involved, but take it with a grain of salt.

Jon Barrett, Collections Volunteer, National Air & Space Museum`

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Air Marshall Sir Keith Park: Victor of the Battle of Britain, Defender of Malta. By Murray Rowlands. Philadelphia PA: Pen and Sword, 2021. Maps. Photographs. Bibliography. Index. Pp. ix, 172. $39.95. ISBN: 978-1-52676-290-5

Rowlands, a native New Zealander now living in the United Kingdom, previously wrote *Aldershot in the Great War* and *Hampshire at War 1939-45*. These two studies examined life in England during the two world wars. In this work, he has chosen to explore the life and times of one of New Zealand's most prominent World War II leaders.

He proceeds chronologically, introducing the reader to Park's upbringing in New Zealand followed by service in New Zealand and British artillery units in World War I. Park participated in the ill-fated invasion of Gallipoli in Turkey and later served on the Western Front where he was wounded. In early 1917, he transferred to the Royal Flying Corps and flew the Bristol F.2 fighter for nearly 16 months.

The vast majority of Britain's World War II leaders came of age in World War I. Park took advantage of that experience better than many others. In April 1940, Fighter Command 's Hugh Dowding chose Park to lead No. 11 Group. This organization included the units responsible for defending England's vulnerable southeast and London from German air attack.

Probably more books have been written about the Battle of Britain than any other aspect of Britain's World War II history. Here Rowlands highlights some of the major engagements while emphasizing the logistical and leadership challenges Park confronted. He stresses the contentious relationship between Park and Trafford Leigh-Mallory, who commanded 12 Group northwest of 11 Group. Much has been said about Leigh-Mallory's "big wing" approach, con-

centrating as many aircraft as possible for a mass attack on the Luftwaffe bombers and fighters. Park, however, found this method entirely unsuitable given the limitations of Britain's early-warning system. He was repeatedly frustrated by Leigh-Mallory's failure to support 11 Group operations.

There is no question that Park's leadership played a major role in the Royal Air Force turning back the Luftwaffe in the summer of 1940. Despite his efforts, Park lost the internal political battle to Leigh-Mallory. The RAF leadership shuffled him off to defend the vital Mediterranean island of Malta and later southeast Asia.

Rowland's respect and sympathy for his countryman is obvious. However, as a serious examination of Park's life, the book fall shorts. Rowland's relies almost entirely on secondary sources. The absence of citations casts doubt over many of his claims. His fundamental lack of knowledge concerning aerial warfare seeps through. For example, he erroneously suggests Adolph Hitler curtailed Germany's development of airborne radar. Elsewhere, he refers to the "Mowhawk" on several occasions in the context of the Hawker Hurricane and Supermarine Spitfire. Perhaps he was referring to the North American Mustang? If so, the publisher deserves some of the blame for this gaff. He informally cites Vincent Orange's 1984 biography of Park. Even though I am unfamiliar with that work, it must be superior to this effort.

Steven D. Ellis, Lt Col, USAFR (Ret), docent, Museum of Flight, Seattle

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With His Hand: The Incredible Story of John C. "Red" Morgan. By Daniel Simmons. Eugene OR: Luminaire Press, 2018. Photographs. Notes. Appendices. Pp. 111. $14.95 paperback. ISBN: 978-1-64388-015-0

This is an insightful and informative biography of Medal of Honor (MOH) recipient John "Red" Morgan, 92nd BG, Eighth Air Force. Simmons, a former KC–135 pilot and 92nd ARW historian, relied on official documents, interviews, and family correspondence. As with Pappalardo's *Inferno* (2020), a bio of Maynard Smith, and Erwin and Doyle's *Beyond Valor* (2020) covering Henry "Red" Irwin, readers gain understanding of the distinctive qualities of MOH recipients.

Twenty five years old in 1939, Morgan tried to join the Army Air Corps to fulfill his ambition of becoming a military aviator. Turned down as unfit due to an old occupational injury, the undiscouraged Morgan instead joined the Royal Canadian Air Force in August 1941. Receiving his pilot wings in October 1942, he shipped out for England in November and began flying RAF bomber missions over Germany. Transferred to the USAAF in March 1943, he was assigned to the 92nd. On the July 26, 1943, mission to Hanover, Germany, Morgan was the co-pilot of B–17 *Ruthie II*. Fw 190s attacked the formation head-on. 20mm shells severely wounded the pilot, who grasped the control column, causing the aircraft to dive. The plane was badly damaged and the interphone was out. For the next two hours, Morgan restrained the struggling pilot with his left hand and flew the plane with his right hand. Discovering this predicament after bombs away, the navigator assisted Morgan in landing the plane safely.

Lt Gen Ira Eaker, Eighth Air Force commander, presented Morgan the MOH on December 18, 1943. To avoid losing an MOH recipient, he subsequently ordered that Morgan fly no further combat missions. Impatient as ever with the Air Force's choices over his career, Morgan seized an opportunity in January 1944, when Maj Gen Jimmy Doolittle replaced Eaker. Unaware of Eaker's order, Doolittle did not object to Morgan's transfer to the 482 BG, where he soon resumed flying combat. Eaker turned out to be prescient, as flak destroyed Morgan's B–17 over Berlin on March 6, 1944. The plane exploded, leaving him in midair at 24,000 feet, grasping his parachute in his hands. He successfully scrambled into it but hit the ground hard, causing injuries that troubled him throughout his life. He finished the war in Stalag Luft 1.

Morgan remained in the USAF Reserve after the war. Recalled to active duty during the Korean War, he served in the Pentagon. Reticent in later years about his MOH experience, Morgan died on January 17, 1991. The 92nd ARW commander at Fairchild AFB renamed the base events center the Red Morgan Center at a ceremony on June 6, 2014. Simmons' thorough research helps correct several inaccuracies that have crept into print over the years: The fateful mission was on July 26, not July 28, 1943. Morgan's plane that day was a B–17, not a YB–40. The MOH citation was dated December 17, 1943, but the medal was bestowed the next day. Written in a clear and simple style, and profusely illustrated with many never-before-seen photos, *With His Hand* helps us appreciate a man who persistently overcame obstacles to serve his country. This book is highly recommended.

Steven Agoratus, Hamilton NJ

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Moral Imperative: 1972, Combat Rescue, and the End of America's War in Vietnam. By Darrel D. Whitcomb. Lawrence KS: University Press of Kansas, 2020. Photographs. Notes. Index. Bibliography. Glossary. Pp. 370. $29.95 paperback. ISBN: 978-0-7006-3006-6

The process of search and rescue for downed airmen might have its origins in the Second World War, but it was in the skies and jungles of Vietnam that it truly came into its adulthood. Whitcomb, the author of *The Rescue of Bat-21* and other works on military rescue, provides the reader

with a treasure trove of information on the evolution of combat search and rescue, focusing on 1972.

The first chapter explains the situation in South Vietnam and Laos during the early 1960s and the North Vietnamese response to the surge in American troops and operations, where he chronicles the first losses of American aircraft. Whitcomb looks at the increased capability of the rescue forces and discusses the reorganization of rescue forces and coordinating agencies to better meet the mission. He also discusses introduction of the HC–130 to serve as an airborne mission command post.

The significance of 1972 becomes obvious with the increasing drawdown of ground troops and the increasing boldness of the enemy. Enemy forces, particularly aircraft, began to make it difficult to rescue downed airmen, as fighters became increasingly aggressive in attacking the vulnerable helicopters. More than one helicopter was severely damaged or lost to MiGs while attempting to rescue a downed airman.

From chapter two on, Whitcomb chronicles every search, successful or not, that occurred in 1972. The many interesting rescues that Whitcomb discusses include that of Bat-21 and others that stretched the limits of rescue forces. As the year progressed with ever increasing air activity (such as Operation Linebacker II), those rescues became not only increasingly challenging, but also increasingly frustrating, as aircrew were either killed or, after hours spent trying to recover them, captured by enemy forces.

The true strength of these chapters is not the chronicling of the searches and rescues, but in Whitcomb's explanations that bring them to life. Rescue efforts became increasingly dangerous as enemy fighter forces began to target vulnerable helicopters, and American fighters would have to choose between performing their assigned missions or protecting rescue forces. In that dilemma was the "moral imperative"—the decision on whether to commit rescue forces to a rescue effort that could result in a raging battle (with the possibility of losing more men and machines) versus ignoring the men who had been shot down to save other lives. General John Vogt, Seventh Air Force commander, chose the former because ". . . the one thing that keeps our boys motivated is the certain belief that if they go down, we will do absolutely everything we can to get them out."

Whitcomb does not restrict himself to USAF rescue efforts, but paints a picture in which Navy rescue, Army and Marine aviation, and Air America took part in these efforts. These were an integral part of the interconnected web of rescue forces. One example cited is the recovery of future USAF chief of staff Captain Ron Fogelman by an Army AH-1 Cobra crew after being shot down in his F–100.

This is a thoroughly enjoyable and interesting read that should be on the shelf of every Vietnam War, airpower, and combat-rescue enthusiast.

Dennis H. Berger, PhD, Texas Tech University

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British Fighter Aircraft in World War I: Design, Construction, and Innovation. By Mark C. Wilkins. Havertown PA: Casemate, 2021. Diagrams. Illustrations. Photographs. Notes. Index. Appendices. Bibliography. Pp. 192. $39.95. ISBN: 978-1-61200-881-3

Wilkins is a writer, historian, and museum curator with a masters in history from Harvard, whose specialty is World War I aviation. In this, his latest book, he covers a lot of ground surrounding his broad subject in a fairly brief and easy-to-read narrative.

The book's purpose is to show the genesis of the British aircraft industry, some of the superb products it developed during the Great War, the technologies employed and improvements made during the four years of the war, and a bit about the individuals behind these companies and aircraft. That is a broad spectrum to handle, and Wilkins uses original factory drawings and patents, and contemporary (black-and-white) and modern (mostly color) photos to back it all up. What I think is a really unique approach to looking at the subject is the heavy use of modern shops that specialize in building replicas of many of these iconic aircraft. And there are some really good ones around the world, but particularly in the US, UK, and New Zealand. Wilkins may not have had an original aircraft to look at, but he certainly plumbed the modern builders for examples of the technologies discussed.

Wilkins starts with a chapter on the birth of the aero industry in Britain. Their story is much like that in the US. Basically, there wasn't one before the war. There were plenty of shops that hand-crafted a few designs of their own or built foreign (Wright, Farman, Bleriot) aircraft under license. The government certainly wasn't much involved. But the war demanded that many aircraft be built as efficiently as possible and at the least cost in resources. That required a modern industry.

The rest of the chapters deal with individual companies: Bristol, Sopwith, the Royal Aircraft Factory, Airco, and Avro. Within those chapters, the most important of the company's products are discussed. For example, within the Sopwith chapter, Wilkins covers the Tabloid, 1½ Strutter, Pup, Triplane, Dolphin, Snipe, and Camel. The focus is on innovations, manufacturing techniques, etc. One is not going to find stories of aces and dogfights over the trenches of France in this book. The final chapter before the conclusion and appendices deals with one of the major components of any aircraft, the engines and propellers that these companies used to power their products—the Gnomes, Hispano-Suizas, and Bentleys. One of the sidebars even discusses remanufacturing these ancient powerplants for use today.

The book oozes quality. The photos, drawings, and other illustrations are all beautifully reproduced on glossy paper. Original drawings are big enough to read the fine print. Wilkins' narrative and the accompanying captions on photos and the like flow well to tie the diverse elements into a

cohesive story. Sidebars add important information at the proper place.

For anyone interested in the birth of a major industry, some of the finest flying machines of World War I, the technologies used, and the people involved in their creation, this is a really fine book that is well worth the price.

Col Scott A. Willey, USAF (Ret), Book Review Editor, and Docent, NASM's Udvar-Hazy Center

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Dien Bien Phu 1954 The French Defeat that Lured America into Vietnam. By Martin Windrow. Oxford UK: Osprey Publishing, 2021. Index. Photographs. Illustrations. Maps. Pp. 96. $24.00 paperback. ISBN: 978-1-47284400-2

This monograph is an easy-to-follow account of the pivotal 1954 battle of Dien Bien Phu (DBP). Its outcome was critically important to both belligerents, as it determined the future of Vietnam at the Geneva Conference to end the war. Windrow takes the reader into the battle.

The French defeat at DBP was the consequence of monumental errors in operational planning and estimates of the enemy's intentions and capabilities. The French overestimated their own capability to maintain and defend a remote base with organic artillery, dependable air support, and defense in depth. However, that was inconsistent with the reality of the terrain, weather, remoteness of the base, and forces available. They also underestimated the Viet Minh's ability to commit substantial forces supplemented with artillery and anti-aircraft weaponry. The purpose of the base was to draw Viet Minh forces away from the strategically important Red River Delta (including Hanoi and Haiphong). Instead, the misguided plan isolated significant French forces, moving them away from areas where they were essential. Despite heavy Viet Minh losses, it was the French who were ultimately crushed.

Although Windrow did not contrast DBP with the siege of remote Khe Sanh 14 years later during America's Vietnam War, one cannot help but look for parallels and differences. There were obvious similarities and important differences that come to mind. The Viet Minh had zeroed in their artillery on DBP's two vitally important airfields, essentially shutting them down. In fact, their use of artillery was central to reducing DBP's defenses. General Giap, the overall commander in both battles, applied the lessons of the first battle to the second one. Tactical airpower at DBP was sorely inadequate with too few successes. This encouraged Giap's tactical boldness. In contrast, US airpower inflicted heavy losses on the North Vietnamese (NVA) at Khe Sanh. Vietnamese artillery, well concealed and protected, was a key component of their siege strategy at both DBP and Khe Sanh. At DBP it was used to support assaulting troops, reduce outposts, deny use of the airfields, and target command and control bunkers. Fuel storage and ammunition dumps were destroyed. At Khe Sanh, the ammunition dump was destroyed, aircraft on the ground were struck and often destroyed, and movement within the camp was greatly restricted. Yet, Khe Sanh, supplied by airdrop, maintained a robust defense posture.

Finally, an important difference: the Siege of Khe Sanh was not the North Vietnamese focus of their 1968 Tet Offensive. Although they employed many of the same tactics, (e.g., artillery, isolating the base from its land approaches and"probing the wire" looking for exploitable weaknesses), the base did not have to be actually taken. It drew key combat forces (the 1st Cavalry Division) away from population centers on the eve of the South Vietnam-wide Tet Offensive. As a veteran of the siege of Khe Sanh, I wanted to learn as much as possible about the battle of Dien Bien Phu. Windrow's excellent linkage between narrative, maps, order-of-battle tables, and timelines allowed me to "see" the battle of DBP as it unfolded. This book accomplishes quite a bit in its relative brevity and is well worth reading.

John Cirafici, Milford DE

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Rain of Steel: Mitscher's Task Force 58, Ugaki's Thunder Gods, and the Kamikaze War off Okinawa. By Stephen L. Moore. Annapolis MD: Naval Institute Press, 2020. Maps. Index. Photographs. Appendix. Glossary. Notes. Bibliography. Pp v, 426. $39.95. ISBN: 978-1-68247526-3

This is Moore's detailed account of the battles between Task Force 58 and the Japanese Army and Navy's Special Attack squadrons during the battle for Okinawa. He has previously written several books about naval carrier aviation in the early years of World War II and co-authored a history of Torpedo Squadron Ten that fought from Guadalcanal to Okinawa. He was fortunate to have interviewed many participants in the air battles off Okinawa and has located other oral histories from pilots who flew during the campaign. His integration of these first-person accounts into his descriptions of air combat against the Kamikaze is excellent.

As a counterpoint to the American side of the battle, Moore uses quotes from the diary of Vice Admiral Ugaki Matome who commanded the Japanese Navy's Fifth Air Fleet for the defense of Okinawa. Ugaki organized and had command of the Special Attack Corps, better known as the Kamikaze, and directed this force in attacks against Task Force 58 and the American fleet off Okinawa. Of note is how exaggerated reports of the success of the Kamikaze attacks influenced Ugaki and his force deployment.

Moore begins by describing the opposing forces and their commanders. He covers the carrier strikes on Japan in February and March 1945 that preceded the invasion of Okinawa, focusing on the intensive air combats that, for

many young Navy and Marine carrier pilots, were their first encounters with Japanese fighters. In describing these attacks he includes the contribution of the carrier dive bomber and torpedo bomber squadrons. He provides a detailed description of the sinking of the super battleship *Yamato* in its sacrificial attempt to counter the US invasion fleet.

Following the landings on Okinawa, Moore concentrates on the battles between Task Force 58's fighter squadrons and the Kamikaze during the attacks that Vice Admiral Ugaki launched against the Task Force and the invasion fleet during April and May 1945. Although his focus is on the carrier Hellcat and Corsair squadrons, Moore also describes air combats involving land-based Marine Corsair squadrons defending the picket ships patrolling off Okinawa, accounts of the destroyers and destroyer-escorts that suffered under the Kamikaze attacks that made it through the screen of fighters, and accounts of the troops on the ground fighting against tenacious Japanese resistance. He provides short but interesting accounts of the carrier night fighters and night-bombing squadrons that defended the fleet and attacked the Kamikaze bases on Kyushu at night. The air battles over Japan and Okinawa were some of the most intense of the Pacific War. Nineteen Navy and five Marine Corps pilots became aces in a day. Moore describes many of these incidents. Two Navy Hellcat squadrons, VF-9 and VF-17, feature prominently in Moore's account, particularly VF-9's Lt. Eugene Valencia and his division, who emerged from the campaign as the highest scoring Navy carrier fighter division of World War II.

The is a well-written and dramatic account of the final great air battles of World War II. Those who seek more information on the Okinawa campaign will be well-served by Moore's comprehensive bibliography.

Edward M. Young, PhD, volunteer, Museum of Flight, Seattle WA

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Nemoto's Travels: The Illustrated Saga of a Japanese Floatplane Pilot in the First Year of the Pacific War. By Michael John Claringbould. Kent Town, Australia: Avonmore Books, 2021. Maps. Illustrations. Photographs. Pp. 119. $99.95 paperback. ISBN: 978-0-6489262-5-2.

Starting with *South Pacific Air War Volume 1* in 2017, Claringbould has produced more than a dozen books on aerial combat in the southwest Pacific during World War II as well as studies of some of the more prominent aircraft employed by both sides. In this work, however, he takes a dramatically different approach. Relying on a Japanese flyer's diary, he examines Japan's expansion into the Solomon Islands and New Guinea in the first half of 1942.

The entries from the diary, while interesting, normally would be insufficient for a book-length treatment and better suited for a magazine article. However, Claringbould's decision to feature lavishly-colored illustrations and photographs to complement a limited narrative results in an entertaining and creative effort.

A typical page will have two or three photographs of a Pacific location with an illustration of an aircraft superimposed. Surrounding the graphics are blocks of text including excerpts from the diary as well as background regarding the strategic situation.

This work emphasizes the Imperial Japanese Navy's use of floatplanes and their associated floatplane tenders. It also demonstrates the value of the Kawanishi H6K flying boat (Allied identifier *Mavis*) as a long-range transport vital to supporting Japan's far-flung garrisons.

Claringbould frequently injects a sense of humor regarding his perception of the daily lives endured by both Japanese and Allied personnel. Initially, he avoids fabricating "bubble" quotes; but, later on, he succumbs to this increasingly common practice to enhance the narrative. He does his best work when he sticks to historical fact. One shortcoming is the repeated effort to promote his newest book. Once would have been sufficient.

Readers interested in the daily lives of Japanese servicemen probably will value this book the most. It also will capture the fancy of those fascinated with contemporary illustration technique in a print format.

Steven D. Ellis, Lt Col, USAFR (Ret), docent, Museum of Flight, Seattle

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MiGs in the Middle East: Soviet-Designed Combat Aircraft in Egypt, Iraq, and Syria, Volume 1 1955-1963 and **MiGs in the Middle East: Soviet-Designed Combat Aircraft in Egypt and Syria, Volume 2 1963-1967.** By David Nicolle & Tom Cooper. Warwick UK: Helion, 2021 (both). Maps. Tables. Illustrations. Photographs. Notes. Bibliography. Index. Pp. 62 and 72. $29.95 paperback (each). ISBN: 978-1-913336-36-3 and 978-1-91405936-0

Dr. Nicolle is a British historian who has for many years devoted much of his research and publishing to military affairs in the Middle East. He has authored more than 100 books, mostly on warfare in the Middle East over the past two centuries. Austrian aerial warfare analyst and historian Tom Cooper has focused his research efforts on "small-country" air forces for many years to the point where he has developed extensive archives. Both men have written extensively for Helion's @ *War* series.

For years, almost everything in English about aerial combat in the Middle East has come with a pro-Israeli Air Force focus. These two volumes dwell almost exclusively on the impact of Soviet-built aircraft in the Middle East.

The titles are a bit misleading in that aircraft designed by Mikoyan i Guryevich are only part of the story. The authors provide the political context within which Egypt, Syria and Iraq chose to acquire various types of Soviet-built aircraft. More significantly, they offer considerable detail on the various conflicts in which these governments used their aircraft.

While generally proceeding in chronological order, the narratives switch back and forth a bit to accommodate the events specific to each country. In the first volume, about 25 percent is devoted to the 1956 Suez War, leaving ample room to discuss the personalities and internal political events affecting the development of each of the various nation's air forces.

Volume 2 omits Iraq, though other Helion publications have examined the Iraqi Air Force in the early 1960s. Several of the chapters are devoted to the conflict in Yemen. One serious omission is the absence of discussion concerning the Egyptian Air Force's use of lethal chemical weapons in Yemen.

I found these volumes to be the most interesting when the authors provided insights into the capabilities of the various aircraft based on interviews with pilots. Also worth noting are descriptions of missions seldom discussed in the West such as Egyptian pilots flying Tupolev Tu-16 *Badger* bombers at night against targets in Saudi Arabia.

These two volumes are highly recommended for anyone with an interest in Soviet export aircraft, Middle East aerial operations, or both.

Steven D. Ellis, Lt Col, USAFR (Ret), docent, Museum of Flight, Seattle

PROSPECTIVE REVIEWERS

Anyone who believes he or she is qualified to substantively assess one of the new books listed above is invited to apply for a gratis copy of the book. The prospective reviewer should contact:

Col. Scott A. Willey, USAF (Ret.)
46994 Eaker St
Potomac Falls VA 20165
Tel. (703) 620-4139
e-mail: **scottlin.willey@gmail.com**

Research Assistance

Request for assistance:

I am trying to find photos of then-Capt. Dale Brannon and then-Capt.John Thompson, when they were respectively CO and XO of the 67th FS on Guadalcanal in 1942, flying the P–39 and P–400 Airacobra. I have plenty of photos of the P–39s and P–400s, and a few of the P–38s but none of these two men. I have been in touch with many of the regular government agencies such as the USAF History Office at MaxwellAFB and the USAF Museum in Dayton, Ohio, and I know Air PowerHistory carried a multi-part article on the squadron a few years ago.Colonel Brannon passed away several years ago, but if there is someone who knows how to contact his surviving family I would greatly appreciate your passing that information on to me. The same for Colonel—maybe BGen--Thompson's survivors.

I usually write about Navy and Marine Corps aviation, but the story ofthe 67th FS and later the 339 th FS with the first P-38s, commanded by then-Major Brannon in theater interests me.

My email is: airwriter@comcast.net

Thanks in advance,
Peter B. Mersky,
Commander, USNR (Ret)

Compiled by
George W. Cully

In light of the coronavirus pandemic, events listed here may not happen on the dates listed here, or at all. Be sure to check the schedules listed on the individual organization's web sites for the latest information.

January 3-7, 2022
The **American Institute for Aeronautics and Astronautics** will host its annual Science and Technology Forum, billed as the world's largest event for aerospace research and development, in San Diego, California and on line. For more details as they become available, see the Institute's website at AIAA SciTech Forum and Exposition | AIAA.

January 6-9, 2022
The **American Historical Association** will hold its 135th annual meeting in New Orleans, Louisiana. For more details as they become available, see the Association's website at Annual Meeting | AHA (historians.org).

March 23-26, 2022
The **National Council on Public History** will present its annual conference in Montreal, Quebec, Canada. The theme of this year's gathering is "Crossroads." For registration and other information, see the Council's website at 2022 Annual Meeting | National Council on Public History (ncph.org).

March 31-April 3, 2022
The **Organization of American Historians** will hold its annual conference in both in-person and virtual formats at the Sheraton Boston Hotel in Boston, Massachusetts. This year's theme will be "Indigenous/American Pasts and Futures." For registration and more, see the Organization's website at 2022 OAH Conference on American History | OAH.

April 1-2, 2022
The **Vietnam Center** and the **Sam Johnson Vietnam Archive and Institute for Peace & Conflict** at Texas Tech University will sponsor a conference in conjunction with the War and Society Program at Chapman University in Orange, California. The theme of the conference is "1972: the War Between North And South Vietnam." For conference details, see the Center's website at Conference Call for Papers and Panels "1972: The War Between North and South Vietnam" | Vietnam Center & Sam Johnson Vietnam Archive News and Updates (ttu.edu).

April 3-5, 2022
The **Army Aviation Association** will host its 2022 Mission Solutions Summit event at the Gaylord Opryland Hotel and Convention Center in Nashville, Tennessee. For registration and other details, see the Association's website at Home (goeshow.com).

April 4-7, 2022
The **Space Foundation** will present its 37th annual Space Symposium at the Broadmoor Hotel in Colorado Springs, Colorado. For program particulars and registration details as they become available, see the Foundation's website at Homepage - Space Foundation.

April 25-28, 2022
The **Association For Unmanned Vehicle Systems International** will hold its annual gathering, Xponential 2022, in the Orange County Convention Center in Orlando, Florida. For additional details as they become available, see the Association's website at Events | Association for Unmanned Vehicle Systems International (auvsi.org).

April 28-May 1, 2022
The **Society for Military History** will hold its annual conference in Fort Worth, Texas. For additional information as it becomes available, see the Society's website at Future SMH Annual Meetings | The Society for Military History (smh-hq.org).

May 11-13, 2022
The **Center for Cryptologic History** and the **National Cryptologic Foundation** will present the 18th Cryptologic History Symposium at the Johns Hopkins University Applied Physics Lab's Kossiakoff Center in Laurel, Maryland. The theme for the symposium is "Icons and Innovation." For more info, visit Center for Cryptologic History (CCH) Symposium (cryptologicfoundation.org)or contact cchevents@nsa.gov.

June 2-3, 2022
The **Society for History in the Federal Government** will hold its annual meeting at the Robert C. Byrd Center for Congressional History and Research at Shepherd University in Shepherdstown, West Virginia. The theme of this year's meeting is "the resiliency of institutions." For registration and other details, see the Society's website at Society for History in the Federal Government - 2022 Annual Meeting (shfg.org).

June 27-1 July, 2022
The **American Institute for Aeronautics and Astronautics** will host its annual Aviation and Aeronautics Forum, which it bills as "the only aviation event that covers the entire integrated spectrum of aviation business, research, development, and technology." The event will occur in Chicago, Illinois and on line. For more details as they become available, see the Institute's website at AIAA AVIATION Forum and Exposition | AIAA.

September 17-18, 2022
The **Air Force Association** will hold its annual meeting and convention at the Gaylord National Resort in National Harbor, Maryland. For registration and schedule particulars, see the Association's website at 2022 National Convention (afa.org).

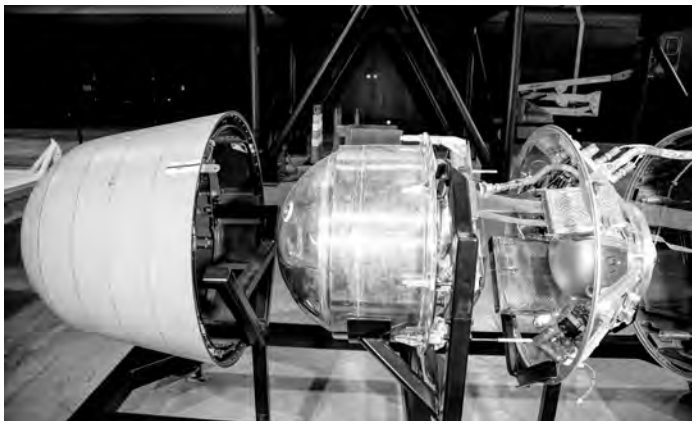
November 7-13, 2022
The **Society for the History of Technology** will hold its annual meeting in New Orleans, Louisiana. For specifics as they become announced, see the Society's website at 2022 SHOT Annual Meeting, 7-13 November, New Orleans (Louisiana) – Society for the History of Technology (SHOT).

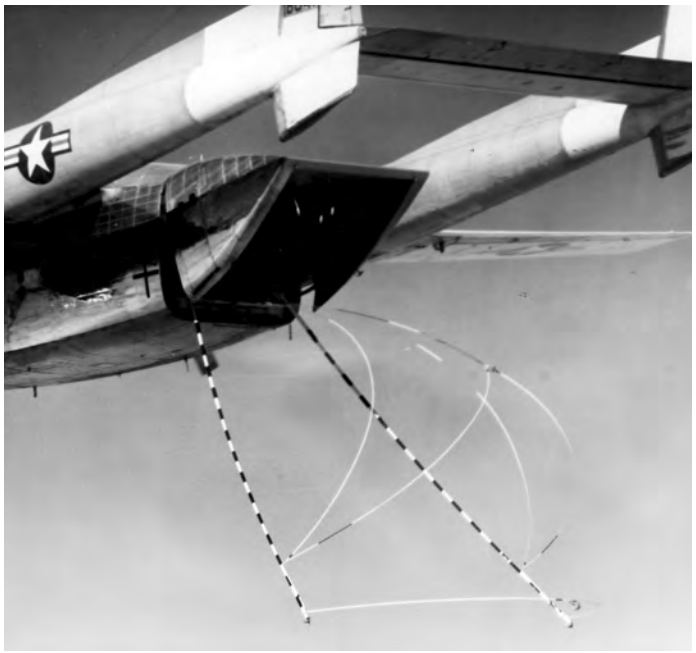
November 17-20, 2022
The **History of Science Society** will hold its annual meeting in Chicago, Illinois. For specifics when they are determined, see the Society's website at Meetings & Events | History of Science Society (hssonline.org).

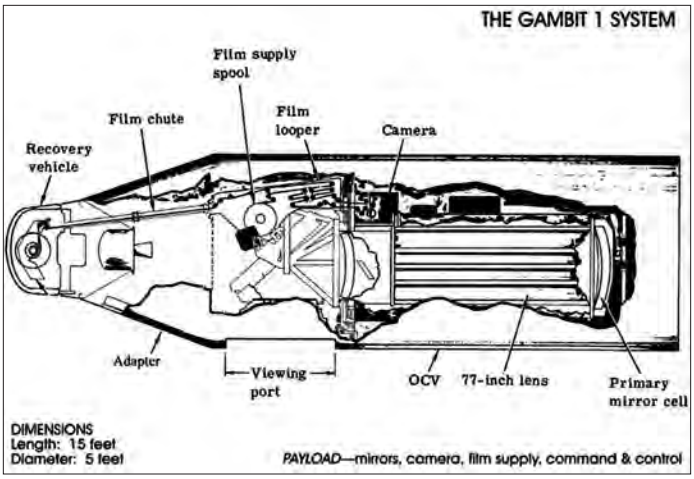
Readers are invited to submit listings of upcoming events Please include the name of the organization, title of the event, dates and location of where it will be held, as well as contact information. Send listings to:

George W. Cully
3300 Evergreen Hill
Montgomery, AL 36106
(334) 277-2165
E-mail: warty@knology.net

History Mystery Answer







The code name for the United States' first overhead imagery satellite is CORONA. CORONA took images on old fashion Kodak-Eastman "wet film." The U.S. used Thor rockets to lift the CORONA satellites into orbit. CORONA took wide area photographs that allowed the U.S. to identify airfields and military bases. After the roll of film was full of images, the film would be dropped from space in a special cannister. At a predetermined height, the recovery cannister would deploy a parachute. A waiting Air Force aircraft (C–119J or C–130) would recover the film cannister in flight over the ocean by snagging the parachute. If the airplane failed to catch the recovery cannister, the water tight cannister would float so that it could then be recovered from the water. After recovery, the film would then be developed and analyzed. Several satellite systems followed CORONA. One follow-on group of satellites are the GAMBIT satellites which are on display at the National Museum of the Air Force. The GAMBIT 1 KH-7 became the first imagery satellite to provide high resolution images of specific targets.

So why can we talk about it today? In 1995 and 2002, Executive Order 12951 declassified almost 1 million of the images (1959-1980) taken by the early imagery satellines. The National Archives now has the declassified film, as well as a viewing copy.

To learn more about the early imagery satellites go to:
Cold War in Space: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195923/cold-war-in-space-top-secret-reconaissance-satellites-revealed/
GAMBIT KH-7 Recon Satellite: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195920/gambit-1-kh-7-reconnaissance-satellite/
GAMBIT KH-7 Film recovery system: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195925/gambit-1-kh-7-film-recovery-vehicle/
The declassified **USGS fact sheet** about CORONA and follow on satellites and images: https://pubs.usgs.gov/fs/2008/3054/pdf/fs2008-3054.pdf

New History Mystery

by Dan Simonsen

This Issue's Quiz: This edition's two-part question relates to reconnaissance, often referred to as "overhead imagery." On May 1, 1960, the Soviet Union shot down Gary Powers' U–2 while he was taking images of various Soviet installations. The shootdown effectively ended four years of overflight reconnaissance missions over the Soviet Union. While the shootdown stopped manned overflight of the Soviet Union, the United States already had begun work to take "overhead imagery to a "higher" level: space. For this edition's questions, what was the code name for the first U.S. reconnaissance satellite system to take images of the Soviet Union and return them to earth? How were the images returned to earth? As a bonus question, name one of the follow-on satellites.

Air Force *Historical* Foundation
P.O. Box 790
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