AIR POWER History

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COVER: F–4D 68795 of the 25th Tactical Fighter Squadron at Ubon, configured with LGBs, on its way to last chance (R), while another F–4D is being checked by maintenance personnel. Note the ECM pod in the Sparrow well, meaning the aircraft received Mod 2147. *(USAF photo via Theo van Geffen.)*

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From the Editor

Our issue this time seems to be split in two, half is about World War II, and half is about Vietnam and some of its hardware.

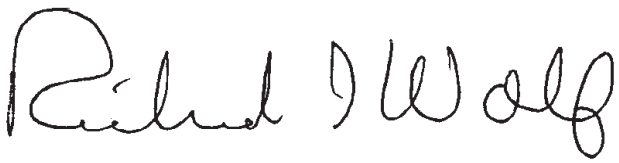
Our first article is the continuation of Theo van Geffen's story of the Thanh Hoa bridge in Vietnam, and all of the work that went in to trying to destroy the span. This segment is about hardware, people, and events.

Our second article is by Robert V. Gates and a very interesting story of the Norden bomb sight from World War II, and the interaction of the U.S. Navy and its Proving Ground in develping and producing that most valuable bit of hardware.

Our third article is by W. Howard Plunkett, and covers the final phase-out of the F–105 Thunderchief. The 1984 "Thud-Out" was a sad occasion for many, and there are some good stories and photos in here.

The final article in this issue is by first-timer David L. Richards, and his fascinating story of how the B–17 was used in the Pacific theater in World War II as a low-level anti-shipping bomber. It's certainly not what the B–17 was designed for.

The President's Message (and State of the Foundation) is on the next page, and Upcoming Events are on page 62. I fear you must take all dates in that section as merely notional at this point. If you see something scheduled, be sure to check with the organization sponsoring the event to ensure it will take place. It's a most uncertain world today. And the closing story is this issue's Mystery. Enjoy!



From the President

President's Message and State of the Foundation

Dear Members,

As we approach a new AFHF fiscal year on June 1, the Foundation has not been immune to the COVID-19 pandemic's impact on American society. Our annual membership meeting and luncheon was postponed, and your Board has transitioned to virtual meetings; fall activities are still very lightly penciled on the calendar. Most importantly, I join other AFHF leaders in wishing you and your families good health and good spirits as we all overcome challenges and recover a sense of normalcy.

In addition to postponing our annual meeting to avoid unnecessary risk to members and participants, these challenges make it sensible to retain the current Board in position until such time when a proper election can be held. We will give you ample notification once a date has been set.

By tradition at the close of each fiscal year the Foundation President delivers a "State of the Foundation Report" to let you all know where we stand, financially and otherwise. In financial terms, your Foundation had a reasonably successful year. Our main goal for 2019-2020 was to solidify our revenue stream, sustaining our ability to seek out and share an accurate and honest account of our Air Force's history. To that end I can report some successes.

I am pleased to report that the Doolittle Awards presentation and Awards Banquet in the fall of 2019 proved to be our most successful ever. Defense industry and other organization financial support was at its highest level in many years, and every seat in the ballroom was sold out, demonstrating the tremendous interest, support and generosity of partners and membership alike. In addition, we were most fortunate to receive a substantial bequest from an unusual veteran who served as a pilot in World War II, Korea, and Vietnam, and was awarded a Distinguished Flying Cross and three Bronze stars for his skill and gallantry. We are proud to have had him as a long-time Foundation member and are grateful to him and his family for their faithful support. Together, these two items mitigated the extraordinary market turbulence of the last few months and have helped keep our financial picture nominal, if not inspirational.

The Foundation again participated in the Air Force Association's Air, Space and Cyber Conference last fall, with a booth featuring books, magazines, and video programs. Our presence was well received by the attendees and suggests that Foundation membership growth potential definitely exists. If conditions permit AFA to host this major event as planned in September, AFHF will be there. Beyond this outreach, we have begun active discussion with leaders in the Department of the Air Force, the Air Force Museum and its Foundation, and the Air Force Association to define ways we can collaborate to support the upcoming 75th Anniversary of the USAF in 2022. Among the potentially unique AFHF contributions under consideration are an update of the "USAF - A Complete History" last published in 2006, and another project yet to be fully scoped.

Our outreach via social media continues its steady growth. We now have over 950 recipients for our daily "This Day in Air Force History" emails, nearly 1,800 Twitter Followers, and Facebook followers reach nearly 5,600 for each post. Our JSTOR archives have been heavily sought during the last few months, reflecting increased scholarly interest. All in all, we are seeing movement toward successful monetization of these efforts in the form of a membership increase in our Associate (online) category. To leverage these and other efforts, we continue to search for both a professional fund raiser and a grant writer to help articulate AFHF's value. Either or both could be highly valuable to us but finding the right fit and price remain elusive.

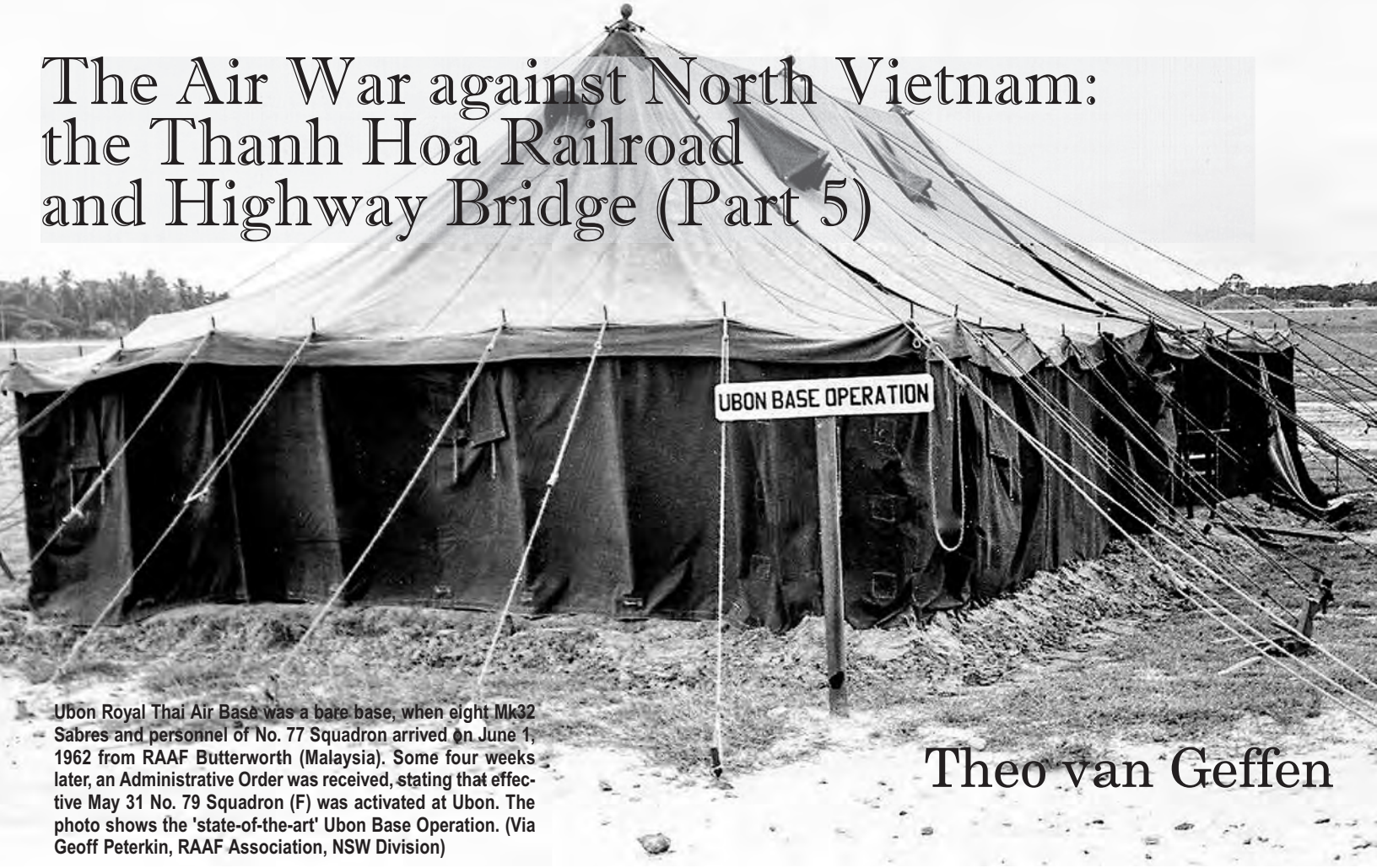
We will soon begin a dialog with leaders of the new U.S. Space Force to determine the scope and nature of AFHF's relationship with the USSF. Continuing airpower's spectacular tradition of innovation—well documented in the pages of our journal—the two Services now belonging to the Department of the Air Force possess a proud shared history and critically important futures to our nation's defense. It's important that the Foundation helps bring the wisdom of the past to the "aerospace" decisions of the future. Our founders, the giants of American air and space power, would expect no less.

I ask for your continued active support—in ideas, time, donations, or just forwarding "This Day in Air Force History" to others who might find the Foundation's work interesting and worthy of support. The day I write this update, my wife and I signed documents including AFHF in our estate planning, and I encourage you to do the same if America's Air Force and its history merit your legacy support. In the meantime, your Board and staff pledge to keep the Foundation on the move and worthy of your interest and investment.

With best regards,

Christopher D. Miller, USAF (Ret.)
President and Chairman of the Board

The Air War against North Vietnam: the Thanh Hoa Railroad and Highway Bridge (Part 5)



Ubon Royal Thai Air Base was a bare base, when eight Mk32 Sabres and personnel of No. 77 Squadron arrived on June 1, 1962 from RAAF Butterworth (Malaysia). Some four weeks later, an Administrative Order was received, stating that effective May 31 No. 79 Squadron (F) was activated at Ubon. The photo shows the 'state-of-the-art' Ubon Base Operation. (Via Geoff Peterkin, RAAF Association, NSW Division)

Theo van Geffen

Due to President Lyndon Johnson's April 1968 bombing restriction, which included Route Package 4 and the Thanh Hoa Bridge, and the November 1, 1968 bombing halt of North Vietnam, the only U.S. strike against the Dragon's Jaw in the 1968 through April 26, 1972 period was the Air Force/Navy strike on January 28, 1968. In the meantime, the 8th Tactical Fighter Wing (TFW) at Ubon Royal Thai Air Base (RTAB) gained quite a bit of experience in employing Laser Guided and Electro-optical Guided Bombs, while North Vietnam well-prepared the Thanh Hoa area for a possible resumption of U.S. air strikes.

Ubon and the Wolf Pack

Ubon RTAB is located forty miles from the Laotian border in eastern Thailand. The USAF had been present as early as July 1962, when Detachment 14, 13th Air Force (13AF) was re-designated as the 6012th Air Base Squadron. There was supposedly an AF radar control unit at Ubon. The Royal Australian Air Force was present as well, as since June 1, 1962 newly reformed No. 79 (F) Squadron had eight Mk32 Sabres stationed at the base, as part of Australia's commitment to the Southeast Asia Treaty Organization (SEATO). Aircraft were placed on alert in July 1965. Personnel were sent to Ubon two months at a time. On July 26, 1968, the Aussies took their Sabres off alert status and closed out their operations on the 31st. As a final salute to the base and the 8th TFW, the Squadron performed a fly past in a figure eight. After arriving at RAAF Butterworth in Malaysia, No. 79 Squadron became a 'name only' unit.

MacDill's 15th Tactical Fighter Wing had two F–4C squadrons performing a TDY at Ubon, the 45th Tactical Fighter Squadron as of April 7, 1965 and the 47th TFS as of July 22. The 45th introduced the F–4C to Southeast Asia (SEA). For some two weeks both Squadrons operated together. The photo shows two 47th TFS maintenance personnel. *(Col Dick Hamilton)*

On April 7, 1965, the 45th Tactical Fighter Squadron (TFS) from MacDill AFB (FL) became the first AF fighter unit that deployed (TDY) to Ubon, while introducing the F–4C Phantom and the SUU-16 20-mm gun pods to Southeast Asia. On December 1, 1965, the 8th TFW initiated its PCS from George AFB (CA) to Ubon, completing the deployment

Both Squadrons had a 'first' while operating from Ubon. On July 10, aircrews of the 45th TFS downed two North Vietnamese MiG–17s with AIM-9 Sidewinders. Fourteen days later, the North Vietnamese took revenge, when they downed Leopard 02 (37599) of the 47th TFS with an SA-2, while damaging the other three F–4Cs in the flight. The photo shows July 10 MiG-17 killer F–4C 40693. Note the many mission markings and the kill marking on the intake. ***(Col Dick Hamilton)***

of TDY units. The Wing brought along the 433rd and 497th TFS, taking over the F–4Cs of the TDY 68th and 431st TFS.

The third fighter unit that was assigned to the 8th, on March 25, 1966, was the 555th TFS, arriving from Naha (Okinawa), but stationed at Udorn. On July 24, the 435th TFS, flying F–104C Starfighters, became the fourth fighter squadron to join the Wing, also stationed at Udorn, resulting in the move of the 555th to Ubon. Their first eight F–4Cs arrived there on July 5.

On January 2, 1967, aircrews of the 8th TFW made history, when they shot down seven North Vietnamese MiG-21s in Operation BOLO, four by 555th TFS and three by 433rd TFS aircrews.

In late May 1967, the 555th introduced the D-version of the F–4 in Southeast Asia (SEA). Concurrently, the phase-out at Ubon of the F–4C was initiated. In the meantime it had been decided to withdraw the F–104Cs from SEA, to PCS the 435th TFS WOPE (Without Personnel and Equipment) to Ubon in late July and re-equip the unit with twenty new F–4Ds. By year's end all four *Wolf Pack* squadrons (433rd *Satan's Angels*, 435th *Eagles*, 497th *Nite Owls*, and 555th *Triple Nickel*) were flying the F–4D.

The arrival of the 25th TFS *Assam Dragons* with F–4Ds at Ubon and assignment to the 8th meant the return of the 555th to Udorn. Starting on May 25, 1968 the move took place in three increments with F–4Ds taking off from Ubon on a combat mission and recovering at their old base. The resulting assignment to the 432nd Tactical Reconnaissance Wing (TRW) was effective June 1.

The assignment, effective October 30, 1968, of the 16th Special Operations Squadron (SOS) with its 8 UE AC–130A Spectre gunships meant a totally different mission for the *Wolf Pack*. The first four aircraft arrived on November 15. The aircraft were later returned to CONUS for the SURPRISE PACKAGE Update modification. However, its KY20A Model Laser Target Designator (LTD) was added after the aircraft had returned to Ubon. The six newer PAVE PRONTO AC–130As arrived with the LTD. It would mark the target for and was compatible with F–4D PAVE PHANTOM and PAVE SWORD aircraft. It was tested and first used in combat on February 3, 1971 when Spectre 12 and its PAVE SWORD F–4D escort successfully destroyed a 37-mm AA gun with an LGB.

The AC–130 fleet was increased with six PAVE SPECTRE AC–130E aircraft. The first E arrived on October 25, 1971, flying its first combat mission on November 2. After the first members of the PAVE AEGIS team arrived at Ubon on February 6, 1972, AC–130E 96574 was equipped with a 105-mm howitzer to replace one of its 40-mm cannons. It flew its first combat sortie on the 24th. On May 12, the Spectre experienced its first encounter with the infrared surface-to-air SA-7 Grail. Five missiles were fired with one

On January 2, 1967, the Wolf Pack commander, Col Robin Olds led his F–4Cs into North Vietnam on Operation BOLO. They made history by shooting down seven North Vietnamese MiG–21s, four by 555th TFS and three by 433rd TFS aircrews. Olds claimed the first of his four MiGs in SEA, two MiG-17s and two MiG-21s. On the May 4, 1967 photo, Olds is adding a MiG kill marking on F–4C 37668, his second MiG–21. ***(Except where noted, all photos by USAF via the author.)***

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. He is the responsible editor for the Foreign News Department of Onze Luchtmacht, *the official magazine of the Royal Netherlands Air Force Association.*

Effective October 30, 1968, the 16th Special Operations Squadron (SOS) with its AC–130A Spectre gunships was assigned to the Wolf Pack. The later addition of the KY20A Model Laser Target Designator enabled the crew to lase the target for F–4D aircraft. AC–130A 50040 returned to Ubon as a PAVE PRONTO-modified gunship on December 22, 1970 and is seen here as such on May 22, 1971.

striking the tail section of the aircraft (96573), forcing the crew to make an emergency landing at Tan Son Nhut.

The 16th SOS was home for the BLACK SPOT Task Force (TF) twice. TF I had arrived with two NC–123K aircraft from Phan Rang on February 3, 1969. Its primary mission was to conduct night interdiction, search and destroy enemy truck convoys. On the night of May 11-12, its last operational mission was completed. The two aircraft, re-designated as AC–123K on April 21, were then returned to CONUS to go through IRAN and modification. Both aircraft arrived back at Ubon on October 28, 1969 as Task Force II. On November 21, operations were begun over Laos. In the July 8-10, 1970 period, TF II began to depart Ubon, this time for good.

On June 30, 1970, the Wolf Pack was authorized 72 F–4D aircraft, while the number assigned totaled 92 with 78 being possessed. Eight Phantoms were at Clark AB in the Philippines for LORAN-D modification. Twelve F–4Ds were configured for the PAVE WAY I (LGB) mission, seven for PAVE WAY II (WALLEYE/EOGB), and twenty-one for the IGLOO WHITE mission. In addition, the Wing was authorized seven AC–130As, with six assigned and three possessed, while two AC–123K aircraft were authorized. The two authorized C–47 transports were recalled by 7/13AF effective July 1.

On October 31, 1970, a sixth combat unit was assigned to the *Wolf Pack*, the 13th Bombardment Squadron, Tactical with eleven B–57G TROPIC MOON III aircraft. Its effectiveness in the night interdiction role had to be determined. It was also to introduce the Mk-82 LGB, becoming the first aircraft in SEA capable of delivering an LGB at night without assistance from a second aircraft. The B–57G flew its first night combat sortie on November 17. The unit lost its first aircraft (33931) on December 12, 1970 during a night sortie near Tchepone in Laos. Its crew was recovered after daybreak. The wreckage was then destroyed by Air Force strikes to prevent the North Vietnamese from enabling to examine the aircraft's equipment. On April 8, 1972, the 13th flew its last combat sortie. The ten B–57 aircraft were flown to Clark. On April 12, the Squadron was moved into a non-operational status until December 24, 1972 when it was PCS-ed WOPE to Clark with assignment to the 405th Fighter Wing.

Because of the heavy burden placed on a single DCO, Deputy Commander for Operations (four F–4D squadrons, plus an AC–130A and a B–57G squadron), the position of Deputy Commander for Bombers and Gunships was added as of January 10, 1971. After the reassignment of the 13th BST, the DCO for Bombers and Gunships became the DCO for Special Operations in June 1972.

At the June 23-25, 1972 Order of the Daedalians national convention at Wright-Patterson AFB, the 8th TFW, winning out over twelve major command units, received the Major General Clements McMullen Weapons Systems Maintenance Award, symbolizing 'the most effective maintenance organization in the Air Force'.

During the second quarter of 1972, the 408th Munitions Maintenance Squadron received information that a new, improved EOGB, known as the Modular Guided Glide Bomb (MGGB), was being developed. It was a Mk-84 EOGB, fitted with a strap-on wing kit for range extension and an autopilot and data link for weapon control. The main differences between the MGGB and the EOGB were the longer standoff distance (in excess of thirty-five nautical miles), mid-course correction capability and lock-on ability while the controlling aircraft was leaving the area. The beginning of the project was scheduled for late June 1972. However, although the MGGB concept was regarded in early 1973, by the Tactical Air Warfare Center at Eglin as feasible, further testing was deemed necessary to prove the system's reliability.

On July 1, 1972, the 8th Organizational Maintenance Squadron (OMS) was activated and assigned to the 8th TFW, combining the maintenance sections of the five flying squadrons into one squadron. Four Branches were created, the F–4D/E, AC–130A/E, Transient Maintenance, and Support Equipment Branch. The TDY F–4Es from Seymour Johnson were also incorporated into the F–4 Branch. With personnel of tenant and TDY units, plus its own personnel, the 8th TFW on July 1 housed over 6,800 people, making the *Wolf Pack* the largest tactical fighter wing in the USAF. Of that number, 555 persons were assigned to the 16th SOS, making it the largest operational combat squadron in the USAF. TDY personnel not only encompassed those of the two Seymour Johnson squadrons, but also ten crewmembers from the 48th TFW at RAF Lakenheath in the UK to augment the Wing's crew shortage.

Units of the *Wolf Pack* began leaving Ubon on July 5, 1974 when the 25th PCS-ed WOPE to Udorn. The 16th SOS moved to Korat on the 19th, the 433rd TFS was inactivated on the 23rd, the 435th on August 6, and the 497th TFS on September 16. The latter was also the date the 8th TFW moved WOPE to Kunsan AB in Korea, replacing the 3rd TFW. The Wing is stationed there to this day.

At noon on June 26, 1975, the U.S. flag at Ubon was lowered for the last time and the base was turned over to the Royal Thai Government. It is home to 211 Squadron *Eagles*, Wing 21, of the Royal Thai Air Force, flying the F–

5E/F Tiger II. The base also has a civilian part, Ubon Ratchathani Airport.

Host

The 8th TFW was also host to units which had no formal relation with the Wing. For example, the 374th Tactical Airlift Wing (Naha Air Base, Okinawa) had an Operating Location (OL-1) at Ubon with 144 personnel, including twelve crews and six C–130A BLIND BAT aircraft.

Due to the congestion at Tan Son Nhut, 7AF requested PACAF to move the Forward Operating Base of the *BIG EYE TASK FORCE* (becoming *COLLEGE EYE* on March 15, 1967) EC–121Ds to Ubon (its Main Operating Base was Tainan Air Station, Taiwan). In early January 1967, the JCS and CINCPAC approved the move. When Col Robin Olds, the 8th TFW commander, learned that *BIG EYE* would move to his base, he made it clear to its commander, Lt Col Waldo Peck, that he did not like the idea of having EC–121s muscle their way in among his Phantoms, taking up ramp space and complicating supply problems. 7AF, however, was determined to reduce congestion at Tan Son Nhut, and the higher headquarters, as always, prevailed. Col Olds accepted the decision and proved a gracious host. In the February 19-21 period, the four Constellations flew a mission from Tan Son Nhut and recovered at Ubon. Due to the arrival of the 25th TFS at Ubon, the Task Force moved to Udorn in late July. As an interim measure, as construction was progressing at Korat for a more permanent home.

Another example was Nakhon Phanom's 23rd Tactical Air Support Squadron which had an Operating Location(OL-1) at Ubon, flying O–2As, OV–10A Broncos and AN/AVQ-13 PAVE NAIL-configured OV-10s. The modified OV–10, with among others an ARN-92 LORAN-D with modified computer and a laser ranger/designator bore-sighted through the PAVE SPOT optics, would be able to search, detect, track, range, and laser designate targets from a standoff position, at night. It would work in conjunction with LORAN/LGB–equipped F–4D aircraft. The 497th TFS participated in the evaluation. On August 15, 1971 the first PAVE NAIL strike mission was flown in Cambodia, with an F–4D being credited with one bridge destroyed as a result of a direct Mk-84 LGB hit with first live bomb dropped using the new system. During the evaluation, a limited adverse weather LGB delivery capability was successfully demonstrated. The most interesting of these missions occurred on August 31, when an F–4D released its weapon above the overcast. As the bomb cleared the clouds, it acquired laser guidance provided by the NAIL FAC in the OV–10, scoring a direct hit. Of the twelve Mk-84Ls released this way, three were direct hits. OL-1 was closed on September 10, 1973.

SEA Testing Center

Col Walter Druen was the 8th Tactical Fighter Wing's Deputy Commander for Operations in the August 21, 1969-June 8, 1970 period. In his End-of-Tour report, Druen stated, among others,

The 16th SOS was home for the BLACK SPOT Task Force (TF) twice. TF II, with two AC–123Ks, returned to Ubon on October 28, 1969 after IRAN and modification in CONUS. On November 21, operations were begun over Laos. In the July 8-10, 1970 period, TF II departed Ubon, this time for good. The February 7, 1969 photo shows still designated NC–123K 40698 four days after its arrival from Phan Rang AB to begin its first assignment at Ubon.

Missions flown by the Wolf Pack F–4Ds included strike, seeding, SAR, sensor drops, all-weather bombing, Spectre escort, sensor strike, and Forward Air Control (FAC). In addition, the development, testing and employment of sophisticated weapons and systems made my job like a 'Southeast Asia Testing Center'.

Col Druen referred to the following systems:

COMBAT EAGLE

The introduction and combat evaluation in July 1967 by the 435th TFS of the Mk-1 Mod O Walleye glide bomb (AGM-62A), USAF's first 'smart' bomb, in SEA. Four specially configured F–4Ds were assigned for this purpose and the first two sorties were flown on August 24 against a dock at the Quang Khe Ferry in North Vietnam.

PAVE WAY I Laser Guided Bombs

May 14, 1968 saw the arrival of the PAVE WAY I Task Force at Ubon with four AN/AVQ-9 'ZOT' illuminator-configured WHITE LIGHTNING F–4D aircraft, which were initially incorporated into the 497th TFS.

ZOT was a very simple system. The designator was in two pieces and partly attached to the canopy and on the canopy rail on the back seater's left side. It included a 4-power scope with crosshairs used to acquire the target and aim the laser. ZOT also had a joystick that allowed the GIB, Guy in Back (initially a GIB was also a pilot. Later on, most were upgraded to AC, Aircraft Commander, with the Weapon Systems Officer, WSO, also called WIZZO, being introduced), to center the crosshairs on the target and a red-guarded switch to toggle on/off the laser. The GIB would hear a pulsed tone in his headset when the laser was firing. This proved to be ideal to locate fleeting targets of opportunity. The Aircraft Commander would fly in a left hand circle anywhere from 12,000 down to 5,000 feet altitude, enabling the GIB to aim and fire the laser. The bombers would fly above the WHITE LIGHTNING F–4D

at around 20,000 feet and roll in on the call of the illuminator's crew and pickle off the LGB at around 12,000 feet. The system was very effective in its ability to illuminate small or camouflaged targets which could not be located with the newer PAVE KNIFE system. Limitations were the vulnerability of the illuminator and the inability of lasing for its own ordnance. Evaluated were the KMU-342/B M-117, KMU-351/B Mk-84 and in October 1969 the KMU-370A/B M-118 laser guidance kits.

In January 1970, eight additional aircraft arrived at Ubon, bringing the total number to eleven. One of the original four F–4D WHITE LIGHTNING aircraft, 68814, was lost on March 1, 1969. January 1970 also saw the arrival of the new YAG PAVE WAY IA (AN/AVQ-9A) laser package, which operated with a narrower beam with higher power output, providing more accuracy. This brought the number of ZOT systems to seven AN/AVQ-9 and eight AN/AVQ-9A systems.

In an effort to increase utilization of the ZOT/WHITE LIGHTNING aircraft, the concept of the 'floating' illuminator was introduced in December 1970. Under this concept, one WHITE LIGHTNING F–4D would launch to the target area, carrying no munitions and maximum fuel. When things went according plan, there would be a mid-strike KC–135A available to the illuminator. It would be followed at appropriate intervals by four conventional F–4 aircraft, each configured with four LGBs. The illuminator then provided the guidance for the LGBs. In this manner, up to eight times more guided ordnance was delivered than had been possible before.

LORAN-D / MUSCLE SHOALS

The Project involved the deployment of the 25th TFS to Ubon to take on the full delivery responsibilities from for instance Navy OP-2E Neptunes and the six F–4Ds of the 497th TFS, which were configured to drop ADSIDs, Air-Delivered Seismic Intrusion Detectors (vibration detectors). The mission was to place sophisticated seismic and acoustic sensors, as well as anti-vehicular and CBU-28 Dragontooth anti-personnel mines along hostile Lines of Communications and staging areas in Laos, and both Vietnams. Due to the nature of the ordnance delivered and the modes used, the aircrews were required to operate their Phantoms at low altitude in a level maneuver over heavily defended high threat areas. In addition, the Squadron would provide integral flak suppression for all IGLOO WHITE sorties. The Squadron arrived at Ubon on May 30, 1968 and was assigned to the 8th TFW. After checkout by the 497th TFS, the *Assam Dragons* flew their first IGLOO WHITE sensor dropping mission on June 25. With, initially, fourteen lead crews qualified, the Squadron assumed the entire IGLOO WHITE commitment five days later.

LORAN-D

The 25th, arriving with twenty F–4Ds that were configured with AN/ARN-92 LORAN-D sets, was levied with its combat evaluation and tactics development. However, the majority of the sets were installed in the aircraft within two weeks of the departure date. Therefore all sets were unqualified and many aircraft had not received a complete LORAN check-out, resulting in a low reliability. This had improved by the end of 1968 after more LORAN sets had become available thanks to better parts support and contracted technicians to keep sets operationally ready, allowing the *Assam Dragons* to achieve a milestone in the validation of LORAN. This resulted in the granting of permission to drop sensors using this method, the first time on November 12, 1968.

On October 31, 1970, a sixth combat unit was assigned to the Wolf Pack, the 13th Bombardment Squadron, Tactical with eleven B-57G TROPIC MOON III aircraft. The aircraft flew its first night combat sortie on November 17, 1970 and its final sortie on April 8, 1972. B–57G 33929/FK shows off its (external) armament, two Mk-82 LGBs, in its Ubon revetment.

A notable accomplishment was scored by the Squadron when on January 29, 1969, an F–4D made the first successful bomb delivery, using LORAN. In the first quarter, the 25th TFS had all its F–4Ds equipped with LORAN, the first time since arriving at Ubon. New sets, called Baseline, arrived at Ubon in February with the first set installed and operational on the 20th. By March 31, ten aircraft had been equipped, while the remaining ten Phantoms were still fitted with the older pre-Baseline sets.

As the original LORAN fin cap antenna had caused frequent break-locks in weather and/or a maneuvering environment, relevant F–4Ds were configured with the Chelton towel bar antennas through TCTO 1F–4D-533, with the first Phantom completed in September 1969. Seven towel bars were installed in the first quarter of 1970, completing the entire LORAN-equipped fleet. The new antenna and a complete retrofit with reliability modifications of all aircraft by the LORAN Section of the 8th Avionics Maintenance Squadron in the second quarter increased reliability into the high nineties.

PAVE PHANTOM

Initially, a tactic had been developed to deliver bombs and CBUs on a selected target by preplanning a release point. However, this limited the aircrew to bombing on a single run-in heading, altitude and airspeed. To tackle this, and in response to 7AF Combat Required Operational Capability (CROC) 6-70 (a requirement for improved adverse-weather weapon delivery accuracy), Lear Siegler Inc. produced a modification to the computer, which would allow

the aircrew to select the target and the computer would then continuously compute the release point. The modified computer would provide two modes of steering, ADF and fixed course. The new equipment would also include a modified control indicator and a new weapon delivery data insertion panel, permitting the aircrew to insert into the computer the weapon type, ejection velocity, release advance, and target elevation. For instance, when an AC–130A would detect a lucrative target, the approximate LORAN coordinates were to be passed to the fighter's crew to insert them into their own LORAN system. This would enable them to release their LGB into a 'basket', in which the weapon could detect the Spectre's laser beam and guide to the target.

After the Defense Communications Planning Group (DCGP) had tasked the Air Force to upgrade the F–4D aircraft of the 25th TFS with the PAVE PHANTOM modification, the first eight of its aircraft were sent to Clark AB in the Philippines in the April-June 1970 period. It was a Class V modification, accomplished by depot personnel and completed in late November. In addition, the DCGP tasked the USAF to equip an additional squadron at Ubon, the 497th TFS, with twenty airframes to be obtained from other F–4D units in SEA and to be configured with Mod 2038D, the basic LORAN modification. In the July-September 1970 period, all 497th crews attended LORAN briefings and flew LORAN training sorties prior to making actual bomb drops. Until they received their own aircraft, the *Night Owls* used aircraft of the 25th to lead the so-called LORAN FLASHER missions. Two additional '2038D' aircraft each were to be assigned to the 433rd and 435th TFS.

Subsequent DCGP action added another 23 F–4D aircraft, for a total of 67, with a planned modification completion date of June 7, 1971. Modification 2038D made a straight F–4D into a LORAN aircraft; 2038T made a LORAN-modified F–4D into a PAVE PHANTOM-capable aircraft; and modification 2038D/T was to take a straight F–4D to the PAVE PHANTOM/LORAN configuration.

On August 4, 1970, the PAVE PHANTOM LORAN system was introduced at Ubon by the 25th TFS when its first modified F–4D aircraft arrived from Clark.
As only limited Operational Testing & Evaluation had been accomplished at Eglin, it was essential to also conduct an OT&E in the combat environment to develop and refine operational procedures. The 25th TFS would play a major role. Based on 7AF OPORD 70-11, a test program, OT&E 70-11, was designed by the Wing's Stan/Eval and Tactics Division. Due to delays in the installation of a receiver reliability modification and inclement weather, the estimated starting date of October 1 could not be met. Phase I, encompassing the entire concept of bombing in SEA, was initiated on November 3 with the first mission. The final sortie was flown on November 27. Phase I was followed by Phase II with objectives those as indicated in 7AF OPORD 70-11 as amended.

In December, plans were made to implement Phase II. Two F–4Ds would be fragged each day on a single target with one aircraft using SENTINEL LOCK (computer-derived) LORAN coordinates and the other COMBAT THUNDER (photo interpreter-developed) coordinates. The most important objective was the evaluation of the two new LORAN targeting systems, with both accuracy and responsiveness being tested. Both had been developed to increase capability, flexibility, and accuracy of LORAN bombing and were new to the theater.

Phase II began on January 26, 1971. A total of 32 sorties were scored by using either the ADF (Homing) or Fixed Course mode. The Homing mode was considered to be more accurate and easier to fly than the Fixed Course mode as it permitted an attack on random heading with minimum straight and level time before release. Testing was completed in the final quarter of 1971.

PAVE WAY II

As of January 17, 1969, the 435th TFS *Eagles* added a new mission to its Walleye mission, the combat testing of the PAVE WAY II Mk-84 Electro-optical Guided Bomb (EOGB).

In February and March 1971, an Eglin contract team at Ubon increased the number of EOGB–configured F–4Ds from seven to twelve. The modification, TCTO 12P2-2APQ109-525, consisted of the installation of a 5-inch Sony television set in the aft cockpit of the twelve aircraft. The new set significantly improved the standoff capability of the EOGB by providing a greatly increased video presentation in the cockpit. The original seven aircraft now had a radar picture in the front cockpit and both a radar and the Sony TV picture in the rear cockpit. The five 'new' aircraft only had the Sony TV scope in the rear cockpit.

Col Donald Stanfield was Commander of the *Wolf Pack* from May 6 1969 to May 6, 1970. In his End-of-Tour report he stated with respect to PAVE WAY II, among others,

Should the decision to resume bombing North Vietnam ever be made, the PAVE WAY II will be the most valuable weapon excluding nuclear weapons presently available. It is phenomenally accurate and has an outstanding standoff

When Col Olds learned in early January 1967 about Seventh Air Force wanting to move the Forward Operating Base for the EC-121D BIG EYE/COLLEGE EYE Task Force from Tan Son Nhut to his base due to congestion at the former, he made it clear to its commander, Lt Col Waldo Peck, that he did not like the idea of having EC-121s muscle their way in among his Phantoms, taking up ramp space and complicating supply problems. However, 7AF persisted and (of course!) prevailed. Col Olds accepted the decision and proved a gracious host. The 1967 photo shows an EC-121D in flight over South Vietnam.

capability, which will result in lower loss rates in high threat areas. I am certain a flight of four ECM-equipped F–4Ds armed with PAVE WAY IIs, flying in ECM pod formation, could successfully disable the Doumer Bridge by knocking down one or more abutments.

The Colonel must have been looking into the future when writing down these thoughts….

PAVE SWORD

In an attempt to improve the Air Force night capability, the initial deployment of five AN/AVQ-14 PAVE SWORD passive laser seeker pods to Ubon took place on November 23, 1970 for combat evaluation. The pod could detect the LTD of the AC–130 gunship and give the crew of the PAVE SWORD-configured F–4D steering information to the release 'basket'. The LGB was then released in the basket and guided to the target on the gunship's LTD beam.

In December, the pods were mounted in the right forward AIM-7 missile well of five F–4D aircraft. The first (day) combat evaluation mission was flown on February 3, 1971, Cash flight of three Phantoms escorting Spectre 12. The Cash aircrews were the original SWORD checkout crews. During its first period with the AC–130, a 37-mm gun fired at the Spectre which its crew was able to pinpoint. They then lased the gun pit and at the same time fired their 20-mm guns at it so that Cash 02 would have a ground reference for rolling in. He then rolled in on the mark using dive toss delivery and SWORD steering needles. The released Mk-84L fell directly into the gun pit destroying it, the first kill for the SWORD. By late February, the Wing had four F–4D PAVE SWORD qualified aircrews, five operational aircraft with four on station, plus four operational pods. 7/13AF approved a 30-day extension of theater clearance for the contractor installation/maintenance team, while 7AF authorized to bring the remaining seven AN/AVQ-14 PAVE SWORD pods into the theater. The team would assist in the aircraft modification and be available to reconcile any PAVE SWORD-oriented problems that might occur. The program was not used again until late March 1971, when 7AF once again fragged PAVE SWORD sorties, 2-4 sorties per night.

PAVE KNIFE

Yet another system that was introduced and evaluated by the 8th TFW was the AN/AVQ-10 PAVE KNIFE pod. It was very similar to the laser designator of the AC–130 gunship. It utilized a LLLTV, Low-Light Level Television, with a steerable laser bore-sighted to the LLLTV's crosshairs. It allowed for self-delivery of LGBs in high threat areas by a single F–4D Phantom, but it could also be used to illuminate targets for other aircraft. PAVE KNIFE eliminated the rather undesirable pylon turn required by WHITE LIGHTNING aircraft. The pod, roughly banana-shaped, was carried on the left inboard pylon of the aircraft. The illuminator aircraft was usually flown with three other aircraft in the flight. After the target had been found, it would be depicted on a scope in the rear cockpit of the KNIFE-configured F–4D. Resolution was depicted in fourteen different shades of green. The Weapon Systems Officer (WSO, or WIZZO) controlled the movements of the pod with a hand controller, which could look through a full 360 degrees longitudinally and almost 180 degrees forward vertically. The KNIFE-configured F–4D could roll in on a target in a 45 degree dive from usually 20,000 feet or so and pickle off the Mk-84 EOGB at around 12,000 feet. The laser could track the target during the dive and up to 5-G pullout. It required a great deal of skill on the part of the WSO to operate the system.

Combat Required Operational Capability (CROC) 25-70 was to modify fifteen straight OV–10A Broncos with among others ARN-92 LORAN-D with a modified computer and a laser ranger/designator. An OV–10 PAVE NAIL aircraft would be able to search, detect, track, range, and laser designate targets from a standoff position, at night. It would work in conjunction with LORAN/LGB-equipped F–4D aircraft of the 8th TFW. OV–10A 67-14695 of the 23rd Tactical Air Support Squadron, which had an Operating Location at Ubon, on this November 1971 photo carries a laser designator pod under its fuselage.

In early March 1971, maintenance personnel, evaluation team members, three PAVE KNIFE systems and three Class V 2404-modified F–4Ds arrived at Ubon for the 433rd TFS. However, the aircraft lacked APS-107 Group B components. This restricted their use to permissive environments, seriously impairing the combat evaluation. In the first PAVE KNIFE status report of March 14, the Wing's DCO, Col William Baxter, requested this equipment to be expeditiously shipped to Ubon with the remaining three aircraft to arrive with the full APS-107 installed. On the 31st, installation of RHAW equipment was still in progress.

The first combat evaluation sortie was flown on March 17 and the final and 104th one on April 28, 1971. One of the missions was flown on March 31 by Brushy flight of two F–4Ds, using both self-illuminated and buddy-type deliveries. Direct Mk-84L hits were scored on an IDP in STEEL TIGER through a FAC, Covey 540.

It had been proven that during the periods of dawn and dusk, the old PAVE KNIFE Videcon camera tube was ineffective due to its inability to withstand the intense light emitted during the blast from M-118 and Mk-84 LGB ordnance. In the October-December 1971 period, the 433rd TFS became involved in an operational test of the new LLLTV camera, designed to prove the effectiveness of the new Silicon camera tube. The result showed that the new

The Mk-1 Mod 0 Walleye glide bomb (AGM-62A) was USAF's first 'smart weapon'. Combat evaluation was accomplished by the 435th TFS with the first two sorties flown on August 24, 1967. USAF F–4Ds expended a total of 232 Walleyes in SEA, of which 103 in North Vietnam (the last four in October 1968) and 129 in Laos (the final one in May 1970). This is a confusing photo because (1) the tail number is incorrect and (2) the 433rd TFS Satan's Angels (FG tail code) did not fly the COMBAT EAGLE/WALLEYE mission. ***(Via Norm Taylor)***

tube was far superior to the previous unit and vastly improved LLLTV camera usage.

WOLF FAC

8TFW Operations Plan (OPlan) 61-69 of December 18, 1968, 'WOLF' established the WOLF Forward Air Controller (FAC). The mission was to collect intel through visual reconnaissance in designated areas of operations. In addition, WOLF FAC missions might, among others, direct air strikes to destroy lucrative targets and assist in SAR operations. The WOLF FAC bridged the gap between night and day operations and was invaluable to other FACs and controlling agencies. Four sorties per day were flown. The seven aircrews worked in a Division under the Deputy of Operations and were all highly qualified volunteers, who stayed administratively assigned to their units. They had an average of over 100 combat sorties in SEA before becoming a FAC and flew WOLF FAC sorties for a period of six months. One officer was Officer in Charge. Aircraft were supplied by the F–4 squadrons. WOLF FACs working with PAVE WAY I-configured F–4Ds proved to be a very effective team working against AAA targets. The Wing disbanded the program on November 6, 1971 as a Division under the DCO with aircrews returning to their respective squadrons. However, 7AF continued to frag the *Wolf Pack* for fast FAC missions, which were flown then by the qualified high-speed FAC crews and aircraft from each of the squadrons.

However, on July 15, 1972 the WOLF FACs formally became self-autonomous under the Deputy Commander of Operations. During the July- September period, an average of six four-hour missions a day were flown in RP 1 and Military Region I in northern South Vietnam.

Wolf Pack Losses in SEA

Category	F–4C/D/E	AC–130A/E	Total
Total aircraft	159 (20)	8	167
MIA/KIA	103 (12)	69	172
POWs	57 (6)	0	57

(WOLF statistics are in parentheses.)

The final WOLF FAC mission was flown on June 17, 1973. It was a SAR effort to recover WOLF FACs Capt Samuel Cornelius (336th TFS) and 1Lt John Smallwood (58th TFS) who were lost the previous day on a mission in Cambodia in an F–4E. They were not recovered and declared KIA on October 4, 1979. They were the final aircrew losses of the 8th TFW in Southeast Asia.

OWL FAC

The 8th TFW also instituted a night FAC concept, the OWL FAC, on October 18, 1969. Its specific objective was to keep key interdiction points in high threat areas closed to traffic throughout the night. The fast moving OWL FAC mission, assigned to the 497th TFS *Nite Owls*, proved to be one of the most challenging and difficult air missions performed in SEA.

The OWL FAC, closely operating with OV-10 NAIL FACs and TROPIC MOON III B–57Gs, proved very successful in all phases, with LORAN playing an important part. Squadron F–4Ds dropped their own ordnance and FAC–ed for numerous other aircraft. The initial phase continued until March 20, 1971 with a total of 311 sorties flown. Suspension (the Squadron added the word 'reluctant') was the result of the arrival of more AC–130A aircraft and the subsequent total backing of the Spectre's night effort by all Wing resources.

The first part of August 1972 saw the beginning of nighttime bombing of North Vietnamese targets. The force consisted of two 497th TFS OWL FAC strike leaders, two strike flights, and one spare of each type. The strike force stood by while a lone NIGHT OWL flew a weather recce mission into RP 6. This prevented many unsuccessful launches. On two earlier occasions, the strike force had partially ingressed into RP 6, when the lead OWL found the target weather unworkable and discontinued the mission as the frag lacked a secondary target. This was remedied on August 11, when secondary and tertiary targets were added to the frag. The primary and secondary targets were unworkable due to weather, but the tertiary target, the runway at Vinh, was relatively clear. The mission had begun in a tragic manner, as Banyan 03 crashed shortly after takeoff, killing its crew. In addition, both OWL FAC strike leaders aborted. The spare OWL crew, 1Lt Gordie Tushek and Capt Narmore directed the strike force to deliver their ordnance.

On August 18, the weather in RP 6 finally broke and the Xuan Mai military barracks and training area seventeen miles southwest of Hanoi was struck. The 497th TFS crew in the first FAC F–4D, Owl 11, flared the target, while the second, Owl 12, marked the target with rockets. The strike aircraft of Banyan flight were in two two-ship formation with the first formation hitting the target with high-drag bombs from low altitude, low angle deliveries. The second two-ship was ordered to turn back. BDA did not come available as the Udorn RF–4C recce airplane assigned to photograph the target was shot down the next day by an SA-2.

On September 16, the first 'Hunter-Killer' operation was launched by the 435th and 497th TFS within the OWL

FAC program. One F–4 was accompanied by a strike aircraft that also had the OWL call sign. The latter aircraft would accompany the OWL FAC throughout three working periods, refueled with him and held in the area when the FAC expended arriving strike flights. The value of the program occurred when the FAC located a target when no strike flights were around. Then, the FAC could call in his 'killer' aircraft to immediately strike the target.

Single specialty

In the final quarter of 1968, the four F–4D squadrons at Ubon were responsible for the following specific weapon systems:
25th TFS, IGLOO WHITE;
433rd TFS, PAVE WAY I;
435th TFS, WALLEYE, PAVE WAY II and III (III was the Infrared Guided Bomb, which was not employed in SEA);
497th TFS, was USAF's only tactical squadron dedicated to night operations.

In addition, a score of other missions were flown by the Phantoms. They included, among others, Search and Rescue, COMMANDO NAIL radar bombing, COMBAT SKYSPOT ground radar-controlled bombing, B–52 escort during ARC LIGHT missions, AC–130, AC–119 and RF–4C escort, pathfinder and (FLASHER night) LORAN bombing.

May 14, 1968 saw the arrival of the PAVE WAY I Task Force at Ubon with four AN/AVQ-9 'ZOT' illuminator-configured WHITE LIGHTNING F–4D aircraft. The Guy in Back's (GIB) office was kind of cramped with the two pieces of the ZOT designator attached to the canopy and on the canopy rail. The ZOT was needed to lase for F–4Ds which would act as bombers to drop M-117, M-118 and Mk-84 Laser Guided Bombs. According to GIB Bill Wideman he had no problem getting in and out of the cockpit under normal circumstances, so he doubted it would be difficult to get out in a ground emergency. He did not know if anyone ever ejected from a ZOT-configured aircraft, but the equipment was out of the way, so there should not have been a problem ejecting.

Effectiveness

These specialties were maintained through September 30, 1971. To increase the effectiveness of the Wing's fighter squadrons and to provide the capability for each to support all contingencies of operations, a study was completed in September, which identified the initial training requirements. This resulted in the October 1 initiation of Phase I of Operation COMBAT CROSS TRAINING. Selected aircrews from each of the F–4D squadrons were sent to another specialty squadron to cross-train into that particular squadron's specialty. For example, by November 13, the 25th TFS had trained eight crews from each of the other three squadrons in IGLOO WHITE missions. Two of their crews had been trained by the 433rd TFS in PAVE WAY I and PAVE KNIFE, while one crew had been trained by the 435th TFS in PAVE WAY II. Once the aircrews had become proficient, they would train other squadron crews in that specific specialty. The program also resulted in specially-configured F–4D aircraft being exchanged among the squadrons. For instance, the 25th obtained PAVE WAY I and II, and PAVE KNIFE-configured aircraft. The 497th TFS traded nine of their LORAN birds for eight 'dumb' bombers. Phase I was completed by December 1, meaning each of the F–4D units could (1) implant sensors, (2) illuminate for LGBs, (3) fly high-speed FAC missions, and (4) had LORAN capabilities.

At the end of the quarter, the program had achieved its purpose, resulting in Phase II being implemented on February 1, 1972. It was designed to further increase aircrew mission effectiveness. After each squadron had become capable of carrying out all of the different types of missions, it was assigned a time block during which most of their missions were flown. For instance, the 435th TFS was assigned the late, night time block (17:00-05:00), and therefore had to transition from a day to a night schedule. The 497th TFS shared the same time block.

1972, first quarter

By late 1971, the Air Force's overall tactical strike force in Southeast Asia had decreased from 535 to about 375 aircraft, of which 198 UE aircraft in eleven fighter squadrons. From a peak of over 100 B–52 aircraft in the Western Pacific in early 1969, the number had declined to fifty-one, eight at Andersen AFB at Guam as a SIOP alert force and forty-three (all Ds) at U-Tapao RTAB.

Earlier, as CINCPAC had believed that contingencies could arise, requiring additional sortie capability, PACAF had been directed to plan the augmentation of tactical air units in Thailand. PACAF's reaction was the preparation of an Operational Plan, OPlan C–101, COMMANDO FLASH. The unit involved was the 523rd TFS of Clark's 405th Fighter Wing. On December 29, the JCS authorized CINCPAC to implement C–101. One day later, two each F–

The 25th TFS Assam Dragons arrived at Ubon on May 30, 1968 with their F–4Ds. Their IGLOO WHITE mission was to place sophisticated seismic and acoustic sensors, as well as anti-vehicular and CBU-28 Dragontooth anti-personnel mines along hostile Lines of Communications and staging areas in Laos, and both Vietnams. AN/ARN-92 LORAN-D modified F–4D 68784/FA, 'Flipper of the Sky', is configured with ADSIDs, Air-Delivered Seismic Intrusion Detectors, and Mk-82 daisy cutters. Note that the aircraft has not yet received the Chelton towel bar.

4D aircraft, aircrews and support personnel were in place at Da Nang, Ubon and Udorn.

By late January, it had become clear that the North Vietnamese buildup in Route Package (RP) 1 and the South Vietnamese border areas had become even a more serious threat to friendly forces. For instance, on February 3, photo reconnaissance revealed tanks and 130-mm guns just north of the Demilitarized Zone (DMZ). A major ground offensive could not be ruled out. CINCPAC supported COMUSMACV's urgent request for more authorizations necessary to counter the buildup and expected offensive. The JCS responded quickly as on January 26, it outlined five expanded authorizations, to become effective upon the start of a North Vietnamese offensive.

However, developments in SEA soon indicated that additional tactical air power augmentation might be required beyond that of COMMANDO FLASH. As a result, PACAF prepared a second OPlan, #103, COMMANDO FLY. On March 16, JCS authorized the TDY deployment of eighteen F–4D aircraft (of the 35th TFS, Kunsan AB, ROK) to, initially, Clark. After the North Vietnamese initiated their offensive, JCS issued the execution order. PACAF then directed 13AF to deploy personnel and F–4D aircraft, nine to Da Nang and nine to Ubon, closing on April 3.

As directed by the Joint Chiefs of Staff, the Strategic Air Command began sending large numbers of B–52s to Andersen and U-Tapao and of KC–135s to U-Tapao, Andersen and Kadena. ARC LIGHT sorties from Andersen were re-initiated on February 14. After the six BULLET SHOT deployments were completed, 8th Air Force had a total of 204 B–52s assigned, more than half of SAC's Stratofortress fleet: fifty-one Ds at U-Tapao, and fifty-five Ds and 98 B–52Gs at Andersen. In addition, the number of KC–135A Stratotankers was increased from thirty to 168 with forty-six of stationed at U-Tapao and fifty-four at Kadena.

In the meantime, the Protective Reaction Strikes (PRS) against North Vietnamese AAA, SA-2 and emitting threat radar installations had continued. On March 19, the Air Force and Navy conducted their 100th PRS of 1972. On the night of March 29, the North Vietnamese began the heaviest artillery barrage since the 1968 Tet offensive against eight South Vietnamese fire support bases between Khe Sanh and Quang Tri along the DMZ, followed the next day by a drive across the DMZ by an estimated 80,000 troops with tanks and heavy artillery.

1972, second quarter, April

Realizing the danger, the JCS, on April 5, directed CSAF to immediately deploy one CONUS-based F–105G squadron to Korat and two CONUS-based F–4 squadrons to bases in Thailand, to be identified later. CSAF then directed TAC to effect deployment as soon as possible, and also prepare four more EB–66s (in addition to the four previously approved) for deployment to Korat. The unclassified nickname CONSTANT GUARD was assigned. About nine hours later, the units to be deployed had been identified. One day later, TAC issued Frag Order 72-3 to OPlan 100 (CONSTANT GUARD), directing CONSTANT GUARD I. Ultimately, CONSTANT GUARD would be implemented in five increments between April 9 and October 15, 1972. Aircraft types involved were A-7D, F–105F/G, F–4D/E, F–111A, C–130E, and EB–66C/E aircraft.

After all options had been weighed, PACAF in its April 8/2015Z message informed Pacific Command et all that it had revised its earlier bed-down of the augmentation forces as follows: (1) to re-establish the 523rd and 35th TFS under their normal commands by reconstituting the parts of the units at Udorn (from Ubon and Da Nang) and Da Nang (from Ubon) and attaching them to the 432nd TRW and 366th TFW respectively; (2) to deploy the 334th and 336th TFS from Seymour Johnson (NC) to Ubon; and (3) to deploy aircraft of the 561st TFS and 39th Tactical Electronics Warfare Squadron (TEWS) to Korat, from McConnell (KS) and Shaw (SC) respectively. All based on the premise of the move of the B–57Gs from Ubon to Clark and of the seven EC–130E ABCCC aircraft from Udorn to Korat. Both were effected.

The 334th TFS *Eagles* arrived with eighteen F–4Es at Ubon on April 11, the 336th *Rocketeers* one day later, also with eighteen aircraft, together with about 1,100 personnel, which were integrated into the logistic organization of the 8th TFW. Aircrews received two days of local orientation/indoctrination training by the local F–4D squadrons. Although initially attempts were made to schedule TDY aircrews to fly their own aircraft, increased sortie rates dictated the scheduling of aircraft to provide greatest utilization. For instance, Chip Luyendyk of the 25th TFS flew nine of his sorties in an F–4E. On April 14, Maj Clarence Friesel, Assistant Operations Officer for the 334th, became the very first crewmember of the two squadrons to fly a combat sortie. His WIZZO was a member of the 8th TFW. During LINEBACKER I, the WOLF PACK would not provide escort or MIGCAP sorties, while the chaff dispensing role was largely delegated to the two F–4E squadrons. In addition, a number of 334th TFS GIBs began training in

LORAN-equipped F–4Ds on April 27, while two days later, Capts Lee Alton and Pete Kulzer started flying in the WOLF FAC program. However, six days later, Kulzer's F–4 was hit by an SA-7 Strela near Quang Tri in South Vietnam. The crew had to eject and was recovered later that day.

The 334th TFS was replaced by the 335th *Chiefs* on July 8, although only personnel was involved. 334th personnel did not stay home long, as on September 25 they were back at Ubon to replace the 336th TFS.

FREEDOM Series

Freedom Train

April 6 was the first time since November 1968 that strikes against targets south of 20°N in North Vietnam were resumed on a continuing basis. The initiating operation was called OPERATION FREEDOM TRAIN. One of the objectives was the reduction of the SA-2 missile threat in RP 1, Laos and Military Region (MR) I in northern South Vietnam. SAM Strike Teams (SST) consisting of Korat F–105F/G and F–4E aircraft were used to strike the sites. During the quarter, the number of confirmed SA-2 sites in RP 1 was reduced by the SSTs from twelve to zero.

In conjunction herewith, a number of strike operations were conducted against key targets north of 20°. The first strikes were flown on the 9th by six U-Tapao B–52Ds which struck the Vinh Railroad Yard and by a similar number of B–52Ds, striking the Vinh Petroleum Products Storage (PPS). Fifteen minutes prior to the B–52's TOT, twenty F–4s, led by the 497th TFS, each with twenty-four M-129E1 leaflet bombs configured with QRC–530 chaff, laid a chaff corridor on the bomb run and egress route over the Gulf of Tonkin to help conceal the striking force from SAMs. The mission was a success with ten of the twelve BUFFs hitting their target within 500 feet of the briefed position.

Freedom Dawn

FREEDOM DAWN was a coordinated plan for a one-time strike on April 12 against targets in the Than Hoa-Bai Thuong area by twenty-four B–52Ds. Targets in order of priority were the Bai Thuong Airfield, Thanh Hoa PPS North, Thanh Hoa Thermal Power Plant (TPP), Thanh Hoa RR&HW Bridge, and the Ham Rong Transshipment Point (TSP) West. The JCS later changed the original execution order by directing that eighteen BUFFs were to strike Bai Thuong Airfield. Two Navy A-6 Intruders struck SAM site VN 607 in the Thanh Hoa area as a diversion twenty minutes prior to the B–52 strike. Twenty F–4s sowed a chaff corridor prior to the B–52 strikes.

Freedom Porch

Other Operations included FREEDOM PORCH on April 15 with a night strike by B–52s against the storage and supply areas at Haiphong; FREEDOM PORCH BRAVO, on the 16th, a one-day integrated B–52, USAF and Navy TACAIR strike effort against selected logistic targets in the Hanoi-Haiphong area. Twelve F–4Es of Korat's 388th TFW participated. One aircraft, F–105G 38342 (Suntan 02) of the 17th WWS, was lost with the crewmembers listed as MIA.

Freighter Captain

The Thanh Hoa area was back on the frag, when on April 21 Operation FREIGHTER CAPTAIN was conducted as a one-day strike effort. The strike plan as sent to the JCS called for a strike force of eighteen B–52Ds (striking in six cells of three), 72 AF and 110 Navy TACAIR sorties. The 388th TFW supplied twenty F–105F/Gs and six EB–66C/Es. TACAIR Thanh Hoa targets included for example the Than Hoa Bridge, Railroad Yard and Station, Army Barracks/POL, and the Qui Vinh Railroad Bridge South. As weather was IFR, only the B–52s struck their targets, the Ham Rong TSP West and the Thanh Hoa Warehouse area. In addition, a few A-6 system runs were employed. Limited BDA was achieved.

However, the mission, although partly cancelled, was not without a loss. Chip Luyendyk was assigned to the 25th TFS twice, in the November 1969-1970 period as a GIB, Guy in Back, pilot flying 226 combat sorties, of which 118 as a WOLF FAC, for a total of 603 combat hours. He was back at Ubon in the August 1971-July 1972 period, this time as an aircraft commander. He then flew 223 combat sorties for a total of 339 flying hours. In other words, Chip collected 940 SEA combat hours in 449 sorties. Chip,

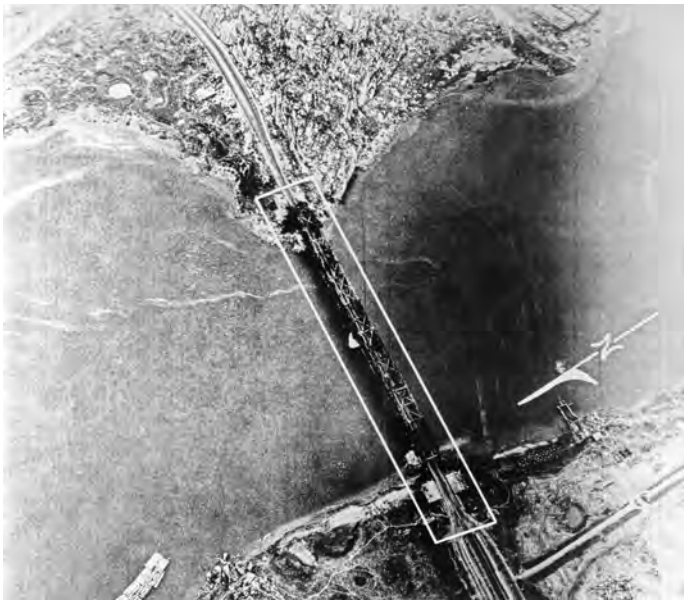
I flew on an aborted strike that was led by Lt Col Richard French, the Commander of the 25th TFS. We were the lead four-ship, configured with 500-lb Mk-82 bombs with fuse extenders and with CBUs. The call sign was Utah and the flight consisted of four TDY F–4Es. Utah 01, 03 and 04 were crews of the 25th TFS, while Utah 02's crew was of the 334th TFS (a total of seven of the squadron's crews participated in the mission). Our mission was flak suppression for the following two PAVE KNIFE flights with Mk-84 LGBs. Although we had ECM pods on all four aircraft and were in close pod formation, two SA-2 missiles hit Utah 01 and 02 with near misses. Due to the damage to their aircraft, both crews attempted to divert to Da Nang. Utah 01

As the original LORAN-D fin cap antenna caused frequent break-locks in weather and/or a maneuvering environment, relevant F–4Ds were configured with the Chelton towel bar antenna through TCTO 1F–4D-533. This Don Logan photo shows a 533-modified F–4D 68738/FP of the 497th TFS Night Owls, carrying, among others, Mk-82 bombs.

did so, but Utah's 02 crew, Capts Doug Brown and Larry Peters, were forced to eject from their F–4E (60494) over the South China Sea about twenty-five miles southeast of the base. They were recovered by a Navy HH-3A Sea King of Helicopter Combat Support Squadron (HC) 7. They returned to Ubon on the 23rd. As two SA-2s were tracking Utah 03 (Capt Lynn High and his WSO, the alternate strike leader) and 04 (Capt Chip Luyendyk with WSO Capt Jim Shaw), the crews jettisoned their bombs. They recovered safely at Ubon with an additional 2.4 flying hours.

Frequent Winner

FREQUENT WINNER was the sequel to FREIGHTER CAPTAIN and was hindered by poor weather. It added the 28,000 POL drums north of Thanh Hoa and the Thanh Hoa TSP to the target list. The U-Tapao B–52D force was to concentrate all sorties against the Bridge, Ham Rong TSP and the Warehouse area, while AF TACAIR was targeted against the drums and Army Barracks South. Twelve Thuds and four EB–66s supported the mission. It was executed on April 23 by eighteen B–52s, striking the Warehouse area and the Ham Rong TSP, but supposedly not the Bridge. One BUFF received damage from a suspected SA-2 burst about sixty seconds from the target, but the crew completed the run. Ubon's 497th TFS planned and led a 20-ship chaff drop, preceding the B–52s over Thanh Hoa. Thirty-three Nite Owl crewmembers participated. BDA showed for example that the Ham Rong TSP suffered heavy damage.



JCS 14.00, the Thanh Hoa Railroad and Highway Bridge, alive and kicking, as witnessed by a BUFFALO HUNTER AQM-34 Firebee that had been launched on Mission Q426 by a DC-130 Hercules on January 13, 1972. Both aircraft were assigned to the 100th Strategic Reconnaissance Wing (SRW).

April 27

Although the Bridge had been part of the frag several times, it would last until April 27 before it was actually struck, the first time since January 28, 1968, and by twelve F–4Ds. Senior flight of the 435th TFS on mission 7320 consisted of four aircraft. Flight lead was Lt Col Hayes and 1Lt Harry Jensen, 02 was Capt Norris Bohm and Maj David Sommers, 03 were Capts Carmichael and Carl Meadows and 04 1Lt Ralph Hudnall and Capt William Bean. The aircraft were configured with two Mk-84 EOGBs each. It proved to be the only strike against the Bridge with EOGBs. Four F–4Ds each formed Dudley (mission 7322) and Brushy (7324) flights. Each of the eight Phantoms was configured with two Mk-84 LGBs, while Dudley 01 and Brushy 01 were PAVE KNIFE-configured F–4Ds. Preceding the strike force, a flight of four F–4Ds dispensed M-129 chaff bombs from the IP to the target. F–105 WILD WEASEL aircraft of Detachment A of the 561st TFS from Korat flew IRON HAND support.

After receipt of the frag order, target study was an important part of the mission planning. As to the Senior aircrews, each had their own responsibility. EOGB strikes required special preplanning with regard to sun angle and shadows. Aircraft headings into or away from the sun had to be avoided since they produced maximum target contrast loss. Reconnaissance target photos were studied to determine the best contrast edges for the planned aiming point. In case there were several equally well-defined edges to lock onto, the pilot had to select an area on the target with only one high contrast edge appearing on his scope in order to not decoy the EOGB in flight. Weather was also a determining factor, which did not mean that marginal weather in the target area always resulted in cancellation of guided bomb strikes. In 1972, for instance, high priority targets were fragged, even under marginal conditions.

Briefing

After the main target briefing, which was attended by all aircrews, the various flights broke into groups depending on their ordnance and Time over Target (TOT). That flight brief was given by the flight commander. Senior Lead stated that each of the crews, if and when the target had been acquired, would release the ordnance without anything being said and then to try to stay together as a 4-ship in pulling off the target and heading 'feet wet', the Gulf of Tonkin. The flight was not to stay in the area for any BDA.

Capt Bohm and Maj Sommers were flying F–4D 67576 with the Squadron tail code 'FO'. Capt Bohm, who had been interim C flight commander of the 435th for a while, had arrived at Ubon in August 1971 after finishing F–4 upgrade training at George. He left in July 1972 with 229 SEA combat sorties and 528 hours under his belt. Of the 229 sorties, only two were with the Mk-84 EOGB, the one to the Thanh Hoa Bridge and the second sortie on May 10 to the Paul Doumer Railroad and Highway Bridge across the Red River in Hanoi. Capt Bohm,

The original strike had been scheduled for the previous day. However, when the flights arrived in the Thanh Hoa area after leaving the tankers over the Gulf of Tonkin, the weather conditions were marginal at best. Attempting to penetrate the low overcast on the Song Ma River was just impossible. In fact, one of the F–4s took damage from an SA-2 that came

out of the low overcast. Although damaged, the crew was able to return to Ubon without further incident. As to the ordnance it was standard procedure to bring back any unexpended ordnance. There was no problem with landings, given that we would configure the flaps and the airspeed depending on the ordnance aboard and weight. Any ordnance that we were not allowed to land with would be dropped on a 'dump' that was a few klicks off the end of Ubon's runway. As the Ubon commanders did not want to risk a similar weather abort on the 27th, an F–4D WOLF FAC was launched about an hour ahead of the strike force to what we would refer as a 'checky check' on the weather. The FAC's comments back to the ABCCC, Hillsborough, would validate whether or not the mission should continue. Obviously he told the ABCCC that the weather was a 'go' for the strike.

Weather recce

That WOLF FAC was an F–4D with Capt Dave Yates and 1Lt Dennis Stanford as WSO. Dave was a 1967 graduate of the Air Force Academy and was on his second assignment to Thailand. His first had been as a TIGER FAC with the 469th TFS (388th TFW) at Korat in the September 1968-69 period, flying the E version of the Phantom. On May 7, 1970 Capt Ted Sweeting and he became the second TIGER FAC to get shot down, while flying F–4E 70293. They were hit northwest of Ban Ban in Laos and were forced to eject. Dave was recovered by an Air America H-34 and Ted by an UH-1 of the same organization.

In July 1971 he returned to Thailand, this time to Ubon. Although he had stints with the 25th and 435th TFS, most of the time in the cockpit was as a WOLF FAC. In a total of 420 combat sorties, Dave collected 1,200 hours. The sorties included thirty-seven as a TIGER FAC, 147 as a WOLF FAC and 65 over North Vietnam. Of the latter number, sixty were WOLF FAC sorties when the crew went in and out at least three times and spent about forty minutes low altitude working flights or finding targets in high threat areas.

It was quite a surprise for Dave and Dennis that after they had landed after flying a 4.5 WOLF FAC mission and on their way to debriefing, the Wing's DO, Col Dick Horne, told them they were to fly another mission after their aircraft had been turned around. It is Dave's guess that maintenance did nothing more than refueling their aircraft and that they had what rockets and rounds of 20-mm ammunition were left from the AM mission. They were to fly a single-ship weather reconnaissance sortie to the Thanh Hoa Bridge area to determine if the weather would be cooperative enough for the strike force to proceed to the target area. As they were not part of the frag, they were not given a mission number and decided to use that morning's Wolf 03 call sign. Dave,

We did not really have time to be briefed and were handed a frequency to report the weather to the mission commander, which was either to be "good", "marginal" or "no-go". I asked if we had a tanker and Horne said to "find one if you need it". We dialed in the bridge after we got the plane started up and concluded we would need gas.

The route took them over Laos and southern South Vietnam to the Gulf of Tonkin and north to the Thanh Hoa area. After they were airborne, Yates and Stanford were faced with the problem of talking to the controllers without even having a line number in the frag. In addition it was not possible to get gas with so little notice. It was concluded there was enough gas to make the run, but it would be necessary to land at Da Nang on the way back if no tanker would be available. When CRAB was passed about fifty miles up the coast, the Navy wanted to know what they were doing there (CRAB, a point of land north of Dong Hoi and south of Vinh, was one of the two geographic points MiG calls were referenced off. BULLS EYE was the second point at Hanoi. A Navy ship, RED CROWN, controlled the airspace and made the call). Dave,

We argued back and forth until we were about 90 miles out from the bridge with threats that we were going to be shot down by Navy aircraft. I guess they were serious about controlling their area, as they should be. We then turned off the modes and codes and hit the deck to 'check the weather' as requested. RED CROWN then started the calls about the different color of bandits and locations from BULLS EYE, the first one being "MiG Bullseye 180 for 65 miles". The number got to about five or six and the location they were from BULLS EYE put them about over or just north of the bridge. Our run-in was begun at the mouth of the Song Ma River with the Bridge some fifteen miles upstream. We stayed on the deck, less than 100 feet, up the river to the bridge. Our weather observation was low puffy clouds and blue skies. I saw the target area about five miles in front of us and started a high-G turn to the left to exit the area. In the meantime, the threat calls had gotten louder and Dennis was burning up the elevation radar wheel trying to find something. He asked if I would shoot if he found one and I confirmed with "Sure if that was the only one" and then I could 'see' neither of my two AIM-7s I had tuned, so that was out. The two Sparrows on a WOLF bird were not

Up to October 1, 1971, the 497th TFS had been the dedicated Ubon F–4D squadron flying night combat missions. The photo shows F–4D 68730/FP being refueled by a KC-135A Stratotanker, while three F–105G WILD WEASEL aircraft are awaiting their turn. The Phantom is configured, with among others, two parachute flare dispensers and two pods with willie pete (white phosphorous) marking rockets. The photographer, Jack Pounds, "Glad I had a camera because we didn't often see the Thuds on the tanker at the same time we were there." Also, unusual because being a night squadron this must have been a late in the day first refueling before going to work.

changed often and many times they did not tune, meaning power up and be ready to function. After reaching 'feet wet' we could hear RED CROWN confirming the MiGs were still in the area. When our squawk was turned back on, the Navy again started the chant about shooting us down.

As the F–4D departed southward, Dave gave the mission commander the 'clear weather' observation report, went up tanker frequency and asked for gas. The strike force was on the tanker at that time for pre-strike refueling and they were told there would be no gas for them. Wolf 03 was probably a hundred miles or more south when the strike was executed. Dave,

We did the old WOLF return-to-base trick of 42,000 feet and max endurance and started begging for gas when we got farther south. Some tanker did come up and we headed for Ubon after taking gas. We had been in the air for about nine hours, but still had several hours of FAC mission intel debriefing to do from our first mission. When the bombers got to the bridge it was clear and all the bandits had run out of gas from launching early on us, I guess. Many medals were handed out, as usual. For us it was 1/15th air medal as we had not been on the frag and 'not formally part of it'.

Song Ma

After takeoff (Senior's was at 12:25), the aircrews flew the same route as Wolf 03 earlier. KC–135As were waiting over the Gulf of Tonkin for pre-strike air refueling and from there they flew north to the target area where Senior flight circled at the pre-determined Initial Point (IP) over the Gulf of Tonkin until it was time to make the run and proceed almost directly west and generally following the Song Ma River up to the Bridge. Norris Bohm,

We were the first flight going into the target, which was about twelve miles upstream from the coast. Each F–4D carried two Mk-84 EOGBs, pronounced 'E-gobs', and the other two flights followed us into the target area a couple of minutes later. The reason for sending us in first was that in order to maximize the effectiveness of the EOGBs, you needed to have the maximum target contrast possible to maintain lock-on as the released bomb flew itself into the target. Since we were attempting to lock on to the area of the bridge where the girders were fastened to the concrete abutments, we needed a clear contrast of that area. If there was smoke and haze from other aircraft going in first, the contrast would be diminished and the EOGBs, when released, could possibly 'wander off' due to blurriness in the area of the lock-on.

As Norris continued,

The approach was made as a four-ship in extended route position…extended to the point where everyone was comfortable with where they were and still could keep track of each other. Despite the weather and SA-2 and AAA fire (earlier there had also been several MiG calls by RED CROWN, both medium and high paints), the flight ingressed the area with a TOT of 13:47. Altitude was 10,000 feet, dive angle 20°, and True Air Speed (TAS) 540 knots.

Prior to April 27, 1972 all EOGBs were expended in Laos. On that particular date, four F–4Ds of Senior flight (435th TFS) dropped the first five of a total of 299 Mk-84 EOGBs expended in North Vietnam in 1972. Target was the Thanh Hoa Railroad and Highway (RR & HW) Bridge. Senior 02 were Capt Norris Bohm and Maj David Sommers, flying F–4D 67576/FO. The photo shows them on last chance to participate in the only EOGB strike against the Bridge.

The weather proved to be passable for the mission. The EOGBs were released independently. After Maj Sommers told me he had the lock-on, I released the first bomb and the picture that he had seen on his TV screen supposedly was now permanently locked into the EOGB's logic with the weapon guiding itself to the Bridge. Meanwhile, Maj Sommers immediately went over to the TV on the remaining EOGB to go through the whole procedure again. This took around ten seconds.

GIB

Capt Bohm stated with regard to releasing the ordnance,

During our training at Nellis, no EOGBs were expended, not even inert ones. The critical aspects of flying an EOGB profile were recorded on the camera in the inert bomb loaded on the aircraft. After a training run, we simply reviewed what was on film. It was obviously a cost saving measure. There was an 'approval' protocol in dropping the EOGBs. After getting a successful acquisition and confirmed by the WSO to the pilot, the latter was supposed to radio lead and ask for 'permission to drop'. Quite frankly, this was a protocol probably designed by non-combat personnel who had never experienced a multi-fighter attack on a fixed target with radio chatter from everyone and his uncle regarding tactics, SAM alerts, possible MiGs in the area…all on main channels. In addition, you could count on distress calls on 243.0, the emergency channel, before, during and after the attack. The voice chatter as well as staying together as a 4-ship while flying at 450+ knots in hazy ocean skies and thin, low lying clouds, while trying to visually acquire the Bridge as far ahead as possible, you can understand why 'combat' protocol was not always in sync with the text book.

About his GIB, Guy in Back, Maj David Sommers, Capt Bohm said,

While it was important for me as pilot to understand and practice the ideal parameters of a successful EOGB use, Maj Sommers was the critical relation in the man-to-machine connect. His 'simple' job was to use a small control stick to acquire the Bridge and the ideal contrast area from the picture being sent to him from the TV camera on the nose of the EOGB. He was head down in the TV screen all the time, while I was trying to get the nose of the aircraft in a 'line-of-sight' somewhere in the direction of the Bridge. In the meantime we descended from altitude at 450-500 knots, still not being threatened by anticipated AAA of MiG defenses, although there were MiG alerts earlier in the day.

Bohm added that while the pilot was watching the actual events taking place, the WIZZO, with his head down in the TV screen, often would have comments from the pilot in an escalating volume and pitch as the target grew ever closer, "Why the hell don't you have a lock-on?"

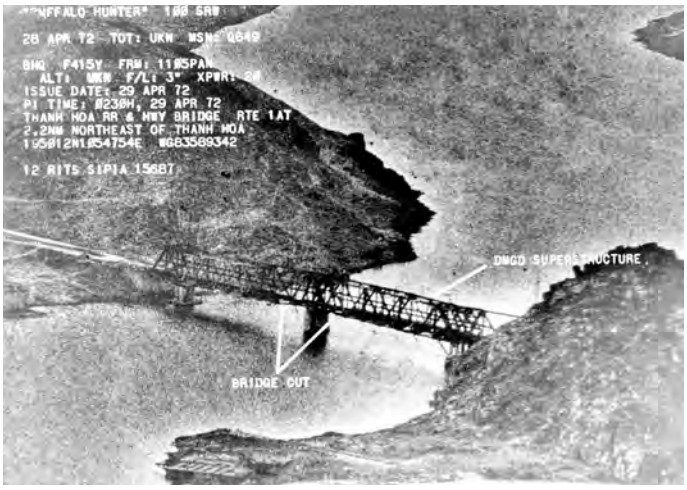
100%

Capts Ralph Hudnall and William Bean were Senior 04 that day. With regard to the Mk-84 EOGB, Capt Hudnall noted that the models with the early Walleye software were still having engineering 'adjustments' after review of combat results, which were not always the best. He stated that not many pilots or WSOs at Ubon were happy with those early versions. Hudnall,

I was trained at the Fighter Weapons School at Nellis to drop both the EOGB and LGB. The 435th TFS did not have a dedicated flight for the EOGB mission, but the schedulers knew who were qualified. In SEA I expended both weapons on many missions. In my opinion, the Mk-84 EOGB was not a very good weapon. It was very expensive and would jump lock to other contrasting items such as a river bank, making it to miss the target.

He continued,

The briefing on the day of the strike was attended by a Hughes technical representative. He kindly told us to not miss the target as he was looking for 100% target hits. Needless to say, we were not.
The plan of attack on the bridge was to ingress from the east, the sea, in what was called the pod formation. It was designed to utilize the radar jamming pods on the aircraft which would give us maximum protection against the SA-2s. The formation put all four F–4Ds in a line abreast formation, about 500 feet apart. Each pilot was to call a lock-on and then we would all launch simultaneously. I was the last one to do so and of course I took a severe debrief after the attack.



After the April 27 strike against the Bridge, a 100th SRW DC–130 launched a BUFFALO HUNTER drone the next day on Mission Q649 for battle damage assessment: the Bridge was cut and the superstructure damaged. Further photo recce on May 9 showed that it had been completely repaired and serviceable.

As to timing, Ralph stated,

Let me put it another way. The plane is descending from an altitude at 20-30 degree dive angle and traveling at 750-800 feet per second. This meant you have travelled one mile closer to the target in 7-8 seconds. It was pretty much left up to the pilot how close he wanted to be to the target to release the EOGBs, but the closer the better as the weapon would have less time to possibly wander off the contrasted lock-on area…remembering of course that two bombs had to be dropped, so timing was critical.

Politely

After Senior flight expended five of the Mk-84 EOGBs, the flight pulled off to the east and started the climb out to the Gulf and the tankers for post-strike refueling. The three remaining bombs were returned to Ubon (two by 01 and one by 03), with landing at Ubon at 14:45. As to a reason of the return of the EOGBs, there could be several according to Capt Bohm. Senior 01 could have had a total equipment failure, or, as often happened, after the release of the first bomb, the second one could not be delivered due to a lack of time or the TV failed in the second EOGB. Because of the expensiveness, the aircrews were asked, politely, to bring back any EOGBs that could not be released and not just eject them. Brushy aircrews released six of their eight Mk-84 LGBs at 13:48, followed one minute later by Dudley flight, which dropped all eight bombs.

The three flights egressed the area without incident. Norris,

I would have liked to report that Senior flight of the Flying Eagles had dropped the Bridge as planned, but this was not the case. While pulling off the target and turning to the east, I observed that 2-3 Mk-84s hit the river bank. I understood later that none of the EOGBs hit the critical targeted area, i.e. the abutment-girder connections. However, the two flights of the 433rd TFS were able to drop the Bridge at one end, making the mission a success.

Although the 435th history stated that the Bridge was damaged to an extent that traffic would not flow over that vital link in the North Vietnamese supply line, an AF

Working Paper of May 31 stated that BDA had shown the Bridge was operable with superficial damage to the super structure and that no other damage was noted. Also, that photo recce on May 9 had shown that it had been completely repaired and serviceable.

May

As the flow of personnel, supplies and material from North Vietnam did not diminish, the JCS directed an air interdiction campaign against the country's entire transportation and supply distribution system. On May 10, Air Force, Navy and (to a lesser extent) Marine Corps resources initiated a coordinated interdiction campaign, called LINEBACKER, although the initial strike was flown as ROLLING THUNDER ALPHA. This resulted in a considerable increase of TACAIR attack and support sorties over those flown in the FREEDOM TRAIN operations in April: from 4,732 in April to 10,892 in May. The majority of the thirty-three major targets struck by the Air Force were railroad/highway bridges.

Since strikes in RP 5 and 6 had priority, every effort was made to minimize the impact on overall TACAIR resources. To accomplish this, specific wings were assigned certain strike responsibilities which enabled aircrews to become experts in their particular field. In addition, a maximum utilization of aircraft and aircrews could be established.

Wing/Base	Responsibility
8TFW/Ubon	Guided ordnance
432TRW/Udorn	MIGCAP*
388TFW/Korat	IRON HAND and ECM
388TFW & 366TFW/Da Nang	Chaff

** all COMBAT TREE-configured F–4Ds were stationed at Udorn.*

Hanoi

The first bridge that was struck by the USAF in May was the Paul Doumer (Hanoi) Railroad and Highway Bridge, on May 10 and 11. The mission on the 10th was initiated by four Udorn F–4s flying weather recce. Eight Ubon F–4s (of which four of Dingus flight of the 433rd TFS), flying in pod formation with one mile horizontal separation between flights, provided chaff protection. Each F–4 dropped nine M-129 chaff bombs at programmed intervals to provide a chaff corridor approximately two miles wide, 4,000 feet vertically and thirty-four miles long.

The sixteen F–4Ds of Goatee (435th TFS), Napkin, Jingle and Biloxi followed fifteen minutes later, located the corridor on radar and flew between the bottom of the corridor to 500 feet above it. Seven of the Napkin flight members were assigned to the 433rd TFS, while lead was Col Dick Horne, the 8th TFW DO. They took off at 08:20 and were back at Ubon at 11:15. Pre- and post-strike refueling was over Northern Laos with an IP of 20-25 miles south of Hanoi and the bridge. After Napkin 01 experienced an INS failure, 03 took over as lead. All crewmembers in Jingle were assigned to the 433rd TFS, with lead being its commander, Lt Col Rick Hilton, and Maj Bill Wideman in F–4D 67675/FG. Takeoff was at 08:27 and landing at 10:47. Bill was responsible in the 433rd for PAVE KNIFE training,

After F–4 school at George, I attended the PAVE WAY/ZOT school at Nellis, which, as I recall, was about a week long. Besides some classroom time, it mostly consisted of locating the targets on the Nellis ranges that were assigned by the instructor and then lasing them. PAVE KNIFE training was even less intensive. Philco Ford built the system and had a company representative assigned to Ubon. He had a shop where the KNIFE pods were repaired. He would hook one up that was on a repair stand and I practiced by aiming at the top of the telephone pole that was maybe 500 yards away. I did this 2-3 times after which I started flying PAVE KNIFE missions. There were probably some discussions with the pilot prior to my first ZOT and KNIFE sorties, but after that they were unnecessary. There were very few of us using the equipment and we all knew the procedures. There was no need for any further training as both systems were simple to operate as long as you had a steady hand.

The flight configuration for the Doumer bridge, as well as some other high value targets, was three LGB flights of four aircraft. In addition, numbers 01 and 03 in Jingle and Napkin flights were configured with PAVE KNIFE pods, while only #01 in Biloxi flight had one pod. Element rollins were used by the first two flights, while the third flight accomplished a successful first time 4-ship delivery. The three flights struck the bridge with a total of twenty-two Mk-84 LGBs, with Napkin expending all eight, Jingle six (lead supposedly did not expend) and Biloxi all eight Mk-84 LGBs. Dive angle was 45° and the release altitude 12,200 feet.

Takeoff for Goatee flight was 08:20. #03 had a cartridge start. Landing at Ubon was 11:20. The four F–4Ds released seven Mk-84 EOGBs. They used 20-30 degree dive angles, releasing the weapons in succession at 8,-10,000 feet AGL. Goatee 04 (67555) was Capt Norris Bohm and 25th TFS WIZZO 1Lt David Ladurini. The one EOGB not released was Capt Bohm's.

On May 10, Air Force, Navy and (to a lesser extent) Marine Corps resources initiated a coordinated interdiction campaign, called LINEBACKER, although the initial strike was flown as ROLLING THUNDER ALPHA. The first bridge that was struck by the USAF in May was the Paul Doumer (Hanoi) RR & HW Bridge, on May 10 and 11. Goatee flight was the one with EOGBs, with Goatee 04 in F–4D 67555 being Capt Norris Bohm and 25th TFS WIZZO 1Lt David Ladurini. Here they are leaving 'last chance' on their way to the runway. ***(Via David Ladurini)***

Goatee was scheduled as the third LGB flight on May 13 to strike the Dragon's Jaw. Goatee 01 were Lt Col Rick Hilton and Maj Bill Wideman of the 433rd TFS. The photo shows them in F–4D 67680/FG with KNIFE pod #4 and two Mk-84 LGBs on last chance.

We had pushed the envelope to get as close as possible to make sure our weapons would hit the bridge and we were descending through 4,000 feet altitude when I started to pull of the target at close to 5-Gs and making an almost 180 degree climbing turn in afterburner to get out of the AAA and head home. This meant the wing with the remaining Mk-84 now had a close to 10,000# bomb instead of the 2,000-pounder. As you can tell, I'm writing you, so my wing didn't fall off in all that stressing of the bird, an illustration of how tough the Phantom was.

David,

This was my third combat sortie in SEA after having arrived at Ubon in mid-April. I will never forget that day. Interesting mission that our ALQ-87 ECM pods were jamming the EOGBs.

This electro-magnetic interference (EMI) problem (distortion and noise on the Sony TV) arose after two ECM pods had been moved from aft of the aircraft to the forward Sparrow missile wells. Emissions then interfered with the functioning of the EOGB. Most of the ECM problems were solved by the acquisition of 'gold dome' weapons which significantly shielded the weapon's electronics to reduce EMI without a loss of target resolution with two ECM pods in the forward Sparrow wells. Older weapons were screened and the screens were grounded. This caused less target resolution loss with the same ECM pods operating. Of course, turning off the ECM pods eliminated almost all of the EMI, but this was highly undesirable when working in SA-2 operating areas. However, it was discovered later that the guidance units of the EOGBs might have been a factor as well. A temporary breakdown of the only AN/G JM-36 shop test set for the guidance unit checkout procedures complicated matters. After partial repair of the test set, the use of copper screening was resumed, but with limited success, resulting in the decision to discontinue the procedure. New kits for the EOGB were received on June 13 and this time used with highly effective results. Photo BDA after the strike showed that the bridge was unusable due to damage to the third and fourth spans from the eastern abutment.

The next day, four F–4Ds of Oyster flight (433rd TFS), as the only LGB flight that day, released six Mk-84 and two M-118 LGBs. Flight lead was Capt Thomas Messett with Maj Wideman again in the rear seat. Takeoff was at 13:35 and landing at 16:22. Two of the supporting aircraft were flown by 334th TFS crews. This time photo BDA showed that one railroad and two highway spans were damaged and three highway spans destroyed.

A total of fifteen F–105F/Gs and four EB–66C/E aircraft supported the strikes. Over 160 SA-2s were launched at the strike force, but through the use of chaff and ALQ-87 pods no aircraft were hit. Forty-one North Vietnamese MiGs reacted to the strike activity against the Doumer Bridge and the Yen Vien Railroad Yard. Expending twelve AIM-7s and one AIM-9, F–4Ds downed three MiGs, all MiG-21s by Udorn's Oyster flight, while losing two F–4Ds (one was Oyster 01 that had earlier downed one of the MiG-21s) and one F–105G (crew was of Det A, 561st TFS, while the aircraft was assigned to the 17th WWS).

Capt Bohm,

Comparing my Thanh Hoa Bridge mission and the Doumer one, the former had been 'a walk in the park'. On the latter we had SAMs up our butt before we even got to the target and then while going down the chute we encountered a sky filled with dark puffs of AAA with hundreds of tracers and flashes below, forcing the flight to keep yanking and banking.

Than Hoa

Three days after the first Linebacker missions, the Thanh Hoa Railroad and Highway Bridge was part of the frag order, this time without the use of Mk-84 EOGBs. Similarly to the Doumer strike, there were three LGB flights on the frag. As had been the case on the April 27 mission, after takeoff the aircrews set an easterly course across Laos and southern South Vietnam to the Gulf of Tonkin, where KC–135As were waiting for pre-strike air refueling. Then heading north to the mouth of the Song Ma, following the river to the target. After dropping the ordnance, breaking to the east and 'feet wet' for post-strike refueling and return to Ubon.

Mission lead was the 8th TFW's DCO, Col Dick Horne, flying as #01 in his Jingle flight of four (mission 7320). #01 and #03 were configured with a PAVE KNIFE pod, while the flight carried a total of three M-118 and five Mk-84 LGBs. Col Horne was to strike the east end of the Bridge near the abutment. According to JCS information, TOT was 04:53. However, after calling in on the strike frequency that he and #02 were rolling in on the target, he and the other flight members aborted their pass for some reason and held high. It proved that they had no opportunity to reattack as weather and the bombs dropped earlier covered the Bridge and then RTB–ed.

The second flight, Dingus (mission 7322), was led by Capt D. L. Smith, assistant D flight commander in the 433rd TFS. His flight had the same configuration as Col Horne's and the aim point was the center of the Bridge.

TOT was 04:30. They dropped as elements. Col Hilton in the third flight saw two of their bombs hit above the center support of the Bridge, but it withstood the impact.

Goatee flight (mission 7324) was led by LtCol Richard Hilton, commander of the 433rd TFS, in F–4D 67680/FG. The Colonel graduated from pilot training in 1955 at the top of his class. His first assignment was George and the F–100A Super Sabre and he flew the Hun for some eight years. Hilton had a previous F–4 tour at Ubon (1967). All together a total of 263 combat sorties (465 flying hours) were collected, of which 135 over North Vietnam. His WSO/WIZZO, Weapon Systems Officer, was Maj Bill Wideman, who had also participated in the April 27 mission against the Bridge. Goatee's configuration was similar to the other two flights, except that only Goatee 01 carried a KNIFE pod. Their aim point was the west end of the Bridge. TOT was 05:00. Said Col Hilton, *As there were only six PAVE KNIFE pods at Ubon, it was a 'treat' that we had permission to configure five of our aircraft with the pod.* (Initially there were five KNIFE pods at Ubon, but earlier in 1972, a sixth pod arrived which had been used at Eglin for testing.)

All M-118s had instant fusing to weaken the upper structure of the Bridge (they had a soft shell and were not likely to survive the impact on its floor), while the Mk-84s were armed with delay fusing.

While the other flights were doing their job, Goatee orbited over the Bridge 3-4 times at 20,000 feet. Deteriorating weather (Maj Wideman said over the intercom, *You would never see it coming*) caused Hilton to call his flight into close formation, *Tuck it in, we are going in together.* That call was made while the flight was in loose formation, maybe 500 feet apart, trying to find the Bridge and keep it in sight, be poised to initiate roll-in. Rick Hilton,

That formation gave flexibility for me to maneuver and not work the flight too hard to stay with me. However, with the flight spread out, the bomb pattern would have been too large a footprint. When I called to tuck it in, the other flight members tucked onto my wing in seconds. I made one more call that we were rolling in. It was not necessary to call that we were releasing the bombs as each flight member was in position to see my bombs drop and simultaneously release their bombs.

The normal tactic for a flight of four with one pod would have been for lead to lase for himself and release his bombs, then orbit and lase for number 02, then 03 and finally for 04. By rolling in together, Goatee had eight bombs trying to hit the same spot, rather than four slightly different wandering aim points and staggered weapon releases. Col Hilton stated, *yes, I was happy I decided to drop together rather than individually. On the other side, we presented a larger, more lucrative target, but got in and out faster.*

According to Col Hilton there were also two chaff flights involved, Brenda and Bertha, with the mission to drop chaff over the target area prior to the arrival of the strike flights. Maj Bob Blake, the 433rd D flight commander, was leading the flights. It seems, however, that because Col Horne got his strike flights early to the Thanh Hoa area, the chaff flights were still several minutes out. An exchange between Horne and Blake followed, resulting in both chaff flights staying outside of the SAM ring and over the Gulf. According to Col Hilton, the chaff drop would have been a benefit, but the mission was paramount so they did not wait for Blake to arrive. There were no MiG or SAM calls and all aircraft returned safely to Ubon.

Lt Col Rick Hilton was commander of the Satan's Angels during three different periods in 1972. He flew a PAVE KNIFE-configured F–4D on the May 10 Doumer Bridge and May 13 Thanh Hoa Bridge missions. Here he poses against KNIFE pod #5 of his F–4D 67680/FG prior to a mission. On the left outboard, a Mk-84 LGB. (Rick Hilton)

JCS information stated that the three F–4D flights expended nine M-118 and fourteen Mk-84 LGBs, with USAF information stating all ordnance was dropped, nine and fifteen respectively. RF–4C and Navy RA-5C photo BDA on May 13 through 15 showed that the western span had been knocked off its abutment. Col Hilton was informed later at Ubon by Col Horne that Goatee flight had been instrumental in the damage to the Bridge. No damage was noted on the eastern span or the approaches. In addition, the rail line to the west of the Bridge had been interdicted.

Col Hilton in this respect and referring to his decision to tuck it in due to the weather,

An argument can be made that luck and deteriorating weather did the job. Instead of bombs falling around the area, we had 37,000 pounds of energy concentrated around a laser spot that Bill Wideman put exactly in the right place. Best of all, there were no losses. All in all, it was a good day at the office.

One of the three strike flights belonged to the 25th TFS. Their history stated that the Bridge was left in 'shambles' and that up to then thirty aircraft had been lost while striking it.

JCS/USAF information shows that four F–4Es, TDY from Seymour Johnson, of Cow Sip flight (mission 7330, TOT 05:03) expended forty-eight Mk-82s on the same mission after the F–4D flights had expended their ordnance. The flight was led by Lt Col Daurice Vest, commander of the 336th TFS. The 334th TFS provided two crews. Its history,

Two crews participated in one of the most significant missions

of the war today – the destruction of the Thanh Hoa Bridge deep into North Vietnam. Both were part of a strike that bombed the bridge and knocked it out for the first time ever.

Extensive

On the 18th, three Navy F–4J Phantoms flew IRON HAND support for three others which struck the Thanh Hoa Bridge/POL and the Petroleum Products Storage Citadel. The first three Phantoms expended twelve Mk-20 Rockeyes, while the second trio dropped a total of eighteen Mk-82 low-drag bombs. Results were not observed due to smoke.

The most extensive LGB strike in May took place on the 25th when twenty F–4Ds of Edsel, Kitty, Lover, Mash and Paste flights attacked the Lang Giai Railroad Bridge (North) on the Northeast Rail Line in RP 6A. As the bridge was situated well within the China's Buffer Zone, the strike required special JCS authorization. It was 1,500 feet long and supported by ten reinforced concrete piers.

Eleven of the crews were supplied by the 25th TFS. The first flight carried eight Mk-84 EOGBs. Due to poor weather, only one crew was able to expend their two weapons. The other sixteen Phantoms released a total of thirty Mk-84 LGBs. The PAVE KNIFE system was used. Post-strike BDA showed six dropped spans, one damaged span and one destroyed support pillar.

Not all Ubon F–4 missions were flown to Route Package 6. For instance, on May 28, Fenway 01, a 433rd TFS F–4D with Lt Col Hilton and Maj Earl Johnson, flew as a WHITE LIGHTNING floating illuminator in RP 1. Takeoff was at 13:05. Working with Musket 10, a Fast FAC, and with Outfox and Parkay flights as LGB delivery aircraft, they had a very successful mission. BDA included two warehouses, one ferry slip and one barge destroyed, and two radar vans and four trucks damaged. Landing was 16:00.

A BUFFALO HUNTER AQM-34 drone of the 100th SRW flew a Thanh Hoa Bridge recce sortie on May 23 on Mission Q701. Damage shown included breaks in the span and the Bridge being off its abutment. According to Col Dick Horne, 8th TFW/DCO, Lt Col Richard Hilton's Goatee flight had been instrumental in the damage to the Bridge.

June

As North Vietnamese MiGs started targeting F–4 chaff flights, a chaff escort element was added to the force package. As in May, U.S. strike activity in RP 6 was primarily targeted against railroad/highway bridges. One of the other significant targets was the Thai Nguyen Iron Combine, on the 24th, with eleven F–4Ds of Salter, Fleecy and Dipper flights, expending twenty-two Mk-84Ls and ten F–4s of Dogear, Gator and Ramada flights dropping 111 Mk-82s. Two of the LGB flights were from the 25th TFS. The aircraft were met by numerous MiGs and extensive AAA. While egressing from the target area, F–4D 67636 (Salter 04), on a KNIFE mission, was downed by a MiG-21's Atoll missile. The aircraft commander (of the 25th TFS) was reported as killed in action while the Weapon Systems Officer (of the 433rd TFS) ended up as a 'guest' of Hanoi and was later released.

The Thanh Hoa area made it to the frag on two occasions. On the 14th, Navy aircraft attacked the Vehicle Repair Facility, the Thermal Power Plant and the Pontoon bridge/Highway Ferry. On June 20, Navy aircraft struck SA-2 site VN 79.

1972, third quarter

Combat operations by the Wolf Pack were directed by 7AF's Linebacker Standing OPORD of May 14, 1972 and by 7AF's Counter Logistics OPORD of May 21. The 8th was tasked to provide forty sorties a day for the LINEBACKER frag, which required the use of ten highly qualified flight leaders and special weapons crews per day for PAVE WAY, PAVE KNIFE, and LORAN missions. Fourteen sorties were required in the RP 1/MR I area which required similarly qualified people. The remaining ten daylight missions per day required the use of about five flight lead/instructor pilots to upgrade newly arrived aircraft commanders and weapon systems officers. The LINEBACKER missions had to be flown at the expense of IP/flight lead upgrade, theater indoctrination, and special weapons training, which created the heart of Ubon's F–4 training problem. However, the Wing's ability to perform the primary mission was not degraded despite the problems.

Weather in the third quarter was unfavorable in North Vietnam, Laos and throughout the Korat Plateau and included typhoons Elsie and Flossie which came inland in August. Ubon received a total of 44.88 inches of precipitation with only fifteen of the 92 days passing without a

thunderstorm or rain shower. Forty-five percent of the daily mission frag was devoted to strikes in RP 5 and 6. Deteriorating weather conditions prompted the beginning of using LORAN bombing with conventional ordnance to strikes in the two upper Route Packs. The first such mission was flown on September 1 to a railroad siding in RP 5 with participation of Walnut flight of the 433rd TFS.

The chaff program was developed to the point where it became an integral part of all LINEBACKER missions. On July 12, the first four new ALE-38 chaff dispensers were employed. As to this program, the 8th Avionics Maintenance Squadron (AMS) stated in its history,

The ALE-38 chaff dispensing pod was a new experimental program that was assigned to this organization on a test basis. Only two Tech Reps, with no technical data, were sent to Ubon to support this program. No increased USAF personnel were allocated to the ECM Shop either. Technical data and maintenance checklists were written, and modifications performed, while flying F–4 combat missions over North Vietnam.

Yet, the 8th AMS was able to increase the mission effectiveness of the pod from the initial low of 68 to 93 percent in September. Not a single aircraft in the chaff corridor was lost to a SAM, while MiGs started an intense effort to stop the chaff force.

The AMS mounted a 16-mm Bomb Damage Assessment (BDA) Camera on the ZOT illuminator, to provide strike photos of the laser designator targets and analyze PAVE WAY effectiveness. The camera had to be procured locally and modified for use. In addition, all lenses had to be hard fitted, while some had to be locally ground to insure picture clarity. Early tests looked good.

A video tape recorder was mounted on the PAVE KNIFE system for a test to (1) improve the clarity of the BDA film, (2) allow the film to be uploaded for greater periods of time, and (3) to eliminate the high failure video recorder. The new recorder had to be adapted for use under high 'G' loading. The results were outstanding with the BDA film having 100 per cent greater clarity.

Most of all chaff missions were flown by the two TDY F–4E squadrons at Ubon. They established chaff corridors from the Initial Point (IP) to the target area to protect the strike flights from the SA-2 threat. That these chaff dropping missions were not without a risk, shows the fact that two TDY F–4Es were claimed by ATOLL missiles from MiG-21s on September 11 (Palm 04/90288 of the 335th TFS) and September 12 (Date 03/97266 of the 336th TFS). Both crews became 'guests' of the North Vietnamese government.

Wing aircraft flew a grand total of 8,613 combat sorties, collecting 18,159 flying hours. Eight Phantoms were lost, five Ds and three Es. Three crew members were recovered, four were KIA, two POW, and seven were listed as MIA. According to the Wing's history, the strangest loss occurred on July 17, when F–4D Owl 02 of the 497th TFS was leading a flight of three Navy A-7C Corsair II aircraft of USS America's Attack Squadron (VA) 86 on a LORAN drop. Owl 02 acted as a FAST FAC in northern South Vietnam. After Owl 02 called "pickle", an Mk-82 on one of the Corsairs detonated, causing Owl 02 to catch fire and lose hydraulics, forcing the crew to eject near the A Shau Valley, and two of the A–7Cs. The Navy pilots were recovered that day, the pilot of the F–4D, 1Lt Gordie Tushek, the next day, while his WSO, Capt Wayne Brown, was listed as MIA. A more extensive account of this incident will be given in the final part of this article.

After the F–4Es of the 334th and 336th TFS arrived TDY at Ubon, their crews were not the only ones to fly their aircraft. 1st Lt Jack Pounds of the 497th, a WSO, flew F–4Es on WOLF FAC missions. Jack is posing in front of a Seymour F–4E which is configured with twelve Mk-82 general purpose bombs prior to flying a night WOLF FAC sortie. (Jack Pounds)

The weapon systems inventory in the 8th TFW on July 1 and September 30 respectively was as follows:

Type aircraft	F–4D	F–4E	AC–130A	AC–130E
Authorized	75/75	36/36	12/12	6/6
Assigned	87/84	32/28	10/10	5/5
Possessed	71/74	31/24	7/3	5/5

A continuous flow of F–4D/E aircraft went through IRAN (Inspection and Repair as Necessary) at Tainan Air Station, Taiwan. Also, a new camera modification program was begun at Clark with twenty-six F–4s going through this program. The large drop in AC–130A possessed aircraft was due to postponed IRAN by Hayes in Birmingham, AL. The reason was the heavy activity by the gunships in the previous quarter in response to the North Vietnamese Spring Offensive. All seven aircraft were expected to return to Ubon before year's end.

July

The Navy returned to the Than Hoa area on July 21, conducting attacks against the Vehicle Repair Facility, the Highway Ferry, the Petroleum Products Storage and Highway Bridge East #1.

Air Force TACAIR was also back in the Thanh Hoa area. On July 30, four F–4Ds of Redwood flight on mission 1554 expended six Mk-84 LGBs against the Dragon's Jaw. Due to smoke, the results were not noted.

July witnessed three LGB–related losses. On the fifth and while egressing the target (a bridge, east of Kep) area, the first KNIFE-configured F–4D was hit by a SAM while ingressing to the target area on the northeast railroad line.

F–4Es of the 334th and 335th TFS were not only used in the chaff dispensing and WOLF FAC roles, but were also to drop LGBs, as depicted on this photo: F–4E, 60327/SA of the 334th TFS on last chance with maintenance personnel pulling the 'remove before flight' banners.

The aircraft, Gaslit 01/67680, and its crew, Capt Michael VanWagenen and Maj Earl Johnson, were assigned to the 433rd TFS. They were able to fly their crippled aircraft to the Gulf of Tonkin where they ejected about 35 miles northeast of the DMZ. They were picked up by an HH-53B SAR helicopter.

Five days later, a second PAVE KNIFE aircraft was lost, Jazz 01. Lt Col Bradford Sharp, Commander of the 25th TFS, and 1Lt Michael Pomphrey, flying F–4D 67707 were to lead a strike force of eight Phantoms. While taking off and at the 'go/no-go' decision point, the F–4D's starboard tire blew out. The wheel then disintegrated, punctured the fuel tank which caught fire. After the aircraft engaged the last runway barrier, it was quickly engulfed in flames. Both crewmembers were able to get out of the aircraft although Col Sharp broke his heel and fell down when jumping on the ground. His WSO and the Runway Supervisory Unit Officer, 1Lt Robert Kendall, ran back into the flames and danger of the exploding aircraft and ordnance to rescue the pilot. The fire did ignite both Mk-84 LGBs and the ejection seats. Ubon was closed for several hours, cancelling a LINEBACKER strike.

These losses reduced the number of pods to four, prompting an evaluation of high threat RP 5 and 6 tactics utilizing the ZOT/WHITE LIGHTNING system. A successful strike was flown in late July against Dong Hoi Airfield to verify tactics derived from practice missions. The system was subsequently used against bridge targets along the northeast and northwest railroad networks and the results were significant. However, aircrews indicated ZOT should not be fragged into the SA-2 rings surrounding Hanoi. The Wing's history stated,

Although results, when used, were exceptional when compared to conventional ordnance, the required higher altitudes produced a higher miss rate than normal. The PAVE KNIFE system with its ability to deliver large numbers of ordnance accurately on large targets such as factories, airfields, and bridges with a relatively low vulnerability, was still preferred.

7AF expressed grave concern over the dwindling resources and urged that extraordinary measures be taken to expedite the acquisition of additional pods. Although no further losses occurred during the month, 7AF continued its efforts to acquire additional pods.

In a July 17 message to the commanders of PACAF, TAC, AFSC and AFLC, USAF's Chief of Staff, General John Ryan, also expressed his concern about the losses of KNIFE-configured F–4D aircraft. He suggested that future losses could possibly be minimized by an increased application of EOGBs.

7AF/CC, Gen John Vogt, in a July 30 message to PACAF/CC, Gen Lucius Clay, stated that although the EOGB with a modified guidance unit did have potential under certain conditions and being used whenever conditions permitted, he preferred the use of LGBs for a number of reasons, which included that (1) the EOGB required ideal sun angle and axis of attack, (2) low release by single aircraft, and (3) ECM pods had to be in standby. Many of those options were denied in high threat areas like RP4 and higher. Vogt promised that 7AF would continue to make every effort to optimize the use of the EOGB, but that in the state of the art of that time, the LGB was a far superior weapon system.

The loss of the two pods did result in an increased use of Mk-84 EOGBs, which were commonly referred to as the 'TV bomb' or 'E-gob' in the upper Route Packs. Through July 31, 1972, a total of 75 EOGBs had been expended, of which seventeen during nine sorties in the high threat areas of North Vietnam and 58 in the lower threat areas. Direct hits were one and thirty-three respectively. A record number of 129 Mk-84 EOGBs was expended during September by the Wolf Pack and 49th TFW F–4Ds staging out of Ubon. The 433rd TFS dropped fifty-two EOGBs in thirty-eight sorties. It was interesting to see in the Squadron's history for the quarter that the Satan's Angels also expended seventeen M-118 and twenty-five Mk-82 LGBs in addition to 527 Mk-84 LGBs. The 49th TFW was TDY at Tahkli RTAB from Holloman (NM). Additionally, four 8th TFW F–4Ds were equipped with Sony monitors to achieve a total of ten EO-capable aircraft and to offset the redeployment of the 49th TFW to CONUS. on October 3.

The primary problem with the EOGB remained the fact that visual acquisition of the target was required at the time of weapon release. This necessitated prohibitively low delivery altitudes. A possible solution was offered through an improved EOGB with command data link, the Walleye II. Due to the low production of the weapon, only five weapons had been produced and deployed to Ubon. This meant that it did not provide a means to alleviate short term PAVE KNIFE shortage problems (the Navy made extensive use of the Walleye II in 1972).

The third aircraft, F–4D 67576/Cedar 02 of the 435th TFS, was, on July 30, on an LGB delivery against the Paul Doumer Bridge, when it was hit and downed by a 'Fat Albert' SA-2 missile. It was described as short, fat, and black with extremely good guidance and much better maneuverability than the SA-2. Intel sources ruled against this being called an 'SA-4', so it remained

a complete mystery for the 8th. The crew ejected about five miles east of Hanoi, was captured immediately and remained 'guests' of the North Vietnamese until their release on March 29, 1973. The flight was able to release six Mk-84 LGBs.

The 'SA-4' sighting prompted the arrival of the PACER GRANITE Program at the 8th AMS on August 15 with twenty-five pods arriving at Ubon. Five USAFE maintenance personnel were received through PALACE DOG 82, while two Westinghouse Tech Reps arrived to support the program. However, as most of the pods had never been uncrated or used, numerous problems were encountered. The Squadron's history recorded, *Presently, the utilization and operation of these pods inflight has been held in abeyance by 7th Air Force.*

A heavily armed F–4D in its Ubon revetment. The aircraft, 67659 of the Satan's Angels (433rd TFS), is configured with a total of four Mk-82 and two Mk-84 Laser Guided Bombs.

August

Linebacker was continued. Higher headquarters directed an increase in strike sorties to a minimum of forty-eight per day. However, due to the loss of two KNIFE-configured F–4Ds, the size of the force, using LGBs, could not be increased significantly. It was decided to limit the number of PAVE KNIFE aircraft on any mission to two. On the other hand, ZOT/WHITE LIGHTNING F–4Ds were scheduled into high threat areas whenever more than two illuminator targets were selected. To meet the directed minimum, 8-16 sorties per day were flown using unguided ordnance. This meant that pin-point targets continued to be struck with LGBs, but that area targets like airfield, truck parks, and railroad yards were being fragged with increasing frequency with 'dumb' bombs.

Major guided weapons strikes were flown against the Cao Nung, Lang Dang, and Vu Chua Railroad Bridges and the Hanoi and Thanh Hoa Railroad and Highway Bridges. The strike against the latter, mission 6474, took place on August 8. It would prove to be the Air Force's final 'visit' to the Thanh Hoa area and the Dragon's Jaw. The first strike by the Air Force had occurred on April 3, 1965. The strike force consisted of four Ubon F–4Ds of Maple flight. TOT was 03:20 and the total flying time, 8.6 hours. Two Mk-84 and two M-118 LGBs were expended. According to the pilots, the BDA was 'one bridge destroyed'. (Of interest is the fact that the July 30 and August 8 missions against the Thanh Hoa Bridge were not mentioned in the 3rd quarter 1972 history of the Wolf Pack.) 'Thanh Hoa' was taken over by the Navy and their first of several strikes against the area and the Dragon's Jaw took place on August 14. The final part Six will deal with those strikes.

The first MiG kill for the Wolf Pack since the downing of a MiG-17 on February 14, 1968 was claimed on August 15 by an F–4E, Date 04, flown by Capts Fred Sheffler and Mark Massen of the TDY 336th TFS. After Massen had gotten a radar lock-on, Sheffler fired an AIM-7E which guided normal. The missile went right into the MiG-21's tail pipe and detonated. The crew was on a LINEBACKER chaff drop mission into RP 6. *To be concluded.*■

NOTES ON SOURCES

Thanks to

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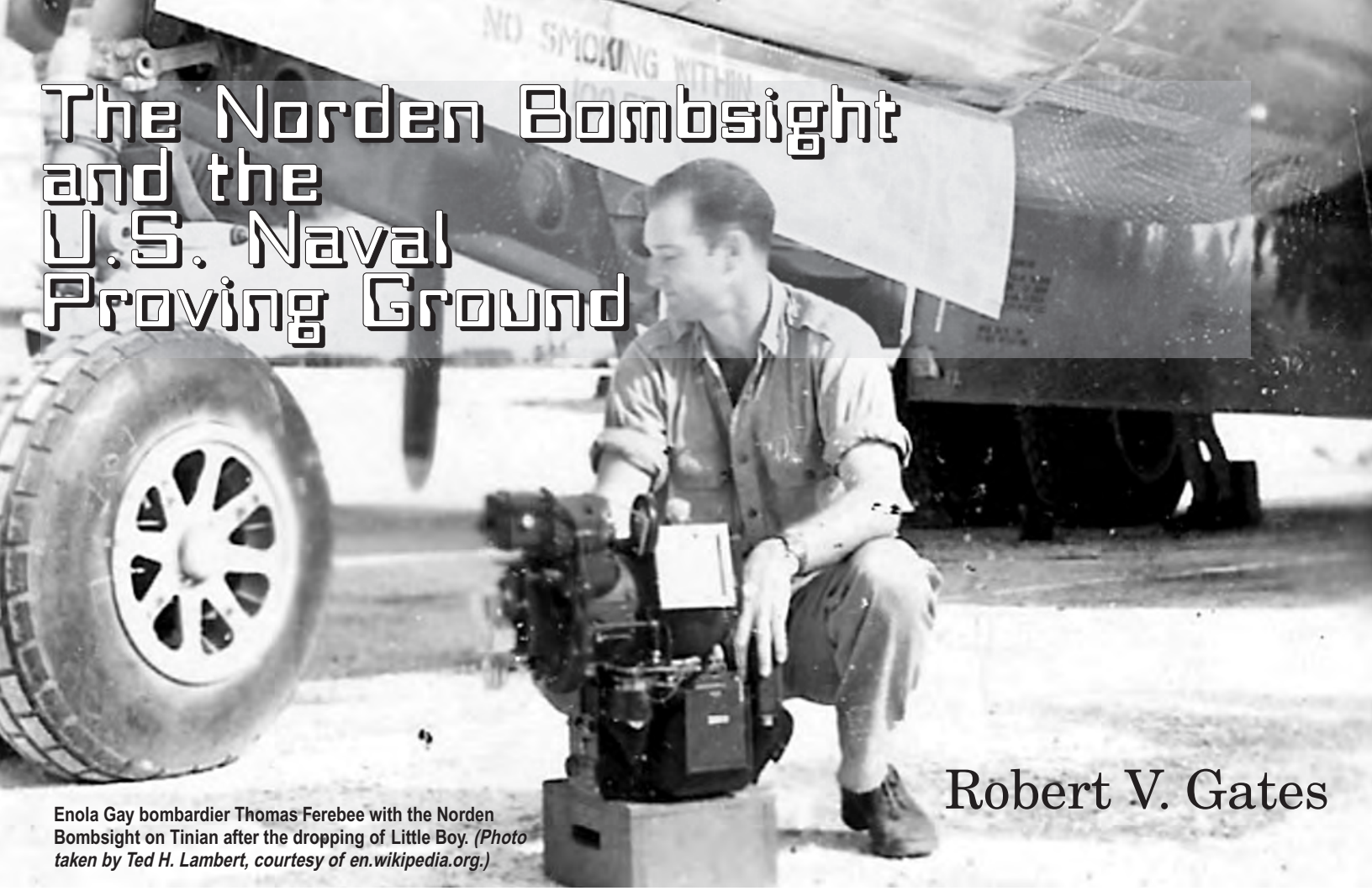
The Norden Bombsight and the U.S. Naval Proving Ground

Robert V. Gates



Enola Gay bombardier Thomas Ferebee with the Norden Bombsight on Tinian after the dropping of Little Boy. *(Photo taken by Ted H. Lambert, courtesy of en.wikipedia.org.)*

The Norden Bombsight and the Army Air Force are forever linked in public memory. Less well remembered, however, are that the bombsight was developed by Carl Norden for the U.S. Navy and the role that the Navy Proving Ground (Dahlgren, Virginia) played in its development and utilization in World War II.

While there were visionaries who saw possibilities for the offensive use of aircraft during war, many senior officers and military theorists thought of aircraft, when they thought of them at all, in scout or reconnaissance roles. During World War I, others began to think of using aircraft as bombers and bombing missions were attempted from low altitudes by aircraft carrying a small load of bombs. Bombs were dropped by the pilot or observer without the benefit of an aiming device, or bombsight. Needless to say, bombing was hit or miss—mostly miss. It was constrained by the state of technology—in aircraft, bombs, and bombsights—as well as operational issues such as poor navigation.

As the development of specialized bombing aircraft increased, the need for accuracy also grew. An approach to solving the bombing problem led to the development of bombsights by the air forces of all combatants.

Early Developments

The bombing problem is more easily stated than solved. It is, essentially, the calculation of the point in space where bombs should be dropped in order to hit the target in the presence of a variety of external forces, such as gravity, wind, and bomb ballistics. Aircraft altitude, speed, and angular orientation also have a significant effect on the bombing solution and, consequently, accuracy.

The problem was generally simplified by requiring the pilot to maintain a predetermined speed and altitude and to maintain a constant attitude in pitch, yaw, and roll. Lower bombing altitudes mitigated aerodynamic (bomb ballistics) effects on accuracy. Early bombsights required the pilot to fly his bombing run either directly upwind or downwind.

One of the earliest bombsight developments was by Lt. Riley E. Scott (U.S. Army Coast Artillery) in 1911. He developed a hand-held device that was used while lying prone on the wing of the aircraft. It used aircraft airspeed and altitude as inputs based on a table of settings that he developed by extensive testing. He demonstrated the bombsight by dropping two eighteen-pound bombs within ten feet of a four foot by five foot target from an altitude of 400 feet.

The British began experimenting with bombsights in 1916. The most promising, developed by Lt. Cdr. Harry E. Wimperis of the Royal Naval Service's Imperial College of Science, was described as "little more than a board fitted with a bubble level and two adjustable rifle sights." (next page) The pilot would fly perpendicular to the bombing run in order to

The Drift Bombsight. ***(USAF photo.)***

measure wind speed which would be used to set ground speed in the bombsight. Predetermined bombing tables and levers to adjust for altitude and speed and bomb ballistics were used to achieve an accuracy of "hundreds of feet." The front and rear sights on the bombsight were used to time the drop. A primary source of inaccuracy was the random pitch and roll of the aircraft during the bombing run. This sight was only effective at low altitudes, e.g., 500 to 2000 feet.

The next evolution, late in World War I, was the vector bombsight. As the name implies, it used vector mathematics to account for wind direction and speed. The observer (in a multi-place aircraft) would use adjustments of the bombsight to measure wind speed and direction and give the pilot course corrections to cancel out the drift. Originally, these corrections were conveyed to the pilot by hand signals or pulling straps attached to his shoulders. This didn't work in larger aircraft and a "pilot direction indicator"—an electrically-driven pointer—was developed after the war. The bombardier then used the front and rear sights to time the drop. The Wimperis Course Setting Bomb Sight (above right, at left) is perhaps the best known and most used bombsight of this type. Versions of this bombsight were used by many air forces, and especially the Royal Air Force, through World War II.

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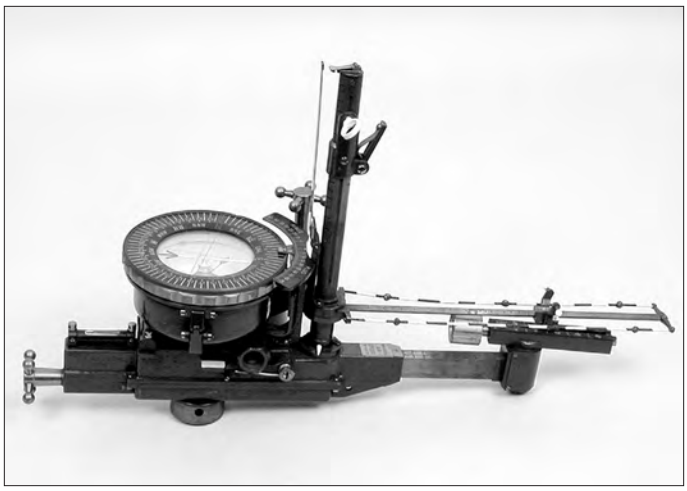
Developments in the Interwar Period

Many in the Army considered that the role of aircraft, including bombers, was support for ground forces. Hence, the emphasis was on operating at low altitude. The U.S.



Wimperis Mark 1A CSBS. ***(RAF Museum Photo.)***

Navy considered ships to be the primary targets of its bombardment missions. In its search for an effective means of accomplishing this mission it considered level bombing, dive bombing, glide bombing, and aerial torpedo attack. Many senior officers in both services continued to believe that aircraft would have little utility in future wars. There were, however, other officers who felt differently and developments in aircraft technology continued.

The Air Corps Tactical School (ACTS) at Langley Field, Virginia (and later Maxwell Field, Alabama) was taking a different look at the bombing mission. While some held that the mission required bombing the civilian population, the view that prevailed was that the proper target was the enemy's economic infrastructure. Destroying such targets given the damage radius of the available bombs and with minimal collateral damage required a higher level of accuracy than was then achievable. A review of expected advances in air defense by the Army also indicated that bombers were going to be required to operate at significantly higher altitudes. Again, existing bombsights weren't up to the challenge. They were designed to operate at low altitudes and accuracy grew significantly worse as bombing altitude increased.

In June and July of 1921, Army and Navy pilots dropped bombs on a variety of targets including the anchored German battleship *Ostfriesland* (right above). The Navy pilots dropped bombs from an altitude of less than 2500 feet and achieved hits with only nineteen percent of them. Brig. Gen. Mitchell's Army pilots did somewhat better—30 percent of their bombs hit the *Ostfriesland*—using a Wimperis Course Setting Bomb Sight.

A 1924 report for the Secretary of the Navy concluded that "it is absurd to think that either the aerial bomb or the submarine torpedo have furnished the effectual answer to the capital ship." The Army came to the same conclusion.

The Army Bomb Board had previously (in 1919) identified bombsight stability (resulting from aircraft movement) as a primary source of inaccuracy and gyro–stabilization of the bombsight as a solution. As a result, the Army attempted to improve the two standard bombsights—the Army Mark 1-A and the Navy Mark III Wimperis bombsights. They worked with several designers and the Sperry Gyroscope Company to develop bombsights that would meet both their low and high altitude requirements. For the next decade the Army evaluated a number of low altitude and high altitude, synchronous bombsights. Each, in turn, was found to be unsatisfactory because of performance or weight and size. The effort culminated with a series of tests in 1931. That summer, the army tested two of their bombsights and the Navy's Norden Mark XI at Langley Field and March Field, California to drop 108 bombs from different altitudes. The results showed that the Norden bombsight performed the best although it was the most difficult to use.

Bombing of ***Ostfriesland. (Naval History and Heritage Command photo.)***

The Navy tested a production model Mark XI and a developmental prototype of the Mark XV against the anchored USS *Pittsburgh* in early October of that year. They achieved three hits out of fourteen bombs dropped using the Mark XI and four out of eight with the Mark XV.[1] This was apparently the first time that the Army became aware of the Mark XV. They stopped their bombsight development program and began efforts to acquire technical specifications of the Mark XV in order to produce their own version. In the end, they agreed to allow the Navy to procure bombsights for both services.

Norden and the Navy

The Navy's Bureau of Ordnance (BuOrd) had the responsibility for developing bombsights for the Navy and in January 1920 contracted with Carl L. Norden (next page) to improve the Navy Mark III bombsight, a modified Wimperis device.

Norden immigrated to the United States in 1904 and worked for Elmer Sperry for two years developing ship gyrostabilizers. Their relationship was a rocky one—Sperry

Carl L. Norden. *(US Navy Photo.)*

disliked Norden's appetite for "vile black cigars" and Norden resented Sperry's proposal that Norden sign over his future gyrostabilizer patents to the Sperry Gyroscope Company. They parted ways in 1913 although they worked together on various projects during World War I.

When the Navy wanted to add gyro stabilization to the Mark III bombsight, they turned to Norden. His first efforts included adding gyro-stabilization to the bombsight along with a telescope to better sight the target and a means for providing flight directions to the pilot. When the results of his first effort were unsatisfactory, Norden used Navy funding for three pilot direction indicators (PDI) for the Mark III bombsight and family funds to continue work on a better bombsight. In June 1922, impressed with his progress, the Navy contracted with him for three experimental bombsights designated the Mark XI.

A year later the Navy was concerned that the project was too big for one man, especially the man they knew as "Old Man Dynamite" because he was so difficult to work with due to his generally unsociable and reclusive nature. They sent him a collaborator, Theodore Barth. Barth brought production engineering, business acumen and political skill—traits that Norden lacked—to the partnership. This successful relationship lasted until both men retired after World War II.

Norden worked out of his home in Zurich and Barth's apartment in New York City, and, using the equipment and skilled labor of the Witteman-Lewis Aircraft Company, delivered the three PDIs and three experimental Mark XI bombsights—all handmade—to the Navy in the winter of 1923 and spring of 1924. Bench and flight testing of the Mark XI was conducted at the U.S. Naval Proving Ground in Dahlgren, Virginia in 1924. Neither Norden nor the Navy was pleased with the performance of the bombsights as test bombs fell with "alarming irregularity." The Navy also believed that the sight was too complicated.

Many changes were identified during the initial testing and BuOrd contracted with Norden for modifications to two of the Mark XI bombsights. The modified bombsights were delivered to Dahlgren for flight testing in 1925. Tests during the summer and fall of 1925 showed that the changes were worthwhile. The eighteen bombs that were dropped from an altitude of 3000 feet in the final test achieved a mean impact point that was nine feet short in range but 187 feet to the right of the flight path.

The Navy test bombardier was impressed but reported that the sight was too complex and required "both hands, both feet, and the teeth" to operate. In an open cockpit, the wind and cold made fine adjustments to the sight nearly impossible. Norden viewed the basic design as good and the problems correctable.

The Navy completed testing of the Mark XI in October 1927 and, despite continuing problems with leveling, vibration, and the PDI, began negotiations with Norden and Barth for the purchase of eight Mark XI bombsights and PDIs. Norden and Barth balked at the proposal because they considered themselves consulting engineers not production contractors. In 1928, after additional encouragement from the Navy and some unwritten agreements, Norden and Barth agreed to form Carl L. Norden, Incorporated and to produce and deliver eighty Mark XI sights with spare parts and toolkits for $384,000. They also agreed to transfer all patents, models, and designs to the government two years later. Norden said he was paid $1 for these rights although Navy records show he was paid $250. A very low price in either case.

Bureau of Ordnance testing related to the development of the Mark XI bombsight at the Naval Proving Ground in Dahlgren, Virginia began in 1922. In the five-and-a-half-year period leading up to the production contract, Norden and Barth visited Dahlgren fifty-one times. The bench and flight testing at Dahlgren are credited with uncovering numerous design and performance issues. Dahlgren was also the site of the first school to teach mechanics how to maintain the Mark XI bombsight.

Production of the Mark XI began slowly and Norden and the Navy tested and improved each sight as it was produced. Norden shipped the first three Mark XI bombsights to Dahlgren for testing in early 1929. The bombsights were essentially handmade and production continued at three units per month. Eighty-three Mark XI bombsights were procured under the first production contract.[2] One was sent to the Army at Wright Field, Ohio for testing and the rest were tested at Dahlgren. With all of its shortcomings and complexity, the Mark XI represented a significant improvement over other bombsights. However, it did not resolve the limitations of high altitude horizontal bombing.

After signing the contract with the Navy Norden went to his mother's Zurich home to work on his next design, the Mark XV. This was the bombsight (known as the M-series by the Army Air Force) that was eventually used by both the Army and the Navy during World War II. Two prototypes of the Mark XV, a timing sight and a synchronous sight, were delivered to Dahlgren in February 1931, for evaluation. While timing sights were the current technology, all developers knew that synchronous sights held more promise for accuracy. Both the Army and the Navy supported the development of such bombsights.

A timing sight uses a telescope and a timer to measure the movement of a point on the ground relative to the aircraft. The time and aircraft altitude are used with a ballistics table to determine the angle at which the telescope should be set. If the pilot keeps the aircraft at the same altitude and speed, then the bombs should be released when the target appears in the telescope. Variations in aircraft altitude and speed, as well as wind, are the major causes of inaccuracy. The Mark XI was perhaps the best of the timing bombsights.

In synchronous bombsights, the bombardier adjusts the speed of a wheel or gear in the bombsight mechanism to match the movement of the aircraft over a point on the ground. This synchronized the bombsight with the aircraft's ground speed. Norden described his Mark XV sight as being able to provide ground speed, angles of drift, and true air speed. It could also hold a true compass course and compensate for earth rotation.

The timing method required a long bombing run at a fixed speed and altitude. Conversely, the synchronous sight precluded a long bombing run since ground speed was computed as an instantaneous rate. Navy bombardiers at Dahlgren found that they could adjust the Mark XV sight in six seconds compared to fifty seconds for the Mark XI.

Testing at Dahlgren was intended to identify deficiencies in a new concept, not as acceptance tests. For this reason, the Naval Proving Ground conducted bench tests of the components of the sight as well as intensive flight testing. Dahlgren provided a final report to BuOrd containing 33 pages of deficiencies and suggested corrective actions. Flight tests showed that the Mark XV was twice as accurate as the Mark XI (i.e., the percentage of hits was twice as high). Testing ended in August 1931 when BuOrd issued a production contract for the Mark XV bombsight.

The Mark XV was given more tests than any other sight ever developed by BuOrd. Life tests of various components and analytical studies continued into 1932. On April 18, 1932 the first order for the new sight was placed—thirty-two for the Navy and twenty-three for the Army. The Navy received its first production unit in September 1932 and the Army received its in April 1933. The sights continued to be nearly handmade and every unit went to Dahlgren for calibration and acceptance testing.

The Naval Proving Ground received Norden's next improvement—the Stabilized Bombing Approach Equipment (SBAE)—in February 1935. The Navy tested the SBAE at Dahlgren from 1935 until the delivery of the first production unit in 1937. It was believed by both the Navy and the Army that a remaining source of error was the transfer of flight instructions from the bombardier to the pilot and the resulting piloting errors during the bombing run. Norden developed the SBAE, an automatic flight control system to transfer adjustments of the bombsight's controls through mechanical linkages to the azimuth gyro which allowed the bombardier to fly the aircraft in roll and yaw. Testing revealed both the strengths and weaknesses of the prototype. Flight tests showed a thirty percent improvement in Mark XV accuracy in smooth air and thirty-nine percent improvement in rough air. The first production models were available in late 1936 and production began in June 1937 at the rate of seven to ten per month.

The Army Air Corps had long worked with the Sperry Corporation to equip its aircraft with autopilots and attempted to connect the Norden bombsight and the Sperry A-2 autopilot—without success. In the end, the Army needed both the Sperry autopilot (for aircraft control) and the SBAE. Carl Norden argued that it was a duplication of effort for the Army to equip its aircraft with both Sperry autopilots and Norden SBAEs. In addition to continuing to compete with Sperry, he also preferred to work with the Navy rather than the Army. (He once told an Army Colonel "No man can serve the Lord and the Devil at the same time—and I work for the Navy.")

Tests at Dahlgren compared the Norden SBAE with the Sperry autopilot and concluded that the SBAE "… is at least the equal of if not superior to the Sperry gyro-pilot." The Air Corps did not want to equip their bombers with both the SBAE and the Sperry autopilot and continued to pursue an SBAE replacement. In response, the Navy developed an adapter that allowed the Norden bombsight to be connected to the Sperry A-3 autopilot. Dahlgren completed tests of the adapter in August 1941 and forty units were produced between September and December.

The Army Air Force asked Minneapolis-Honeywell Regulator to develop new automatic flight control equipment (AFCE[3]) with electronic parts to link the A-3 autopilot and the Norden bombsight without the Navy's adapter. This system (designated the C-1), ordered into production in October 1941, was the standard autopilot/AFCE/SBAE for the remainder of World War II.

Procurement became a major headache because the Navy refused to share production with the Army. In addition, because the bombsights were essentially handmade between 1932 and 1938, the Norden Company produced only 121 bombsights per year. The Navy had agreed to share production with the Army but the Navy and Norden never developed a production schedule. The Navy filled its requirements—even as it moved away from horizontal bombing—before sending any bombsights to the Army.

The Army reacted by restarting the acquisition of Sperry S-1 bombsights, which they had stopped in the 1930s. The object was to bring pressure on Norden and the Navy to meet Army needs. The Army authorized Sperry to produce 5000 S-1 bombsights in 1941. After testing and training, the Army decided that the S-1/AFCE combination was inferior to the Norden Mark XV and production was halted in 1943. In the end, 5,563 S-1 bombsights were pro-

cured by the Army (compared to 81,537 Norden bombsights[4]) and most were installed in B-24s. Even after Norden added additional production sources to meet Army Air Force needs, shortages of materials, specialized machine tools, and skilled labor kept production below required levels. There was a major shortage of bombsights that extended to late 1943.

All Norden bombsights continued to go to Dahlgren for bench and flight testing. After a period of shop testing, bombsights were sent for flight testing. Typically, each sight was used to drop six to eight bombs. Approximately half were dropped on each of two opposite courses. Bomb impact data were collected and mean impact points and mean deviations (both in range and deflection) were calculated. Finally, the Aviation Officer reviewed the data and either accepted or rejected the sight. Rejected sights were sent back for additional shop and flight testing. It was estimated that this process delayed delivery for four to five weeks.

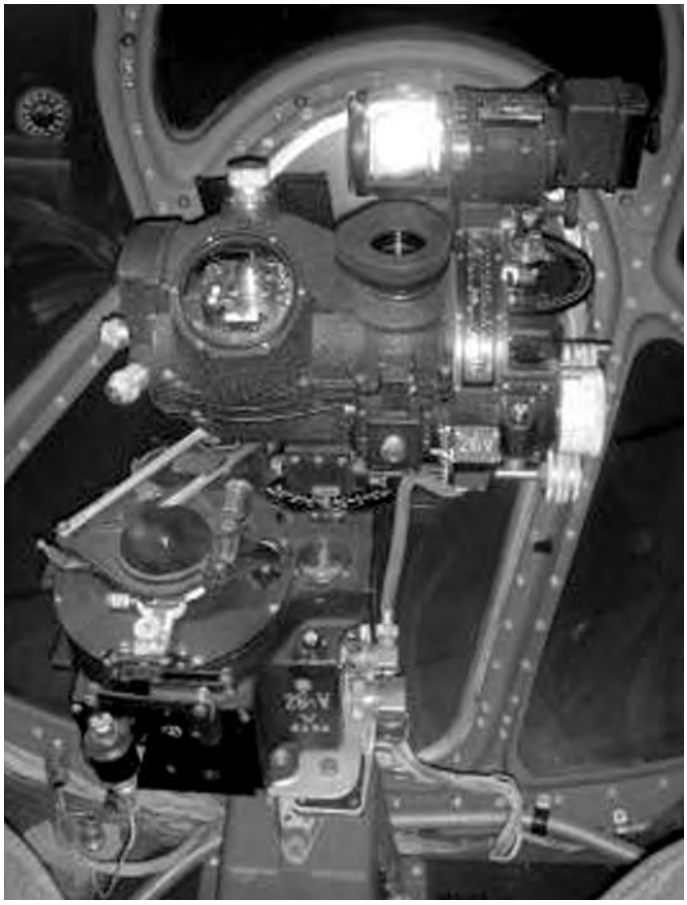
Even though Dahlgren testing was impeding bombsight availability, BuOrd refused to eliminate the testing. They did make some concessions—only one bombsight of every ten produced would be sent to Dahlgren for testing. They also agreed that bench testing would be completed on the day that the sight was received. Further, Dahlgren would only flight test the number of sights that could be completed within fifteen days of bench testing.[5]

The number of Mark XV bombsights that underwent acceptance testing at Dahlgren each year are given in the following table[6]:

Year	Number Tested
1932	52
1933	41
1934	104
1935	92
1936	122
1937	181
1938	85
1939	187
1940	473
1941	876
1942	610
1943	1494
1944	2316
1945	873

Note that lot acceptance testing started during 1942 and only 10 percent of the bombsights were delivered to Dahlgren thereafter. A total of 4,938 bombsights were delivered to the services in 1942. The totals given for the remaining years are 10 percent of total production.

As the war went on, it became clear that Army Air Force performance requirements exceeded those of the Navy and that the Navy had little interest in modifying the sight since it had chosen dive bombing as its preferred means of attacking moving targets. Thus, improvements to the bombsight were motivated by the Army and, by late in the war, were being developed by someone other than the Norden Company.



Norden Mark XV Bombsight with C-2 Stabilizer. ***(Twinbeech.com photo.)***

Between 1932 and the end of World War II, nearly 90,000 Mark XV (or M-9) bombsights—81,537 for the Army Air Force and 8,353 for the Navy—were produced at a total cost of $1.1 billion. Production began to catch up with demand by late 1943, but mass production techniques also led to declining quality. The Norden Company was not interested in helping to solve the problem and in late 1944, seventy-five to eighty percent of all sights produced failed to meet specifications.

Operational Accuracy

The accuracy achieved at Dahlgren during testing was never duplicated in combat. The Navy specification was for two and a half mils (or two and a half feet mean miss for every 1,000 feet of altitude). The inherent accuracy of the 1944 Norden sights was fourteen mils, due to looser manufacturing tolerances. By some reports, the accuracy achieved in combat was more than fifty mils.

The standard measure of bombing accuracy was the statistical parameter Circular Error Probable (CEP), the radius of a circle, centered on the target, within which fifty percent of the bombs would fall. This proved impossible to visually quantify for the large missions over Europe in World War II. CEP was replaced by the number of bombs that fell within a 1,000 foot circle. This was calculated by drawing a circle with a 1,000 foot radius (on a post attack photograph) around the greatest concentration of bombs.

The distance from the target point to the center of the circle was the circular error and the measure was the percentage of bombs that fell within this circle.

There were several problems that contributed to the reduced accuracy under combat conditions. The first is inherent to the sight itself. Norden bombsights were optical sights and the bombardier had to be able to see the target. That would be nearly impossible for all but the first few groups over the target due to smoke and dust generated by the bombing. Data gathered in 1943 show that an average of 13.6 percent of bombs dropped by the first three groups fell within 1,000 feet of the target while the average dropped to five percent for the last groups.[7] Cloud cover over the target had the same effect. European weather data from 1942 show that there were only 113 days when conditions over the target were acceptable for visual bombing.[8] Data from January 1944 through March 1945 are similar—there were 132 visual bombing days in Northern Europe.[9] In general, miss distances at least doubled when targets were obscured.

The limitations of an optical bombsight were well known to the Army and they had started working on the problem as early as 1939. They tried a variety of options, including beacon and radio direction, but settled on radar aiding of the bombsight. The most used system was the H_2X (or "Mickey") radar. It replaced the optical telescope and allowed the operator to pass angle measurements to the bombardier so that he could align the sight to the unseen target. The bombardier would drop the bombs based on the radar although he could override the radar if the target was visible. This system was inherently inaccurate. Operator error, beam width, and target spot size all contributed to error. Thirty percent of bombs fell within 1,000 feet with visual bombing in clear weather while zero to five percent of bombs fell within 1,000 feet with H2X or H2X-aided visual bombing.

Another significant factor was altitude since error increased with altitude. Most testing (and training) was done below 10,000 feet altitude. The average bombing altitude in Europe through the end of 1944 was 24,500 feet. The improvement in accuracy obtained in 1945 was largely due to a reduction of average bombing altitude to 16,000 feet because air supremacy had been achieved.

The human factor also contributed to inaccuracy. Bombardiers at Dahlgren were, in general, better trained and more experienced. Perhaps more important was the fact that they were operating in benign conditions. Errors in determining and maintaining altitude, speed, or angular orientation in combat contributed to inaccuracy.

Army Air Force tactics also contributed to inaccuracy. While protection of the bombers forced them to fly and bomb from higher altitudes, it also required them to fly in large formations. As a result of these large formations, bombardiers could not drop bombs individually. The standard tactic by early 1944 was for a formation to have a lead bombardier (and deputy lead bombardiers) who would use his bombsight while all others dropped their bombs on his signal. Weather also drove changes in tactics. Precision bombing was only possible on clear days. On other days, bombing of area targets was dictated by H2X accuracy. Accuracy increased in late 1944 and 1945 due to bombing from lower altitudes.

Another factor was target selection. Given the small size of the high explosive bombs typically dropped (250 or 500 pounds) and the relative lack of bombing accuracy, the aim point was usually the center of the target system or city. This was done, in part, to ensure that the greatest amount of damage was done to the target system. Unfortunately, the critical areas of the target system or city were seldom in the center. That, coupled with the small damage radius of the individual bombs, usually resulted in damage to buildings but not always to the equipment in the building. The typical result was a temporary reduction in production. Synthetic oil targets were easy to locate visually and highly concentrated which lent themselves to accurate visual bombing. The greatest damage—often permanent—was done at the end of the war with 2,000—4,000 pound bombs.

While some used the discrepancy between design and operational accuracy to question the effectiveness of high altitude bombing, the performance of the Eighth Air Force in Europe refutes this. In the end, seven and a half million bombs were dropped from an average altitude of 21,000 feet with 31.8 percent of them falling within 1,000 feet of the aiming point. While strategic bombing and the Norden bombsight did not meet prewar expectations for precision, German oil production was stopped and twenty percent of German war production was destroyed in the last sixteen months of the conflict.

Epilogue

The Norden bombsight continued to be used into the 1950s. Bombsights on older aircraft were left in their wartime state and used when the aircraft were deployed during the Korean War. Mechanical bombsights were made obsolete by technology and radar bombsights began to replace them during the 1950s. While contemporary radar bombsights were less accurate than the Norden, precision bombing was not important with nuclear weapons. In addition, mechanical bombsights, like the Norden, operated too slowly for the newer, faster bombers.

Over the years, more advanced radar bombsights were developed and, later, electro-optical systems such as laser and infrared target designators and GPS satellite systems eliminated the need for bombsights altogether.

The last recorded use of a Norden Mark XV bombsight was in Vietnam. It was installed in the P2V aircraft of Naval Air Observation Squadron Sixty-Seven (VO-67). The bombsights were used in *Operation Igloo* White for implanting Air-Delivered Seismic Intrusion Detectors (ADSID) along the Ho Chi Minh Trail in 1968.

The Norden bombsight represented a major step forward in bombsight technology and was a prerequisite for the implementation of Army Air Force strategy in World War II. Even though it didn't live up to its reputation for "pickle barrel" accuracy, it made an important contribution to victory in World War II. Its position in popular history is also secure.

The Navy's role in the development of the Norden bombsight is less well known than is its use by the Army Air Force in World War II. Even less known is the role that the Naval Proving Ground in Dahlgren, Virginia played in the development, testing, and acceptance of the Norden bombsights beginning soon after World War I. It's clear that all deserve credit for their significant contributions to the breakthrough capability represented by the Norden bombsight. ■

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NOTES

1. McFarland, p.72.

2. Hedrick, p. 240.

3. The Army called this equipment "AFCE" because the Navy classified the term "Stabilized Bombing Approach Equipment (SBAE)."

4. McFarland, p. 148.

5. There were critics of flight testing at NPG. They felt that flight testing provided an inadequate measure of acceptability. However, they conceded that flight testing was required in order to discover if there were conditions that cause errors that wouldn't be revealed by ground testing.

6. Hedrick, p. 240.

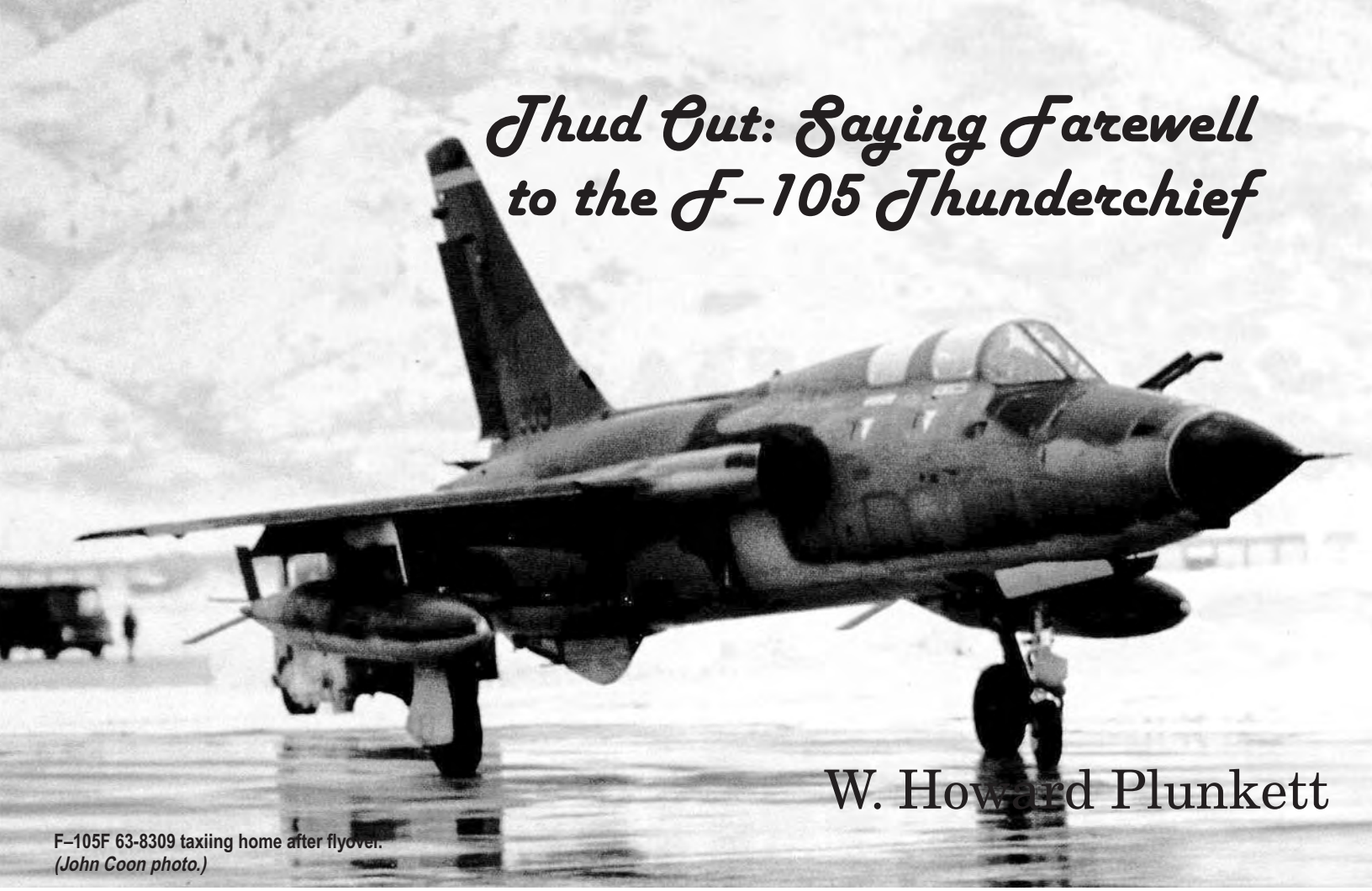
7. Overy, p. 157.

8. Overy, p. 155.

9. McFarland, p. 178.

Thud Out: Saying Farewell to the F–105 Thunderchief

W. Howard Plunkett



F–105F 63-8309 taxiing home after flyover.
(John Coon photo.)

On a cold, snowy, overcast weekend in February 1984, over 300 former F–105 pilots and maintainers gathered at Hill AFB in Utah to celebrate the final farewell to the Thunderchief. The affair was called the "Thud Out" and was hosted by the Air Force Reserve's 419 TFW, the last unit to operate the F–105. The Wing was well on its way to convert to the F–16, the first Reserve unit to do so. A couple of months before the event, an invitation from the 419th's Project Officer, Major Tom "Waldo" King, circulated throughout the Air Force and units of the Air National Guard and Air Force Reserve. "If you (or your unit) were ever associated with the F–105, you should be here." He had carefully planned the festivities that included a memorial dedication of an F–105 on static display, a flyover of the last three flyable F–105s, and a dinner reception for all.

The F–105 was a favorite of the people who flew and maintained it during its nearly thirty years of service that started in 1955. During the plane's first ten years, it became the Air Force's primary fighter-bomber and sat nuclear alert in Germany, Korea, and Okinawa. For the next ten years, between 1964 and 1974, it carried its pilots from two bases in Thailand to brutal combat over Laos, North Vietnam, and Cambodia. After the war, Guard and Reserve units flew the plane for another ten years in New Jersey, Oklahoma, Washington D.C., Virginia, Texas, Kansas, Georgia and Utah.

The plane's early years were marred by accidents that revealed deficiencies, which the Air Force eventually corrected. It was during this period that it acquired the sobriquet "Thud", originally a derisive name that referred to "... the sound it makes when it crashes". However, by the time of the Vietnam War, most of the plane's deficiencies had been fixed and its nickname became one of affection for its power, speed, durability and the sound of its bombs hitting their targets. The high esteem given to the F–105 by those involved with it over its thirty years was reflected in the theme of this final farewell at Hill—"People let me tell you 'bout my best friend."

Friday – Day 1

The Thud Out started Friday morning February 24, 1984. As arriving guests registered, they met people they had known during their F–105 days. On Friday evening they gathered in the officer's club for drinks and the telling of favorite Thud stories. MSgt John Coon, a former F–105 maintenance troop who made it to the Thud Out, remembered, "... that evening at the Officers Club was another gathering of old friends, many of whom had not seen each other for some time. The atmosphere was social and convivial with everyone exchanging remembrances and 'war stories'." Vendors in hallway booths exhibited Thunderchief memorabilia and sold pins, T-shirts, and made-to-order hand-carved models. A popular

The last three F–105Fs on the ramp at Hill AFB. ***(John Coon photo.)***

item was a plastic F–105 model on an arrowhead base that sold for $45.00. The party lasted until well after midnight and prepared the group for the next day's more formal activities.

W. Howard Plunkett is a retired Air Force lieutenant colonel. His twenty-year career as an aircraft maintenance officer began with F–105 Thunderchiefs in 1964. He supported F–105s in Kansas, Japan, and Thailand, as well as F–4s in Germany and Korea. He earned an MS in Logistics Management from the Air Force Institute of Technology. He commanded the Avionics Maintenance Squadron at Kunsan AB, Korea, and the Field Maintenance Squadron at Wright-Patterson AFB, Ohio, was an F–4 Avionics Staff Officer at Hq TAC, served as a depot inspector on the AFLC Inspector General team, and was a Maintenance Division Chief at the Air Force Operational Test and Evaluation Center. Beginning in 1983, he worked in the aerospace industry as a reliability engineer on the B–2 stealth bomber and for other companies as a software quality assurance manager, a logistics manager, a technical writer, and in business development. For the past twenty-five years he has researched the operational history of the F–105 Thunderchief. He has provided many other aviation authors with historic details of the F–105 during the Vietnam War. His own publications include three articles in Air Power History Journal, two articles in the Friends Journal of the National Museum of the U.S. Air Force, and two books: F–105 Thunderchiefs*, detailing the histories of all surviving F–105s in museums and on static display around the world, and* Fighting Cavaliers: The F–105 History of the 421st Tactical Fighter Squadron 1963-1967.

Saturday Morning – Day 2

Saturday's Thud Out ceremonies began at 9:30 a.m. when the 419 TFW hosted an open house in their hanger. John Coon described the mood as "... more somber and nostalgic, in keeping with the motto of Thud Out - 'Let me tell you 'bout my best friend'. The mood was also reflected in the weather - low, gray overcast, cold temperatures (in the twenties), and it was snowing off and on."

Two restored F–105s were parked inside, gleaming under the hanger lights. F–105B 57-5814, which, twenty years earlier, had flown as "Thunderbird 1", was now camouflaged and marked with the 419th "HI" tail code. The 419th had flown the plane since April 1973, when they received it from the New Jersey Guard, and had retired it at the end of 1980. (It later ended up displayed at the Salt Lake City airport where it was left to deteriorate so badly it was eventually scrapped.)

At the other end of the hanger, parked beneath a large American flag hanging from the rafters, was F–105D 59-1743 with bombs loaded on all of its stations. A Vietnam combat veteran from 1967 to 1970, it had ended up its career in 1981 with the Virginia ANG, and was now in the collection of the Hill Aerospace Museum across the base from the 419th hanger. It was marked with the "JJ" tail code of one of its earlier units, the 34 TFS from Korat, Thailand.

Beginning at 10:45 a.m., three two-seat F–105Fs took off from the Hill runway. Flying the planes from the front seats were all highly-experienced F–105 pilots from the

The Thud Out pilots left to right: Maj Barry D. "Taco" Wyttenbach, Col Merlyn H. Dethlefsen, Maj Frank P. "Blackjack" Bernard, Col Leo K. Thorsness, Lt Col James K. "Gringo" Webster, Col Thomas J. Coady. ***(Photo from Waldo King.)***

419th's 466 TFS. The men in the rear cockpits, "Backseat Honorees", were well-known F–105 pilots from the Vietnam War.

Flying 63-8287 with call sign "Thud 01" was Lt. Col. James K. "Gringo" Webster, who had flown 137 F–105 combat missions. In his back seat was Col. Thomas J. Coady, who had over 1,000 combat hours in the F–105, the first Thud pilot to achieve this record.

In "Thud 02", F–105F 63-8261, was Maj. Frank P. "Blackjack" Bernard who, on October 6, 1970, was one of four pilots flying the last F–105D combat mission of the Vietnam War. In his rear cockpit was Col. Merlyn H. Dethlefsen, a former Wild Weasel pilot with the 354 TFS who had been awarded the Medal of Honor for his combat mission over North Vietnam when he and his EWO, Capt Mike Gilroy, supported the first strike against the Thai Nguyen iron and steel mill on March 10, 1967.

Flying 63-8309, "Thud 03", was Maj. Barry D. "Taco" Wyttenbach who had flown 159 combat missions from Korat and Takhli, the two F–105 bases in Thailand. Behind him was the Wild Weasel pilot and former POW Col. Leo K. Thorsness from the 357 TFS who had received the Medal of Honor for his mission over North Vietnam on April 19, 1967.

At 11:15, 30 minutes after the three Thuds had taken off, F–105D 62-4347, mounted on a pylon in a small park near the 419th area, was "... dedicated as a monument to all Air Force personnel who lost their lives while flying the Thunderchief ...." This plane had accumulated more flying hours on its airframe, 6,730.5, than any other F–105 and was known as the "High Time Thud".

The dedication speaker was Brig. General Roger P. Scheer, deputy to the Chief of the Air Force Reserve, from Washington D.C. General Scheer had flown F–105s for years starting as a First Lieutenant at Spangdahlem AB, Germany, in 1961. As a Major, he had been awarded two Silver Stars during his 450 combat hours flying F–105s in Vietnam. He later commanded a Reserve F–105 squadron and, as a Colonel, commanded the Reserve's 301 TFW that flew F–105s from Carswell AFB, Texas, and Tinker AFB, Oklahoma. He was one of six pilots to log more than 3,000 hours in the F–105.

Col. Victor Vizcarra, a former F–105D pilot from Yokota AB, Japan, who, as a Captain, flew F–105s in combat over North Vietnam and Laos in 1965 and 1966, was watching the ceremony. "I would best describe [the atmosphere as] being very much like a 'wake', mostly festive but still solemn at times, everyone being sorry to see an 'old friend' go. The weather was brisk for the ceremony outside.... [General Scheer] ... spoke from a raised podium so he was easily visible from the back of a good size crowd gathered around the front of the static display. I'd estimate there was close to a couple of hundred people ... for the speech."

The final flyover of the three F–105Fs was timed to pass over the crowd in a missing man formation at the end of General Scheer's speech. Waldo King recalled, "... I was in radio contact with them to work the timing."

Colonel Vizcarra, recalled his feelings about the flyover:

I remember being disappointed that they were all 'two holers', not a single 'D'. It was ... extremely cold but well worth enduring the low temperatures to see and hear that great distinctive sound of the Thud as they took off and then came back over the field several times. The flight was rela-

F–105D 62-4347 was dedicated during the Thud Out "… to all Air Force personnel who lost their lives flying the F–105 Thunderchief, from Captain Jack B. Mayo, January 1961 to Captain Dennis J. Mason, August 1981. This aircraft … with 6730.5 hours flying time is the 'High Time' F–105." (*Plaque caption on aircraft pylon. John Coon photo.)*

tively short, less than an hour, and then they came in for individual landings. They ... didn't drop their drag chute as they cleared the runway and instead taxied in with the billowing chutes trailing behind the aircraft. It was a chilling and emotional sight that made your eyes water knowing that this was the last operational time these great birds would take to the air. It was pretty quiet with not too many people talking as we all walked back to the busses. It was definitely the saddest time of the 'Thud Out' - It was as if we had just buried our closest friend and were walking away from the grave.

After lunch, the 419th hosted a three-hour Tactics Symposium for active duty and Guard and Reserve people with Secret clearances. Those attending heard briefings on Compass Call, the EF–111, and an assessment by Dick Pawloski from General Dynamics of military threats throughout the world.

Saturday Evening – Day 2

The Thud Out banquet started with cocktails at 5:30 p.m. Originally planned for the Officers Club, tables were set up in the 419th hanger to handle the larger-than-expected crowd who paid the $25.00 fee. As they did in the Officer's Club the night before, vendors offered Thud memorabilia from booths along two side walls of the hanger. Former F–105 pilot, John Piowaty, famed for the handle-bar moustache that he sported during his combat tour at Takhli in 1967, manned the booth sponsored by the Red River Valley Fighter Pilots Association — The River Rats.

John Coon described the set up in the hanger. "There were quite a number of displays pertaining to the F–105 — charts of MIA, POW, and KIA Thud pilots; high-time pilots and Thuds; many strike and post-strike photos. ... Slides of F–105s were constantly being shown on a large screen hung from the ceiling."

The high-time pilot chart listed 20 names. At the top was Col. Raymond F. Kingston with 3,709.6 hours flying the F–105. He had flown acceptance test flights from the Republic factory during the F–105's production period. General Scheer, the morning dedication speaker, was number three with 3,493.3 hours. Not noted, but an indication of the hazards of flying the Thud, nine of the 20 high-time pilots had ejected from an F–105, all but one due to accidents.

Vic Vizcarra described another detail. "One thing ... that really impressed me was a computer printout of every pilot that had flown the Thud, sequentially listing from the highest time and date of checkout to the lowest time and latest checkout date. The computer list was long and was posted starting along the hanger wall of one side and then wrapped through the front hanger doors to the other side hanger wall. I remember seeing Jim Caldwell's name, a good friend from the 80 TFS [at Yokota], being either the second or third high-time pilot with over 3,000 hours in the Thud. At the end of the list there were several pilots with only 10 hours Thud time which I thought was strange and then figured out they were students that didn't finish the checkout program. ... "

Dinner began at 7:00 p.m. It was conducted as a "Semi Dining Out" with formal toasts and guest speakers throughout the evening. The 419 TFW's commander, Col John J. Closener was President of the Mess and Capt David

F–105B 57-5814 in Thud Out Hanger with "HI" tail code of the 419 TFW at Hill. ***(Bane Lyle photo.)***

G. Perry, the last F–105 pilot to become combat ready, served as Mr. Vice or master of ceremonies. For the uninitiated, a program handout described Dining Out protocol under the heading "Thud Out Rules of Engagement". "This event is a last tribute to a grand ole warbird. What made it a legend in its own time was a team effort of Thud pilots, maintainers, engineers, and Thud lovers. Therefore, we have opened the doors to whoever would like to attend." John Coon recalled that, "The temper and atmosphere during the dining out was at times festive and at other times somber and nostalgic."

The dinner menu started with shrimp cocktail and featured a 10-ounce New York strip steak. It ended with apple pie, an appropriate All-American meal for the occasion.

The party planners raffled a wire sculpture of an F–105 produced by the aircraft maintenance squadron at Hill. The raffle winner donated the sculpture back for an auction to raise money for the Scholarship Fund of the River Rats. Tom Carlson won the auction by bidding $400. He then gave the sculpture to the Rats for permanent display. The auction raised a total of $3,200 for college scholarships for sons and daughters of men who had died in the Vietnam War. Later, the River Rats decided to use the sculpture as the award to the person selected as the River Rat of the Year.

Speeches started during dinner. The first of seven speakers was Theodore W. Van Geffen, Jr., a Dutch aviation writer who was well-known as a historian in the F–105 community, and who had been gathering information on the F–105 since 1965. "The Dutchman" spoke for nearly an hour, illustrating his talk with 35-mm slides while he recited key events and dates, along with achievements and deficiencies encountered in the plane's development and deployment over the years.

The plane's early test flights were the subject of the next talk by Mr. Henry "Hank" Beaird, who had been a Republic test pilot at Edwards and had flown the first F–105B with a J-75 engine in May 1956. "I'm very proud to be here tonight. I wouldn't have missed this thing for anything." Referring to Van Geffen's long talk, he joked, "It must have been written by North American. I'm going to tell you a few good things about the airplane. I have never seen a pilot who had over 10 hours in it who didn't like it." Hank showed a few Republic film clips on tests at Edwards that included the 190-knot wheels-up landing he made at the end of his first F–105B test flight after its gear wouldn't come down. The plane skidded 4,000 feet down the runway. "How many of you guys remember your first flight that well? I remember every foot of it! When the drag chute didn't work, I was pushing on the brakes and it still didn't stop any quicker."

Due to the public's attitude against the Vietnam War, he lamented the lack of awareness of the plane and its combat record. "Some of the cadets over at the Air Force Academy said, 'What's that airplane?' It carried the war for five years and nobody seems to know it! But you guys do! ... This was one of the greatest machines to ever take to the air. And it still is." Commenting on what has been important to him, he remarked, "Let me give you a little of my philosophy. It's not the ten first flights that I've made for which I'm very proud. It's not the 15,000 hours that I've accumulated over the years in flight testing and in the Air Force. What means the most to me are the friends you pick up along the way. Witness you guys here! There will never

The formation flyover during the Thud Out. (John Coon photo.)

be another airplane to be retired with a history that this one has and I'm glad I'm a part of it."

The next speaker was retired Brig Gen Robert R. Scott who had had one of the longest associations with the F–105 of anyone. He had retired in 1970 and was operating a cattle ranch in California. General Scott reminisced about his long military career. He was a 55-mission World War II pilot who flew P-61 night fighters in China where he shot down two Japanese planes. He flew 117 combat missions in the F–86 in Korea and became involved with the F–105 at Edwards AFB in 1956 as a Tactical Air Command test pilot comparing the Thunderchief with North American Aviation's F–107A. He described the F–105 as "... the most versatile single-engine fighter that the world has ever seen", and said the Air Force definitely made the right decision in selecting the F–105 over the North American F–107. After his work at Edwards, he commanded the Air Force's first F–105 test squadron, the 335 TFS, at Eglin AFB, Florida. As a Colonel in 1966 he was the 355 TFW's commander at Takhli, Thailand, where he flew 44 F–105 combat missions over North Vietnam and was credited with shooting down a MiG-17.

Speaking next was renowned F–105 combat pilot, Wild Weasel instructor, and humorous story teller, retired Lt. Col. Billy R. "Sparky" Sparks from Las Vegas, Nevada. He had flown 2,067 hours in the F–105 with 184 1/2 combat missions in Vietnam having been shot down and rescued on his last one. He had also flown as a Wild Weasel pilot and was credited with destroying five SAM sites. He first met the F–105 at Nellis in 1961, then again at Spangdahlem in Germany, and as an instructor pilot at McConnell AFB, Kansas. "McConnell", he joked, "is a lot like Utah without the mountains but with the dumb liquor laws." He was, he said, supposed to talk a lot about Rolling Thunder. "For those of you who don't know what Rolling Thunder was, it was a lot of fun over in South East Asia." What he remembered was, "... Robert McNamara as Ops Officer, the Government of the United States as Flight Commander, and 4,983 other assholes sitting back here as flight leads." He talked about being in the first TAC F–105 squadron to go to Thailand where he began flying Rolling Thunder missions. His reference was to the 563 TFS who departed McConnell in April 1965 for Takhli. "I don't really know how to describe Rolling Thunder. Anyway, they wrote a song called the "Doumer Bridge Blues" and the first verse goes something like this:"

Tell me a place just south of the Ridge.
The name of the place is the Doumer Bridge.
You take the mike and I'll take the flak,
Come on I'll show you where it's at.
Come on I want to show you the way!

Sparky had recited the first of seven verses of a song composed by Capt Robert B. Middleton when he flew with the 354 TFS at Takhli. Middleton had composed the song for the third River Rat Convention in November 1967 at Takhli shortly before he had flown his 100th combat mission in December.

In his characteristic rapid-fire story telling, Sparky described several of his combat missions. "My first Rolling Thunder mission that I can remember, Fred Cherry was going to take us up. We were going to find a bunch of things that looked like ammunition bunkers by Phuc Yen Airfield. ... Fred had to go get in a spare airplane, so as I taxied out, Fred said, 'Why don't you go and find it and show me where

F–105D 59-1743 was one of two restored F–105s displayed in the 419 TFW's hanger during the Thud Out. It had the "JJ" tail code from one of its combat units, the 34 TFS from Korat. (Bane Lyle photo.)

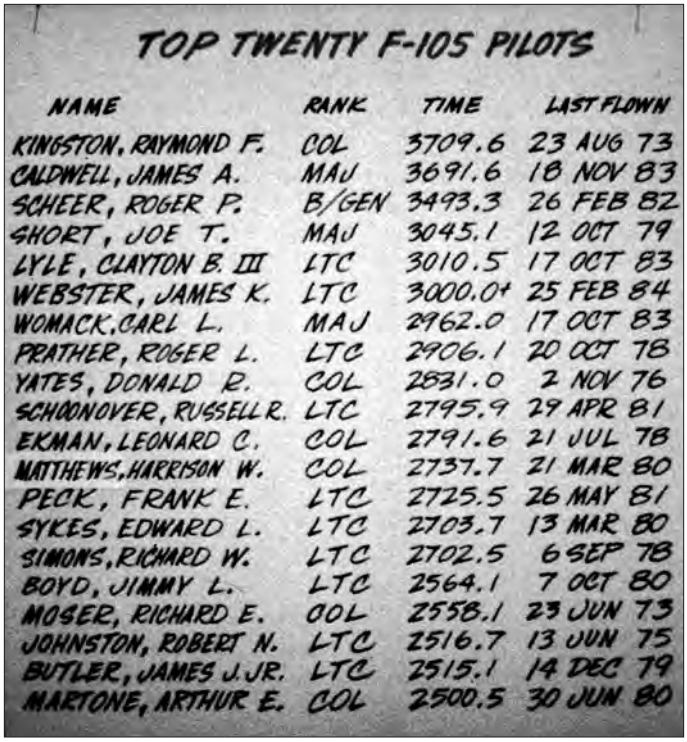
it is'. We found the place and rolled in. We did our very best bombing job to put bombs right through that first bunker. We got this great secondary. Two or three other flights got these great secondaries. About that time Fred Cherry showed up and said, 'Where are they?' I said, 'Don't bomb none of those buildings there's nothing in them. We got the most secondaries you've ever seen in your life!"

Sparky told of his least favorite Rolling Thunder target — the Thanh Hoa Bridge. "To show how smart Rolling Thunder was, we went back to the Thanh Hoa Bridge about 937 times dropping 750-pound bombs on that sucker and it would have taken a major earthquake to knock just the dirt off it! The only smart comment I ever heard about that stupid bridge was from the guy that commanded the Navy. You know, guys that fly off boats and run around on water and have trouble in rolling up their airplanes when their boat runs off? He said, 'I'll make a deal with Ho Chi Minh. I'll push two squadrons of Phantoms off the fantail if he'll blow that sum'bitch up and leave it.' Ho Chin Minh wouldn't do that and so we lost more Phantoms than that. They finally got the damn thing when they got 2,000-pound bombs in '72."

The Thud Out marked the retirement day for the next speaker, MSgt Wally "Knuckle Buster" Craggs. He recalled events from his 14 years as an F–105 crew chief, at Nellis, Korat, Takhli and the 419th at Hill. He remembered hanging 450-gallon wing tanks at Korat "... about four or five times a day", and told of one memorable pilot write-up on an F–105 at Hill — "The cockpit lighting was too dim." He signed that one off; "It was evening. Remove the pilot's sunglasses." He ended by leading a toast, "... to the weapons loaders and the shit-hot maintenance troops of the Thud!"

Speaking next was Dr. Robert J. Sanator, President of Fairchild Republic Company. He offered his perspective on the airplane his company produced. "I thoroughly enjoyed today's events and I'm proud to be here to represent the many thousands of men and women who worked at Republic for over 50 years and have designed and built more than 24,000 aircraft. In this day of mixed emotions, the thrills of this final flight equate to those I fully remember of the first F–105 flight I witnessed years ago. The F–105, as you know, had a difficult birth, an uncertain childhood, and a dubious adolescence. But did it ever have a magnificent maturation ... when it mattered. ... There was no sight more beautiful than today's flight of the F–105. Even now in the 1980s this creation of the 1950s looks like it belongs. It's as sleek and modern looking as any aircraft flown anywhere in the world today. ... The F–105", he continued, "introduced for its time a long list of firsts ... an especially designed internal gun capable of firing 100 shots in one second ..." and the first to include integrated avionics. "It was born of a day," he said, "when things were simpler, bureaucracies smaller. ... It was bought on the basis of a proposal, a document consisting of one book of 150 pages." He pointed out that, "... along with the lasts of today, tomorrow the Air Force accepts the 713th and last [Fairchild-Republic] A-10A better known as the Warthog or just plain Hog."

Retired Col. Leo Thorsness was the evening's keynote and final speaker. He filled in for former POW Lt. Gen. John P. Flynn who fell ill during the day's activities and didn't make the banquet. Thorsness characterized flying the F–105 as "pure ecstasy". He told of his feeling watching his wingman circle him as he was parachuting into Hanoi



TOP TWENTY F-105 PILOTS

NAME	RANK	TIME	LAST FLOWN
KINGSTON, RAYMOND F.	COL	3709.6	23 AUG 73
CALDWELL, JAMES A.	MAJ	3691.6	18 NOV 83
SCHEER, ROGER P.	B/GEN	3493.3	26 FEB 82
SHORT, JOE T.	MAJ	3045.1	12 OCT 79
LYLE, CLAYTON B. III	LTC	3010.5	17 OCT 83
WEBSTER, JAMES K.	LTC	3000.0+	25 FEB 84
WOMACK, CARL L.	MAJ	2962.0	17 OCT 83
PRATHER, ROGER L.	LTC	2906.1	20 OCT 78
YATES, DONALD R.	COL	2831.0	2 NOV 76
SCHOONOVER, RUSSELL R.	LTC	2795.9	29 APR 81
EKMAN, LEONARD C.	COL	2791.6	21 JUL 78
MATTHEWS, HARRISON W.	COL	2737.7	21 MAR 80
PECK, FRANK E.	LTC	2725.5	26 MAY 81
SYKES, EDWARD L.	LTC	2703.7	13 MAR 80
SIMONS, RICHARD W.	LTC	2702.5	6 SEP 78
BOYD, JIMMY L.	LTC	2564.1	7 OCT 80
MOSER, RICHARD E.	COL	2558.1	23 JUN 73
JOHNSTON, ROBERT N.	LTC	2516.7	13 JUN 75
BUTLER, JAMES J. JR.	LTC	2515.1	14 DEC 79
MARTONE, ARTHUR E.	COL	2500.5	30 JUN 80

This chart listing the F–105's high-time pilots was one of the displays in the Thud Out hanger. ***(John Coon photo.)***

on April 30, 1967, the day he was shot down and became a POW. "Here comes that Thud, he's coming right at you. You've got zero airspeed, you're going down; you're stuck under that damned chute. He's close by — 50 to 100 feet to the side. You'd give everything in the world and everything you ever wanted to change places with that guy." While acknowledging his fellow pilots, he gave credit for the success of the airplane to the people behind it. He had all the maintainers in the audience stand for applause. "Hats off to you!" he said as the crowd clapped and cheered. He spoke eloquently of his experience as a POW. "I had freedom and lost it for a few years. I can say to the rest of the world there is still no other nation that offers its citizens opportunities, freedoms, delights, as does the United States of America. Thank you so much for asking me to be here."

It was after midnight when the party ended. Victor Vizcarra remembered that, "... after the dinner and speeches, [the 419th] started handing out ... parts from ... bins at the back of the hanger to anyone that wanted a piece of the Thud. I picked up a wing tip light fairing with a red lens and a couple of blue lens formation lights, which I still have." As a Thud maintainer, John Coon chose a different souvenir. "I obtained an 'Iron Maiden'. This was a set of avionics equipment cooling air ducts from the lower electronics compartment. I still have the scars on my head and arms from banging into the sharp edges when I worked on the F–105."

The crowd gradually drifted out of the hanger with everyone taking not only spare parts no longer needed, but fond and often sad memories of the plane that was once a significant part of their lives.

Final Flights

Over the next two weeks, the three remaining F–105s were flown to their destinations. On February 27, 1984, two days after the "Thud Out", Lt Col. James "Gringo" Webster flew F–105F 63-8309 with no one in his back seat to Robins AFB, Georgia, where the 2955 Combat Logistics Support Squadron used the plane for aircraft battle damage repair training. It was scrapped in July 1995.

The next to last Thunderchief to fly was F–105F 63-8261. On March 3, 1984, it was flown from Hill to Little Rock AFB, Arkansas, for static display at Camp Robinson outside Little Rock. The pilot was Maj Kent 'Supe' Clark and his rear-seat passenger was Mr. Theo Van Geffen, the F–105 historian and aviation writer from Holland who had spoken at the Thud Out. The plane sat in the grass for the next 14 years at All Flags Heritage Park at Camp Robinson. On November 24, 2008, it was trucked to the Museum of Military History at Jacksonville, Arkansas, where it was restored and placed on a pedestal. The museum dedicated it on Sep 25, 2009. Col Leo K. Thorsness was the dedication speaker.

F–105F 63-8287 was the last Thunderchief to fly when, on March 10, 1984, the aircraft was flown from Hill to Chanute AFB, Illinois, for static display at Chanute's Aerospace Museum. The pilot of the last flight was Capt Joe Gelinger. His rear cockpit was empty. The plane sat on the ramp outside Chanute's Aviation Museum for over 30 years. The Air Force closed Chanute on 30 September 1993 but the museum remained open for the next 22 years. Unfortunately, due to a lack of operating funds, the museum closed on November 1, 2015. As of December 2018, the badly deteriorated airframe was heading to the scrap yard at the direction of the Defense Logistics Agency. ■

Notes on Sources

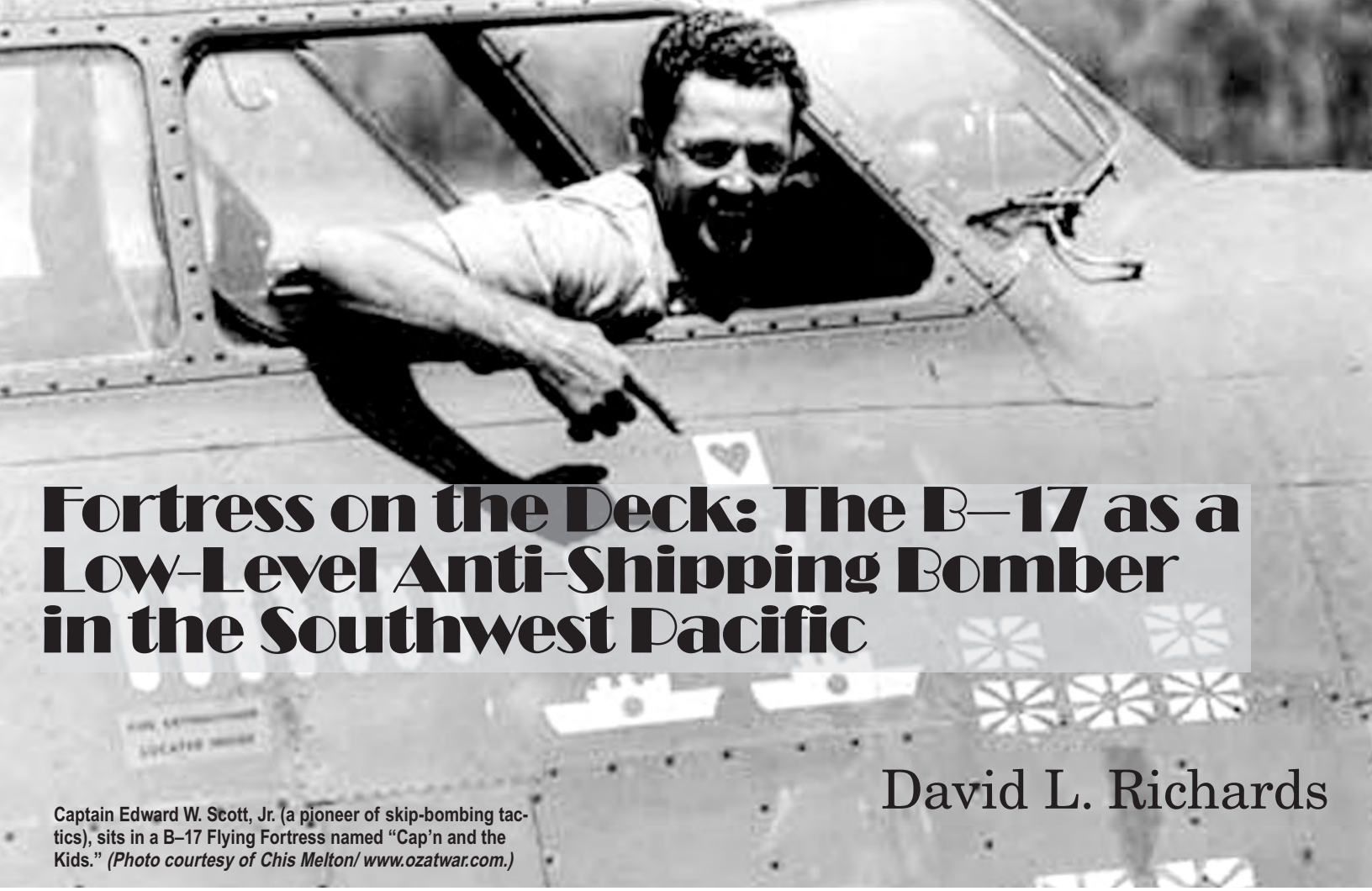
Information for this article came from the following sources:

Thud Out Program Handout; Thud Out List of "Known Attendees"; Col Victor Vizcarra, e-mail to author, Jan 4, 2001; Bruce Brandt letter Jan 8, 1988, in author's archives; MiG Sweep #46, Summer 1984, pp 1-2; MSgt John Coon undated letter to author and author's transcription of MSgt Coon's audio tape of dinner speeches; e-mail from Waldo King, 10 Sep 2019.

In his Feb 27, 1999, e-mail to the RATNET, Mr. Theodore W. Van Geffen told of the initial destinations of the last three F–105s. HQ 2852 ABG/DADF letter May 22, 1985, documented the use of F–105F 63-8309 as an ABDR trainer at Robins AFB.

Photos on Web site http://www.jaxmilitarymuseum.org/f105.html illustrate the museum's relocation and restoration of F–105F 63-8261.

The status of F–105F 63-8287, came from https://en.wikipedia.org/wiki/Octave_Chanute_Aerospace_Museum. Jeff Duford from the National Museum of the U.S. Air Force told of its intended fate in his December 14, 2018 e-mail to the author.



Fortress on the Deck: The B–17 as a Low-Level Anti-Shipping Bomber in the Southwest Pacific

David L. Richards

Captain Edward W. Scott, Jr. (a pioneer of skip-bombing tactics), sits in a B–17 Flying Fortress named "Cap'n and the Kids." *(Photo courtesy of Chis Melton/ www.ozatwar.com.)*

"When I leveled off at 200 feet, I picked up the wake of the ship," reported [Lt.] Murphy. "As I move closer, the 'x' marks on my window met the middle of the ship. I called 'bomb, bomb, bomb, bomb." At each command a 1,000 pound bomb dropped from the belly of the low flying B–17, hitting the transport, leaving it on fire and sinking. On the other side of Tonolei Harbor, Captain Scott and his crew skip bombed and damaged an 8,000 ton cargo ship while another Fortress piloted by Captain Sogaard sank a merchantman, planting a 1,000 pounder amidships and two along the waterline using the same method.[1] It was another night's work for the low flying B–17s of the 63rd Bomb Squadron (BS)/43rd Bomb Group (BG) (Heavy) of General George Kenney's Fifth Air Force.

People are familiar with the role of the iconic B–17 Flying Fortress as a daylight strategic bomber in World War II. It performed this mission spectacularly, although at a high cost, in Europe with the Eighth and Fifteenth Air Forces. But in other theaters of WWII the B–17 struggled to fulfill the mission for which it had ostensibly been designed and crews trained: aerial bombardment of an enemy fleet at sea. In the twenties and thirties, defense of the United States was predicated on the defeat of the only threat to the continental U.S., an enemy naval fleet, sinking it as far from the American mainland as possible.[2] Following the doctrine of General William "Billy" Mitchell that bombardment aircraft will always sink enemy ships; the United States Army Air Corps (USAAC) announced a requirement for a "multi-engine bomber to perform a coastal defense mission".[3] Boeing entered their Model 299 which became the famed B–17 Flying Fortress.

Boeing lost the contract to Douglass's B–18, but the performance of the Model 299 impressed Air Corps brass. War Department doctrine at the time allowed only for defensive weapons, eschewing offensive, strategic bombers. The ground Army preferred to support ground tactical attack aviation in lieu of strategic bombardment. Naturally the Navy, who considered the U.S. fleet the first line of defense of America, wanted the Army Air Corps limited to a coastal defense role within 100 miles of the U.S. coastline. Under these restrictions the Air Corps let a contract for a limited number of YB–seventeen Flying Fortresses for further operational testing, allegedly in the guise of a defensive bomber able to intercept enemy fleets far out at sea, but in reality to be developed as an instrument of strategic bombing theory.[4]

Gen. Frank M. Andrews, commander of General Headquarters (GHQ) Air Force, was a strategic bombardment proponent. Having acquired twelve Y1B–17 heavy bombers, he tested the doctrine with a profile-raising demonstration flight to highlight the new bomber's ability to intercept an enemy fleet, in accordance with the MacArthur-Pratt agreement of 1931. This agreement between the Army and Navy gave the Army a coastal defense mission, albeit only one hundred miles out to sea. On May 12, 1938, the 2nd Bomb Group, the first to acquire the new B–17, flew a "training mission" in

Boeing Y1B–17 fly-by near the Italian liner "Rex" about 800 miles east of New York City.

which a flight of B–17s intercepted the Italian ocean liner "Rex" 800 miles out to sea. Although the Navy protested this mission, its subsequent publicity underlined the long-range bomber's capabilities as a coastal defensive and strategic offensive weapon.[5]

As war clouds gathered over Europe in the late thirties, War Department defense policy was replaced with an offensive, strategic minded doctrine that concentrated on mass formations of strategic bombers launching precision attacks on critical enemy war industries in Europe. But war came to America first in the Pacific. With the vast distances of the Pacific, the B–17, surreptitiously designed and tasked with strategic operations in Europe, was unable to reach strategic targets in the Japanese home islands. Instead, the B–17 was forced to be used in offensive tactical, coastal defense, and antishipping operations. The initial tactics for these differing missions were the same employed against enemy industrial targets, i.e. mass formation, precision bombing from high altitude. This reflected the strategic doctrinal foundation of the Army Air Force.[6]

B–17s operating from the Philippine Islands utilized this tactic with little to show for the amount of ordinance expended. Even with the mass formations envisioned in pre-war doctrine, and the vaunted Norden bombsight, all that was achieved were a few lucky bomb hits. General George Kenney calculated that the percentage of hits on moving, maneuvering ships at less than one percent.[7] In one attempt to interdict a convoy bringing Japanese reinforcements for Buna, Fifth Air Force flew twenty-two B–17s in four attacks against the convoy using these tactics. No hits were made on the ships.[8] It was evident that if B–17 operations in the Pacific were to be effective, a change in tactics was necessary to exploit the strengths and flexibility of the Flying Fortress.

With his background, General Kenney recognized this. He attended M.I.T. for three years before enlisting in the U. S. Signal Corps as a flying cadet in 1917. He earned his wings after a trying time in training, but was notably suc-

David L. Richards was born and raised in Barberton, Ohio. He joined the United States Air Force in 1975 and retired as a Master Sergeant in 1995. His job while in the USAF was aircraft maintenance. He attended many Air Force leadership schools and academies. He earned Community College of the Air Force and Cerro Coso Community College Associates Degrees in General Education. Several years later he graduated from Nyack College with a Bachelor's Degree in Organizational Management, later returning to school at Wright State University in 2010 and graduated with a Master of Humanities degree in 2016. He has given a presentation to the Ohio Historical Society on Senator Benjamin F. Wade, his thesis subject. As a volunteer at the National Museum of the United States Air Force (NMUASF) he became interested in several aspects of the 5th Air Force operations during World War Two resulting in unpublished papers on B–17 usage as a low-level skip bomber, and the Battle of the Bismarck Sea. He has over 4000 hours as a volunteer at the NMUSAF and considered an expert on the C–130 Hercules aircraft.

cessful once he got to France, earning credit for two air victories. The intervening years saw General Kenney attending the War College, Air Corps Engineering School, and the Air Corps Tactical School (ACTS). He became an instructor at the ACTS in low level bombing tactics; developing parachute retarded bombs which increased accuracy for low level bombers.[9] He was an experimenter and was the first to install fixed, forward firing machine guns in aircraft wings.

Traveling to the Southwest Pacific in mid-1942 to assume command of the Fifth Air Force, he and his aide, Major William Benn, discussed bomber tactics. Major Benn had seen recent Army testing of a British ship-bombing tactic called skip bombing. Kenney wrote, "Benn and I had been discussing low-altitude bombing all the way from San Francisco. It looked as though there might be something in dropping a bomb, with a five-second-delay fuse, from level flight at an altitude of about fifty feet and a few hundred feet away from a vessel, with the idea of having the bomb skip along the water until it bumped into the side of the ship. In the few seconds remaining, the bomb should sink far enough so that when it exploded it blew the bottom out of the ship. In the meantime, the airplane cleared the enemy vessel and was far enough away so that it was not vulnerable to the explosion. Everyone would be happy except the Japanese on board the sinking ship."[10] On one of their layovers they requisitioned a B–26 and tested this method of bombing. Impressed with the results, Kenney gave Major Benn command of the 63rd BS of the 43rd BG (H), a B–17 group that had recently been activated in theater. Even though the B–17 was designed for high altitude formation bombing, Kenney thought it possible to use them down on the deck in an anti-shipping role as low-level skip bombers.[11]

The 43BG, formed less than a year before Pearl Harbor, had shipped out for Australia in February of 1942 without aircraft. Consisting of the 63rd, 64th, and 65th Bomb Squadrons and the 403rd Reconnaissance Squadron they had languished in support roles spread out across the vast continent performing duties such as weather reporting, running emergency landing fields, and depot level maintenance. Upon discovering this asset in theater, Kenney had the 43rd BG reassembled, reconstituting them with B–17Es and Fs from maintenance depots and stateside replacements.[12] Familiar with the work Major Benn had performed for him in getting a heavy bomb squadron back on its feet when Kenney was commander of Fourth Air Force, he gave the 63rd BS to Major Benn.[13] Training in the new low-level tactics soon made the 63rd "the hottest new outfit in the whole air force" according to Kenney.[14]

Shipping was the life blood of operations in the Pacific. Shipping maintained the Japanese offensive in New Guinea, and shipping buttressed the Allied defense of this area. Therefore, it was imperative that Kenney utilize the few bombers that he had with the most effective ship killing tactics.[15] To that end, Maj. Benn and the crews of the 63rd BS began practicing low-level attacks with their B–17s. Exploiting a wrecked merchant marine hulk on a reef close by Port Moresby, they experimented with varying speeds and altitudes for bombing to determine what suited the Fortress best.[16] In ten bomb drops, six of them skipped along the surface hitting the hulk perfectly.[17] The two tactics most effective were low altitude bombing and skip bombing.

Both tactics offered the bombardier a closer target, actually allowing the pilot to use a marked "x" on his windscreen as a bomb sight; it did not give the ship time to maneuver from under the bomb, and it allowed a B–17 to make multiple attacks. The range of the B–17 allowed Kenney to reach out and touch the Japanese at Rabaul. Low altitude bombing consisted of a two-plane formation attacking from ~2,000 feet at 200 knots and dropping two to four bombs, preferably diagonally compared to the movement of the ship, either on or close alongside the target. Skip bombing consisted of approaching a ship abeam at ~200 feet, dropping a bomb ~ 300 feet from the target that skipped off the surface of the water, and either punched a hole in the hull or hit the side and slid under the ship with a five second delay before exploding. The time delay prevented the self-immolation of the attacking aircraft.[18]

The main drawbacks to these methods when employing the B–17 were anti-aircraft fire and fighters. To compensate, the 63rd BS used these tactics at night or dawn, utilizing the moon to illuminate the target or rising sun to mask their attack approaches. Diversionary attacks by B–17s at medium or higher altitude distracted searchlights and anti-aircraft fire.[19] Some crews augmented the forward firepower of the B–17 by installing nose guns operated by the pilot to suppress shipboard anti-aircraft fire.[20] They tested various bombs, settling on either 500 or 1,000 pound general purpose bombs. The 63rd practiced and refined these maneuvers for the next two months. By October of 1942 they had become skilled at operating the heavy bomber as an attack aircraft in the antishipping role.[21]

The 63rd BS introduced the Japanese to these new low level heavy bomber anti-shipping tactics on the morning of October 2 with a six plane raid on Rabaul's Simpson Harbor. Not utilizing skip-bombing due to faulty fuses, they thundered into the harbor before sunrise at 2,500 ft. The only heavy bomber squadron trained in low altitude anti-shipping tactics scored a huge success on their initial operational mission. Each aircraft, carrying four 1,000 lb. bombs, picked individual targets to attack. One pilot, targeting a 15,000 ton merchant ship, remarked on his attack, "I had a good 20 second run, straight and level. The bombs went exactly as we hoped; one hit the ship directly, with the other three very close to it. Major fires broke out all over the ship." Another B–17 set a 7,000 ton cargo ship on fire, one hit a destroyer, and a fourth scored near misses on another ship. The remaining two aircraft struck an ammunition dump and Rabaul's seaplane base. All the aircraft received varying degrees of damage from anti-aircraft guns, but returned to base without loss. Although dangerous, the results of this mission demonstrated that the new bomber tactics worked.[22]

An armed reconnaissance mission by four 63rd BS bombers scored again in the early morning hours of October 15 when they hit a Japanese cruiser off the island of

64th Bomb Squadron crew at Mareeba, Australia.

Bougainville. Damaging but not sinking it, they still impressed upon the Japanese that their capital ships were prey to these new antishipping attacks. On October 16 the 63rd used low altitude attacks to strike again at Rabaul's Simpson Harbor and Shortland Islands shipping traffic. Attacking Buin at low altitude on October 17 the B–17s hit an 8,000 ton merchant ship and destroyed thirteen seaplanes before moving on to Tonolei Harbor were they hit another 8,000 ton Japanese maru. The 63rd's two weeks of antishipping operations resulted in damage to, if not actually sinking, seven Japanese ships.[23]

With the bomb-fusing problem solved, the night of October 22-23 saw the initiation of skip bombing tactics by the 63rd. With a concentration of shipping in Rabaul's Simpson Harbor the 63rd and 64th BS, each with six aircraft, attacked. The 64th provided a diversion, bombing Rabaul from medium altitude, allowing the 63rd to burst into the harbor at low altitude. Each aircraft picked an individual target and made their skip bombing runs at 200 ft. before returning in low altitude attacks to release their remaining bombs. A Japanese cruiser, destroyer, and two cargo vessels were sunk while another was left burning. With a full moon, a diversion, and the audacity of using the heavy bomber at wave top height, skip bombing proved to be an effective tactic.[24]

The 63rd, with the help of the 403rd BS, which had recently trained with the 63rd in the new tactics, finished October on a high note. A raid on October 25 to Simpson Harbor by the 63rd scored a 5,000 ton cargo ship sunk and damage to another. Between October 28 and 30, they attacked Tonolei Harbor at Buin twice. The first, from low altitude, left an 8,000 ton Japanese merchant ship on fire and damaged two warships. They struck the harbor again the next night which resulted in, to quote General Kenney, "direct hits on a battleship and two other unidentified vessels and damaged a light cruiser and an aircraft carrier."[25] Kenney gave the 63rd a break and sent the 403rd to skip bomb Simpson Harbor on the 30th to round out the month. This action resulted in the sinking of a large cargo ship and two destroyers.[26]

November 2 saw the 63rd continuing the anti-shipping offense in an effort to relieve pressure on Guadalcanal and New Guinea. They hit a four ship convoy trying to reinforce Buna from low altitude. No direct hits were observed but several near misses left a freighter damaged. On November 11 the 63rd went back to work. Two raids by seven

Rabaul and Simpson Harbor. ***(Photo courtesy of John R. Bruning, https: theamericanwarrior.com.)***

Fortresses on Tonolei Harbor November 11-12 sunk or damaged three 10,000 ton freighters, an 8,000 ton merchantman, and a medium size cargo ship. Two B–17s raided Tonolei the next night for a score of one 8,000 ton and one 10,000 ton ship left burning. On the 18th the 63rd was again called upon to stop a reinforcement convoy to Buna, sinking or damaging two destroyers and a light cruiser using low altitude bombing. Using both low altitude and skip bombing tactics seven planes from the 63rd and 65th BS hit a convoy on the night of November 24.[27]

The following months saw the other squadrons of the 43rd BG training in these low altitude tactics as they became operational. Whenever intelligence indicated Japanese shipping activity within range of the group's B–17s they were sent into action. After-action reports and bomb damage analysis tended to be overly optimistic at this time, but it was evident by the Japanese response to these tactics that they were effective. Night fighters were deployed over Rabaul, searchlights were refocused to low altitude, and convoys within range of allied aircraft were discontinued in favor of coast hugging barges.[28] After the Battle of the Bismarck Sea, the Imperial Japanese Army was forced into a defensive posture throughout the Southwest Pacific area.

With a modification of tactics by General Kenney and Major Benn, the B–17 Flying Fortress performed at low altitude, the anti-shipping and coastal defense missions for which it had ostensibly been designed for. By abandoning the high altitude, mass formation bombing doctrine of the Army Air Force, the crews of the 63rd BS proved the concept of low altitude and skip bombing as effective tactics. The lessons learned in those short months were applied to more capable aircraft as they became operational. With heavy bombers a precious commodity in the Southwest Pacific Area (SWPA) and no replacement B–17s available the 43rd BG was pushed back upstairs. Modified A-20 and B–25 bombers with more speed and forward firepower took over these efforts as newer bases brought them within range of Japanese shipping. As the other squadrons of the 43rd slowly swapped out their B–17s for B–24s, the 63rd soldiered on with their Forts at high, medium, and low altitudes until October of 1943 when they became operational in Liberators. As the saying goes, "necessity is the mother of invention" and Kenney and Benn had adapted the B–17 Flying Fortress to what they needed most at that time, a down and dirty anti-shipping bomber "on the deck." ■

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The Handley Page Victor: Tales From a Crew Chief, 40 Years of Life with the Victor. By Roger R. Brooks. Barnsley UK: Pen and Sword Aviation, 2019. Photographs. Pp. 128. $39.95. ISBN: 978-1-52673-257-6

This book emerged from series of lectures given by Brooks in his capacity as a volunteer maintaining the Handley Page Victor *Lusty Lindy* as a taxi-capable exhibit at the Yorkshire Air Museum. I was excited, as few books about aircraft are written by a maintainer. All too often, the men and women who support aviators by fueling, fixing, and arming the planes are ignored completely or mentioned in passing. Any aviators worth their salt know that they never turn a wheel without the hours of toil by these consummate, often unrecognized, professionals. Coming from a maintainer, this book promised to help redress that imbalance.

Brooks lived with the Victor for forty years starting as a young RAF maintainer in the 1960s and continuing as a museum volunteer through 2007. He served first as an engine mechanic and later transitioned to airborne crew chief. After retiring from the RAF, he put his skills to work at the Imperial War Museum at Duxford and, later, the Yorkshire Air Museum maintaining their Victors in near flyable condition (several British museums maintain both flyable aircraft and others for taxi demonstrations only).

Brooks' previous two volumes cover the history and development of the iconic Victor, so he doesn't spend any time discussing the background, development, or employment beyond his personal experiences. He worked on the bomber variant for a short time and then spent the rest of his time working on and flying the air-refueling tanker version.

Brooks is uniquely qualified to share his story; but, ultimately, there is not enough of that to satisfy. His discussions of TDY (temporary duty) are formulaic with each being a bare account of facts and a very minimal account about down time. His detailed information includes dates, tail numbers, crew leader, flight times, receivers, shopping, and perhaps grabbing a beer. What is missing is the color—the personalities and unique events that would have made each trip memorable. He repeats this litany for every trip, ending with turning in his Mae West and heading home. One of the few entertaining anecdotes he shared dealt with the universal rivalry between the tanker crews and their receivers—in this case fighter pilots all too ready to prove their superiority to their slower and less maneuverable brethren. The repartee continued until the tanker crew suggested the Lightnings could just wend their home to England (from the Middle East) alone if they didn't need any help. That apparently ended the ribbing, and everyone made it home together. The book would have benefitted immensely from more tales like this.

The other worthwhile aspect was Brooks' experiences as a museum volunteer. This is not a side of the coin many of us ever see, but maintaining an aviation museum is a huge undertaking and counts on many hours of volunteer work for aircraft upkeep and a multitude of other tasks. It is disappointing to find out that in both museums, Brooks' experiences weren't what he hoped for but are interesting and add to an understanding of these organizations.

One of the book's great strengths is the variety of pictures, some from the Brooks' personal collection, including ground and flight, interior and exterior. They are all black-and-white (except for the jacket) but show the aircraft from all angles and give an appreciation for its futuristic lines and appearance. Brooks describes multiple trips to Mediterranean and Middle Eastern locations, so a map would have been useful. The book ends very abruptly, exactly as if he had stopped talking and left the lectern.

While it is an interesting look at flying and maintaining an iconic aircraft, it left me wanting more like specifics about aircraft strengths and weaknesses, accidents, incidents, and notable accomplishments. These may be in the other two volumes. The other element I wanted more of was personal information about his service, training courses he took, perceptions of life in the RAF, and such. Overall, this is a good book with useful information, but it could have been so much more.

Golda Eldridge, Lt Col, USAF (Ret), EdD

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Lionel Morris and the Red Baron: Air War on the Somme. By Jill Bush. Philadelphia: Pen and Sword, 2019. Photographs. Notes. Index. Pp. xiii, 247. $39.95 ISBN: 9781526742223

Lionel Morris was one of millions of service men and thousands of British fliers who lost their lives during the First World War. Were it not for an accident of history, he would probably have remained as anonymous as almost all the rest; but it was his misfortune to become the first official victim of Baron Manfred von Richtofen, later known as "The Red Baron." This book is the story of one young man who answered his nation's call to service, choosing the life of a flier in the world's first aerial war.

The book's cover art in many ways sums up the book itself. On the top left is a familiar face to airpower enthusiasts, a young, confident Manfred von Richtofen, destined to be photographed many times. On the top right is an equally young and seemingly as confident young man, Lionel Morris. Only two photographs of him are known to exist. These two men met over the Somme battlefield in the late summer of 1916, the mortally wounded British pilot crash landing behind German lines, and the German on his way to immortality. The lower portion of the jacket cover says as much about why this combat ended the way it did as the actual text itself. On the left is Morris' de Havilland DH.2, a gangly and ungainly looking craft, smoking and obviously in trouble. On the right is the compact, sleek, and obviously far more advanced Albatross D.II of von

Richtofen. The disparity between airplanes could not be more plain.

The combat that cost Morris his life was also the debut of Oswald Boelcke's handpicked new fighter squadron using tactics of his own devising. Boelcke built this organization with the express purpose of creating a unit of outstanding pilots who could wrest control of the skies over the battlefield from the British. His new method of air fighting focused on teamwork and discipline, teaching his pilots to always seek an advantage and work together in their attack. The success of his efforts were grimly evident in that six of the eight aircraft in Morris' formation fell to the Germans, who suffered not a single loss. Morris had been acting as C flight commander that day and fell victim to the inadequacies of his plane and superior German tactics when he turned back to help another plane in his flight. All of C flight had been wiped out. This lopsided victory was over a year after the initial Fokker Scourge caused by the introduction of the Fokker Eindecker with its synchronized forward-firing machine gun and eight months before "Bloody April" 1917, when Richtofen and his Circus nearly drove the RFC from the skies. It keenly demonstrates the impacts that both technology and tactics had in the constantly seesawing battle for air superiority.

I was very taken with this book. The time period is endlessly fascinating, but it was Bush's ability to bring the story to life that made it so vivid. She is a distant cousin of the unfortunate Morris and began to research his life and death as a personal project. The deeper she delved, it became apparent that she needed to tell this story. At first, I thought the connection to the Red Baron was played up as a ploy to sell books. Wrong! While von Richtofen plays a very small part in the actual narrative, his embodiment of the German fliers is central to the story. The reader learns about the haphazard state of British flight instruction at that stage of the war (unfortunately never to significantly improve) that often saw pilots entering combat with as little as fourteen flight hours (I could barely control an airplane at that stage of my training). Bush also covers the process of assignment and methods of operations of frontline British squadrons. She also covers Boelcke (who figures larger in the narrative than von Richtofen), the genius behind the shift from lone-eagle combats between pilots to organized air fighting as we know it today. The collision of these systems is deftly described while not belaboring the narrative with jargon or statistics.

This is a biography that follows Morris' life in a conventional chronological order. But it is far more than that. Although not military or a flier, Bush brings into focus a specific moment in history whose impact was far out of proportion to the number of people or the time involved.

The book has few issues: some minor editing errors and no bibliography, but sources are quoted in the notes. It well complements other first person accounts of World War I air combat in the RFC/RAF such as Arthur Lee's *Open Cockpit* and *No Parachute* (both memoirs of his time in the RFC about a year after Morris) and *Rising* by Cecil Sagittarius (a fictionalized version of his experiences in the RFC), both cited as sources. I highly recommend it.

Golda Eldridge, Lt Col, USAF (Ret), EdD

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South Pacific Air War Volume 3: Coral Sea & Aftermath, May-June 1942. By Michael Claringbould and Peter Ingman. Kent Town, Australia: Avonmore Books. 2019. Glossary. Notes. Appendices. Maps. Tables. Illustrations. Photographs. Bibliography. Index. Pp. 248. $46.95 paperback. ISBN: 978-0-9945889-9-9

Michael Claringbould is a digital aviation artist and globally recognized expert in Japanese aviation. He is a contributing editor for *Flight Path* magazine and is the author of several books on the Fifth Air Force and World War II Pacific history. Growing up in Papua New Guinea in the 1960s, he became fascinated by Pacific war aircraft. He has assisted with recovery and identification of such aircraft and has helped both the U.S. and Japanese governments to identify missing aircraft crews.

Peter Ingman is an acclaimed military aviation historian with a key interest in the early stages of the Pacific war. He has traveled widely throughout northern Australia and the South Pacific conducting research for his books. He chairs the South Australian Aviation Museum History Group and has written five widely acclaimed Australian World War II history books.

This volume chronicles the critical months of May and June 1942. It can be read alone or as part of a trilogy that spans the first six months of the Pacific war. Its seventeen chapters cover the period leading up to the Battle of the Coral Sea, the battle itself, the subsequent continued Japanese air offensive against Port Moresby, and the defenses of New Caledonia and the New Hebrides.

Operation MO, a complex Japanese plan to take control of southeastern New Guinea and other locations in the South Pacific, was launched in early April 1942. The goal was to isolate Australia and New Zealand from the U.S. It included seizure of the port of Tulagi, occupation of territory in the Louisiade Archipelago to establish a seaplane base to access the Coral Sea, and the capture of Port Moresby. A further objective (Operation FS) was an assault New Caledonia, Fiji, and Samoa. In early May, the Port Moresby invasion fleet advanced toward the Coral Sea. The U.S. had learned of the Japanese plan through signals intelligence and sent two carrier task forces to oppose the offensive. The opposing forces ultimately found and engaged each other via carrier-based aircraft—a first—in the Battle of the Coral Sea. Also covered is the ordeal of the joint Australian-U.S. cruiser force that was detached from the main allied fleet and subjected to land-based aircraft attack. The authors maintain that the outcome of the battle was not

an Allied victory in the sense that the Japanese were forced to abandon their plan to capture Port Moresby. Rather, the Japanese still retained the capacity to mount the invasion; it was a serious error by their rigid and hierarchical command structure to postpone the invasion for another time.

Following the Coral Sea battle, the aerial campaign continued in earnest between the land-based air forces at Lae and Port Moresby, just one hour's flying time apart. The Allied offensive was carried out primarily by B–17, B–25, and B–26 bombers. P–39 fighters were assigned to protect Port Moresby and, in doing so, suffered an astounding loss rate. On the Japanese side, *Betty* and *Nell* bombers regularly pounded Port Moresby. These bombers were protected by the wide-ranging *Zeke* fighters with their highly trained and experienced pilots.

As in the previous volumes, this one provides an almost day-by-day account of the aerial operational encounters between Australian, Japanese and American sea- and land-based aircraft. The authors match Allied operational accounts with those from Japanese records to provide a multi-dimensional view. Daily sorties from both sides are recounted. Key lessons were continuously learned by both sides. Trained and rookie pilots alike had to deal with constantly changing weather across the theater of operations and were hindered by the mountainous terrain separating the Japanese forces at Lae/Rabaul from the Allied forces at Port Moresby and northern Australia. Both sides accommodated the relative ineffectiveness of high-level bombing with low-level bombing and strafing.

The authors provide well researched data on personnel involved on both sides. There are excellent data on primary aircraft involved in the conflict, both throughout the text and in appendices, showing three-views, key performance, and liveries. Ample, sometimes rare, photographs are employed throughout. Several good theater maps are provided. The three-dimensional graphic portrayals of aircraft in action are particularly well-done and add much to the total presentation.

As with the previous two volumes, this is an excellent book. It is a well-written and easy-to-comprehend source for the aircraft and Pacific war enthusiast and researcher alike.

Frank Willingham, docent, National Air and Space Museum

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Battle of Midway: America's Decisive Strike in the Pacific in WWII. By John Grehan. Yorkshire UK: Frontline Books (Pen & Sword Books), 2019. Maps. Photographs. Bibliography. Notes. Pp. 164. $28.95 paperback.. ISBN: 978-1-52675-834-7

John Grehan has written, edited or contributed to more than 300 books and magazine articles covering a wide span of military history from the Iron Age to the recent conflict in Afghanistan. He has also appeared on local and national radio and television to advise on military history topics. From its inception until 2014, he was employed as Assistant Editor of *Britain at War Magazine*. Grehan now devotes his time to writing and editing books.

This book is one of a Pen & Sword series entitled *Images of War*. Each book contains photographs (often rare) from wartime archives along with detailed captions and references. Most books in this series focus on World War II campaigns.

After the battle of the Coral Sea in early May 1942, Admiral Isoroku Yamamoto assessed that the United States had only two serviceable carriers remaining. If those carriers could be lured into battle and destroyed, nothing could stop the Japanese from achieving complete control of the South Pacific. Aware of the sensitivity of the Americans toward Pearl Harbor, Yamamoto selected the furthest point of the Hawaiian Islands for the attack, the naval air station on Midway atoll. The U.S. was able to intercept Japanese signals and knew Yamamoto's plans. Admiral Nimitz lured the Japanese into an ambush. The resultant four-day battle resulted in a U.S. victory from which the Japanese were never able to recover.

Grehan's book begins with a concise introduction to the battle that combines text, regional and island-layout maps, a battle chart, as well as photographs to quickly bring the reader up to speed on the "Build Up to Battle." This introduction is followed by nine chapters that follow both the bombing of Midway and the sea battle in chronological order. Each chapter contains photographs of the battle, related personnel, aircraft, and naval craft. The photo captions are detailed and well written. Included are many vignettes describing actions by individuals throughout the battle. Grehan devotes several chapters, with many photographs, to the actions by, enemy attacks on, and final demise of the *USS Yorktown*. The book ends with the memorial to the men of the U.S. armed services who successfully defended the Island. Their service and sacrifice marked a turning point in the war against Japan.

The book is a quick and good read that contains many moderate-quality photographs. I personally like the *Images of War* format, as it focuses on pictorial composition supported by descriptive captioning. The book provides an excellent overview of the Battle for Midway.

Frank Willingham, docent, National Air and Space Museum

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Biplanes at War: U.S. Marine Corps Aviation in the Small Wars Era, 1915-1934. By Wray R. Johnson. Lexington: University Press of Kentucky, 2019. Maps. Tables.

Photographs. Notes. Appendices. Bibliography. Index. Pp. xii, 440. $50.00. ISBN: 978-0-81317704-5

Dr. Wray Johnson brings his expertise on airpower in small wars to his most recent work. He previously co-authored *Airpower in Small Wars: Fighting Insurgents and Terrorists,* a must-read for anyone interested in thinking carefully about how to employ airpower in so-called "small wars." That work advocated generally using airpower in a supporting or indirect role, such as to enable mobility, rather than in a more direct kinetic role.

This book expands upon one of the chapters in *Airpower in Small Wars* highlighting Marine Corps aviation in Central America and the Caribbean. The result is an encyclopedic treatment that might stand for decades as the standard work for understanding and appreciating the Marine Corps' balanced development of airpower during the inter-war years.

Johnson, a retired Air Force officer, has connections to the Marine Corps by virtue not only of his father's service in the Corps but also because he taught at the Corps' School of Advanced Warfighting for many years. He wrote this work to provide "adequate recognition" for how the Corps advanced aviation in the inter-war period. He provides three case studies focused on Haiti, the Dominican Republic, and Nicaragua.

The work begins with a brief introduction to the Corps' history before discussing the nature of small wars, to include the Corps' seminal piece of inter-war counterinsurgency doctrine, the *Small Wars Manual*. Johnson highlights the Corps' relatively progressive recognition of the fact that the less violence used in small wars, the better. However, this central theme is not quite the work's argument. Indeed, in contrast to *Airpower in Small Wars,* this book lacks a clearly overarching argument. Still, Johnson consistently stresses the variety of ways that Marines used airplanes in numerous "nontraditional ways" to stimulate how to think more productively about using airpower in similar conflicts today.

As such, veterans of recent U.S. conflicts will find much to relate to in the Marines' inter-war experiences. In one particularly interesting section, for example, Johnson highlights Major Harold Utley's reflections. Utley observed that "in Small Wars we are at peace no matter how thickly the bullets are flying." He came to this conclusion during what Johnson describes as a significant period of transition for the Corps from a "rough neck" time of minor "punitive expeditions" to the far "more complex requirements" of counterinsurgency. While acknowledging the challenges of this change, Johnson offers some pointed, yet fair, critiques of the Corps, highlighting that it took some Marines a while to appreciate that overly kinetic actions could be counterproductive. At other places in the work, however, aviation drops out of the narrative, leaving the reader unsure what lessons to pull from the book. The epilogue of the first chapter on Haiti, for example, focuses almost exclusively on larger questions of strategy devoid of a discussion of airpower.

By contrast, Johnson's conclusion proves to be the most intellectually stimulating part of the book, as he expands on some of the points raised in *Airpower in Small Wars.* In light of the return to great power conflict, for example, Johnson insists that small wars cannot be waged simply "using the conventional strategies and tactics of 'major theater war.'" Of course this contention, if correct, has significant ramifications for how the Air Force trains and equips its forces. For Johnson, moreover, major theater war diverges significantly from small wars because the former is really positional warfare, thus requiring the taking and holding of territory. As such, arguably the most "decisive" application of airpower in positional warfare—epitomized by the "rapid concentration of firepower against the enemy at some 'decisive point'"—is usually "doomed to failure" in small wars. Likewise, he also argues that the Corps more successfully used aviation in small wars than did European nations. Where European nations sought more narrowly to "control" populations through the use of military force, the Corps used it more effectively within a "theory of restrained combined-arms operations" to serve as one facet of a much more encompassing intervention. Those interested in this line of thought may also want to pursue another recent work, Richard Newton's *The RAF and Tribal Control: Airpower and Irregular Warfare between the World Wars,* which argues that the British applied airpower in a similarly nuanced way.

Those serious about the application of U.S. airpower in small wars should read *Biplanes at War,* one of the most detailed and scholarly works on how the Corps' refined its application of airpower in the Caribbean and Central America.

Dr. Heather Venable, Air Command and Staff College

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'Sam' Marshall of the Royal Air Force The Lord Elworthy KG, GCB, CBE, DSO, LVO, DFC, AFC, MA: A Biography. By Richard Mead. Barnsley, UK: Pen & Sword, 2018. Photographs. Notes. Bibliography. Index. Pp. xiii, 298. $49.95. ISBN: 978-1-52672-717-6

An accomplished biographer, Richard Mead switches his focus in this volume from British Army leaders to one of the most distinguished of all post-World War II Royal Air Force (RAF) commanders. In this concise biography, he traces the life and times of former Chief of the Defense Staff Samuel Charles Elworthy (1911-1993) from his upbringing in New Zealand and England to his final days back in New Zealand.

Reviewing Elworthy's life year by year, Mead initially provides insight into the family's prosperity in New Zealand and their eventual decision to educate their sons in England.

After graduating from Cambridge University in 1933, Elworthy enlisted as a reserve pilot with the RAF. In his early years, he flew Hawker Harts and Hinds. In 1937, he transferred to Bomber Command as the personal assistant to its commander, Air Chief Marshall Sir Edgar Ludlow-Hewitt.

During World War II, Elworthy completed 35 combat missions flying Bristol Blenheim twin-engine bombers; commanded a squadron, an air base, and a group; and twice served on the staff of Arthur Harris, Bomber Command commander.

After the war, he briefly was assigned to the staff of the Tactical Wing of the Central Bomber Establishment, the organization responsible for future planning and aircraft procurement. After that, he served in India. Returning to England, he attended staff college and moved on to command RAF Tangmere, a fighter base, at a time when jet aircraft were arriving in substantial numbers. He followed that up with command of Metropolitan Sector of Fighter Command. After briefly serving as Assistant Chief of the Air Staff, Elworthy in the summer of 1960 was named Commander-in-Chief Middle East Command headquartered in Aden (today part of Yemen).

On January 1, 1964 he became Chief of the Air Staff, a position he would hold until 1967 when he became Chief of the Defense Staff. The 1960s proved an especially difficult time for the British military as budget cuts and loss of influence in many Commonwealth nations resulted in an extensive consolidation of forces.

After retiring from the RAF in 1971, Elworthy led an active life that included personally serving Queen Elizabeth II as Constable and Governor of Windsor Castle and as Lord Lieutenant of Greater London.

In this comprehensive treatment, Mead covers a lot of ground. Perhaps it might have been better to break the work into two parts—one dealing with a more detailed account of Elworthy's influence on Bomber Command and the other with a more careful examination of the reduction in force of the post-World War II British military. Furthermore, the attention devoted to Elworthy's personal life and particularly to his wife's role as a hostess for social gatherings detracts from the principal effort concerning his career. Nevertheless, Elworthy is indeed worthy of a biography. His story should be of interest to anyone wishing to learn more about Bomber Command, the RAF, or the British military.

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

The Gilbert and Ellice Islands—Pacific War. By Jim Moran. Yorkshire, England: Pen & Sword Military, 2019. IMaps. Photographs. Appendices. Pp. 176. $28.95 Paperback. ISBN 978-1-52675-119-5

Jim Moran lives in the UK and has had a long career as a civil engineering surveyor working on major highway and airbase construction projects. He is an expert in the history of the United States Marine Corps and assisted Hollywood productions on uniform and equipment details for *Flags of our Fathers, The Pacific* (HBO mini-series), and *Windtalkers*. Moran is a member of many Marine organizations and is an honorary U.S. Marine. His publication include *U.S. Marine Corps Uniforms and Equipment in WW II* and *U.S. Marine Corps Women's Reserve—They Are Marines*.

This book is one of a Pen & Sword series entitled *Images of War*. Each book contains often rare photographs from wartime archives with detailed captions and references. Most books in this series focus on World War II campaigns.

After the attack on Pearl Harbor, the Japanese occupied the Gilbert Islands and built a seaplane base at Butaritari. In August 1942, this base was attacked by the U.S. 2nd Raider Battalion (Carlson's Raiders), after which the Japanese reinforced the Butaritari base and built a second at Apamama Island. In addition, Betio Island, on the Tarawa Atoll, became the main Japanese stronghold. In 1942 the U.S. established air bases and PT boat moorings in the Ellice Islands to monitor Japanese progress in the Gilberts and stage pre-invasion bombing of Tarawa. In November 1943, the 2nd Marine Division and the Army's 27th Infantry Division launched Operation GALVANIC, the U.S. assault on Butaritari, Apamama, and Betio. While short in duration (seventy -six hours), the Betio battle was the costliest in U.S. Marine Corps history.

Moran begins with a short description of geography and culture of the islands. He follows with chapters describing the initial (minimal) Japanese occupation of the Gilberts, followed by the U.S. Marine Raider's assault on Butaritari (Makin). This raid, while initially successful, caused the Japanese to build-up and reinforce bases on the islands, for which the Marines paid dearly, during the assaults on Tarawa, Makin and Apamama a year later.

The book goes on to describe the U.S. occupation of the Ellice Islands (Funafuti, Nukufetau, and Nanumea), in October of 1942. On Funafuti, the Seabees constructed anti-aircraft defenses, OS2U Kingfisher facilities, and an airstrip for use by B–24 bombers.

Chapter Six, the longest of the book, reviews the U.S. assault on Tarawa, Makin, and Apamama. Moran provides the rationale for the assault (island hopping, with the eventual goal of capturing the Mariana Islands). This chapter starts with a moderate textual introduction followed by numerous photos of the battle with detailed captioning.

Moran ends with coverage of the U.S. occupation of Makin and Tarawa; the construction of airbases; and, the transfer of Seventh Air Force aircraft in preparation for the bombing of the Marshall Islands, the next step in the island-hopping campaign. Ironically, with the fall of the Marshalls, the Gilbert and Ellice islands were deemed to be too

far behind the frontline; and USAAF bases were ultimately moved to the Marianas

I like this book! It is a quick and good read containing many moderate quality, but rare, photographs. I personally like the *Images of War* series format, as it focuses on pictorial composition supported by descriptive captioning. The book provides an excellent overview of the battle for the Gilberts.

Frank Willingham, Docent, National Air and Space Museum

From Kites to Cold War: The Evolution of Manned Airborne Reconnaissance. By Tyler Morton. Annapolis MD. Naval Institute Press, 2019. Photographs. Maps. Notes. Bibliography. Index. Pp xvii, 305. $49.95. ISBN: 978-1-68247465-5

Tyler Morton, a career USAF intelligence officer, took on a major task in attempting to fulfill the expectations of the title of this addition to the Naval Institute Press series, *History of Military Aviation*. He largely succeeded.

To be sure, this is not an all-encompassing tome. Rather, Morton divides his story into six chapters and an introduction, each chapter addressing an easily definable period. Chapter 1 starts with the earliest balloons and kites in early France and provides a solid discussion of the attempts to discern a military use. Chapter 2 then picks up the story at the transition from balloons to airplanes and the early applications in both the Italo-Turkish War and the U.S. Army's skirmishes along the Mexico-U.S. border. Chapter 3 moves into World War I and the first large-scale application of airborne reconnaissance. Also covered are the difficulties of communicating the intelligence gained by the airborne observer to the soldier on the ground. Chapter 4 covers the inter-war period and the loss of the lessons learned in the Great War as well as the resurgence of aerial reconnaissance in World War II. This chapter primarily focuses on developments in the U.S. Navy, USAAF, and the RAF. Each of these first four chapters includes a section on each of the major players of the particular era. These sections highlight the developments in each country and their resulting applications.

Chapter 5 examines the Cold War and the transition of manned airborne reconnaissance from its purely military applications to its use as a strategic policy instrument. Finally, Chapter 6 documents the manned airborne reconnaissance in the post-World War II era and the development of the ability to place real time intelligence in the users' hands directly. Both of these chapters discuss the developments and implementation primarily within the USAF.

Overall, Morton accomplishes his goal and does a creditable job of providing a solid history of the development and implementation of manned airborne reconnaissance systems. Particularly notable are the discussions of a) early attempts to provide a reliable and timely method of passing the information gained by the airborne platforms to the user, and b) the realization, during recent conflicts, of the goal of making intelligence available to aircrews in real time. Errors are miniscule and don't detract in any way from the reading. The provision of a list of acronyms at the front of the book is especially useful to those not familiar with military terms, and the comprehensive bibliography is extremely thorough and useful for those interested in further reading.

The book is a good read but does require the reader's attention in the early chapters, because many the players may not be well known. Morton could have included a few more pictures, especially for the earlier times periods when the various platforms may not be as familiar. Overall, this is an excellent book for anyone interested in the development of manned airborne reconnaissance.

Al Mongeon, MSgt, USAF (Ret)

Gott Strafe England: The German Air Assault Against Great Britain, 1914-1918, Volume 3. By Nigel J. Parker. Warwick UK: Helion, 2019. Maps. Diagrams. Photographs. Notes. Appendices. Bibliography. Pp. xiii, 343. $69.95. ISBN: 978-1-911512-75-2

Whereas the first two volumes in this series dealt with the German attacks against Great Britain proper in chronological order, Parker, in the third and final(?) volume of this epic series has produced an encyclopedia breaking down the assault on a topical basis. Much of the text is drawn verbatim from after-action reports, both German and British.

He begins by listing by manufacturer—Zeppelin (131 built), Schütte-Lanz (24), and Parseval (30)—all the German airships ever built. He includes builder number; military designation; date lost, destroyed, or decommissioned; and the airship's final fate. The second chapter expands on the first by emphasizing British analysts' interest in exploiting crash sites to better grasp the behemoths' strengths and weaknesses. This chapter includes many photos showing examples of German construction techniques ranging from small details to large overviews.

During World War I, Germans surface ships and submarines shelled British coastal communities nearly two dozen times. The third chapter features an accounting of each of these incidents frequently based on after-action reports. In some instances, a translation of a German communiqué associated with an attack is included, as are photos of some of the ships involved.

Beginning in May 1917, the Germans launched their heavier-than-air raids on England. Initially, they conducted

daylight raids; but, as their losses mounted, they switched to night time raids. The fourth chapter mentions virtually every raid, enumerating them in chronological order. As with the airships, German after-action mission reports provide details and insight into the challenges of bombing Great Britain. Complementary British reports are sometimes included. This chapter features two appendices: the first lists the production of Gotha and Zeppelin-Staaken bombers, and the second contains biographies of German flyers who influenced the fixed-wing effort.

In the fifth chapter, detailed accounts penned by four different German Naval Air Service officers offer considerable insight into the planning and use of the airships to take the war home to Britain. The presence of German airships in British skies naturally prompted a vigorous response. The sixth chapter details the variety of weapons employed against the airships. Casting aside some rather radical ideas, the homeland defense forces ultimately settled on antiaircraft artillery and lightweight fighters armed with machine guns.

The final chapter lists the bases from which the airships operated. Maps of some bases are included providing some insight into the logistical support required for sustained airship attacks.

Without question, this volume reflects Parker's passion for the subject. Hardly intended as a leisurely read from cover to cover, this outstanding reference work is highly recommended to anyone with an interest in the beginning of strategic bombing. He emphasizes thoroughness over analysis. Nevertheless, students of airpower doctrine aware of how Germany's bombing campaign influenced Britain's Trenchard, Italy's Douhet, and America's Mitchell should consider this book an indispensable resource.

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

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Eagles Over the Sea: Luftwaffe Maritime Operations 1935-1942. By Lawrence Patterson. Annapolis MD: U.S. Naval Institute, 2019. Photographs. Drawings. 464 Pp. $44.95. ISBN: 978-1-526740002-1

Passage to Marseilles and *Action in The North Atlantic* are not usually included in lists of Humphrey Bogart's greatest hits. Both 1940's movies are set aboard antiquated merchant vessels transiting dangerous Atlantic waters where they are beset by U-Boats and Luftwaffe marauders as well as copious amounts of crew drama. The Luftwaffe attacks were conducted by aircraft that I was not familiar with. After a steady diet of German jet technology and other innovations, I was surprised to see open cockpit float planes with parasol wings and the crews employing handheld, rifle-caliber machine guns. The aircraft in the films looked more like 1915-vintage Fokkers than 1940-vintage Messerschmitts, but they still struck fear in the hearts of our heroic cinematic mariners.

Patterson's *Eagles Over the Sea* offers an outstanding and unique view into an oft-overlooked niche of the early European air war. He begins his story in the late years of World War I, clearly establishing the deep roots of maritime air operations within German aviation. Patterson describes early German efforts to develop both aircraft carriers and "catapult barges" to defend German ports and waterways. But he also shows that, despite early innovation and success, maritime air operations became something of an unwanted step child. Existing on the periphery of "core" missions, maritime air operations never received the resources to become an effective fighting force on par with Great Britain's Coastal Command or the USAAF's Fifth Air Force.

I found this narrative detailed but a bit discordant. Given the extraordinary innovation that Dornier and Heinkel design bureaus demonstrated in the field of sea and float planes throughout the interwar years, Luftwaffe and Kriegsmarine leadership ignored technologies that offered significant capability to control sea lines of communications during the earliest stages of the war. Hence, Bogart and his minions faced 10-15-year-old open cockpit fabric and metal float planes instead of designs more consistent with contemporary land-based platforms. When modern aircraft, such as the Arado 196 and Dornier 18, did appear in service in time for the Norwegian campaign, they finally offered the Germans effective maritime platforms. Eventual reliance on the land-based multi-mission Ju 88 and He 111 designs presages USAAF employment of the B–25 as commerce raiders in the Pacific Theater.

Of some interest is Patterson's description of attempts to use commercial technologies and platforms as stopgap measures until more capable systems arrived. The FW 200 Condor, often referred to as the "Wolf of the Atlantic," was ill suited to the maritime role with its poor visibility and without an effective bombsite. These limitations forced the crews into low level attack profiles which left the aircraft vulnerable to small arms fire. Do 26 commercial seaplanes were drafted into service with the Luftwaffe for the Norwegian campaign only to be lost after long and expensive militarization modifications. The German failure to develop an effective aerial torpedo until the war was a year old receives attention as well.

This book is the first volume of a planned two-volume set on the subject. It is meticulously researched and presents a wealth of both technical and personal information, all supported by a plethora of photographs. Patterson builds a solid case for the premise that neither the Luftwaffe nor Kriegsmarine had a clear vision for what maritime air operations would look like, or could accomplish, when the war started. The book spends a great deal of time explaining the seemingly endless, and often chaotic, re-organization plans offered by the German General Staff in

the hopes that they would compensate for the lack of sufficient aircrew manning effective aircraft.

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

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From Texas to Tinian and Tokyo Bay: The Memoirs of Captain J.R. Ritter, Seabee Commander during the Pacific War, 1942-1945. By Jonathan Templin Ritter, ed. Denton TX: U of North Texas Press, 1919. Maps. Photographs. Notes. Appendices. Bibliography. Index. Pp. xi, 176. $24.95 ISBN: 978-1-57441-771-5

This is the story of one man's journey from civilian engineer to commander of a naval construction battalion in World War II. Capt. Rex Ritter, USNR (Ret.), wrote it from memory in the 1970s through 1990s. His grandson, Jonathan, discovered the typed manuscript after his grandfather's death in 1994. He made some stylistic changes and added an introduction, explanatory notes, and appendices; but, other than those, the text is what Ritter wrote of his experiences in the Navy from 1941-1946. An excellent historian and writer, young Ritter is the author of *Stillwell and Mountbatten in Burma*, reviewed in APH in the Summer 2017 issue.

A Texan, Ritter was a civil engineer who had been in the Merchant Marine for a while, worked for the Houston Parks Department and several oil companies, and was a nearly 39-year-old Assistant District Engineer responsible for 1000 miles of Texas highways when the Japanese attacked Pearl Harbor. He applied for a commission in the Navy's Civil Engineer Corps and reported to Norfolk VA in April 1942, a month after the Seabees had been created. This group was comprised of experienced construction personnel who were part of the Navy, uniformed, trained, and subject to international military conventions, unlike civilian workers.

Following introductory military training, Ritter was assigned to the 4th Seabees and soon was on his way to the Aleutian Islands. He well chronicles the duties and the harsh conditions encountered throughout his service on a number of "garden spots" in the island chain. By March 1943, he was the executive officer of the 6th Seabee Regiment. Three months later, after the Battle of Attu, he was sent to Camp Peary in Virginia.

Assigned as the skipper of the new 107th Battalion, his job was to get the unit formed, trained, and ready to head overseas. After several stateside moves (and getting married in San Francisco in November 1943), he took his battalion to Kwajalein in the Marshall Islands. After service there, the battalion moved to Tinian Island in the Marianas. There, the 107th joined eleven other Seabee battalions in transforming the relatively small island into the world's largest and busiest airfield complex. When the war ended, Ritter got to participate in the great flyover of Tokyo Bay after the treaty ceremony aboard the *USS Missouri*.

The 107th was deactivated a month later, and Ritter left for the CONU.S. to be separated. He worked for the San Francisco Housing Authority until retiring.

This is a wonderful look into the formation of, and life within, the fabled Seabees. They and the Army Corps of Engineers performed remarkable feats in all theaters of war and were, to a large extent, responsible for U.S. successes during World War II. My only complaint with the book revolves around Ritter's recollections regarding the atomic bomb activity on the island. Much of what he says is wrong. For example, he states that the Seabees opened up a cave on the island where the bombs could be assembled. Actually, the Seabees built three dedicated, air-conditioned buildings on the NW shore of the island to do that job. His battalion was not involved with this aspect of the Tinian work.

Other than that section, the book provides a look, from a man who was there, at an important aspect of the war effort—one that has received far too little coverage. It is well worth reading.

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

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Chinese Airpower in the 20th Century: Rise of the Red Dragon. By Andreas Rupprecht. -Vienna, Austria: Harpia Publishing, 2019. Maps. Tables. Diagrams. Illustrations. Photographs. Notes. Appendices. Glossary. Index. Pp. 253. $59.95 paperback. ISBN: 978-1-9503940-0-5

With this latest volume on Chinese military airpower, Andreas Rupprecht has solidified his standing as one of the world's leading experts on the topic. In the past decade, he has written at least seven books that cover all aspects of military aviation in the People's Republic of China (PRC).

Rise of the Red Dragon examines the turbulent history of what was to become the People's Liberation Army Air Force (PLAAF) from the end of the Manchu Dynasty in 1911 through current times (yes, the book does cover a bit more than the title implies). Much of the genesis of the PLAAF took place during the equally turbulent history of the country until China unified in 1949. There were actually a number of air forces in existence under control of the "central" government or some of the more powerful of the various warlords. And establishment of a real aeronautical industry was really out of the question, given the turmoil in the country overall.

Once the mainland was unified under the control of Mao, formation of the PLAAF began in earnest. Rupprecht traces creation of the various military region air forces and air divisions. He does this in four chronologically organized

chapters: founding period, Jan. 1949-Dec. 1953; overall development, Jan. 1954-Apr. 1966; Cultural Revolution, May 1966-Oct. 1976; and modernization, Oct. 1976 to the present. While it would be silly to say that one period was more important than the others, I found the 1949-1953 period fascinating, considering all that was going on. The Chinese had to build a modern air force almost from scratch. They founded an aviation industry where none had existed previously. They conducted their first air campaign in Tibet, created an airborne capability, fought the Korean War, and undertook a massive expansion while working with the USSR. All of this was accomplished in a relative short period of time.

After the chronological chapters, Rupprecht devotes nearly a third of the book to three appendices that cover brief histories of the final seven military region air forces and the many air divisions. The last appendix examines the evolution of the PLAAF serial number system. That may not sound important; but, given the paucity of information that comes out of the PRC government, codes may be the only clues to military structure, numbers of assets available, etc.

I can never say enough good things about the quality of Harpia's products. This book—as with all of their other products—is first-rate. They may be a bit pricey, but the reader gets what he pays for: glossy white paper, hi-res photos (both B&W and color), photo captions well removed from regular text, other-information boxes highlighted in different colors, a pleasing layout, and quality editing. But best of all—given the almost encyclopedic nature of the book—is a well-done and useful index. Aircraft types (and sub-variants) are lumped together, as are people, units, places, and the like. If a reader wants to find information on something specific, he can easily do so.

All of Rupprecht's China books are must-haves for anyone who wants to better understand the evolving military powerhouse of Asia.

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

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Modern Chinese Warplanes: Chinese Air Force – Aircraft and Units and **Modern Chinese Warplanes: Chinese Naval Aviation – Aircraft and Units** and **Modern Chinese Warplanes: Chinese Army Aviation**. By Andreas Rupprecht. Houston TX: Harpia Publishing, 2018, 2018, 2019 (respectively). Maps. Tables. Diagrams. Glossary. Photographs. Illustrations. Bibliography. Index. Pp. 237, 94, and 93. $59.95, $29.95, and $29.95, paperback. ISBN: 978-09973092-6-3, 978-09973092-5-6, and 978-0-9973092-8-7

Andreas Rupprecht is a German national who says, in his Twitter account, that he is a "China military aviation researcher, book author and China news reporter." From all accounts, he has no inside track for classified information on the Chinese but relies on open sources. However, he does acknowledge Chinese sources that remain unnamed who provide him with materials and translations. That being said, these three books show that he is an excellent researcher who gleans as much as possible from whatever sources are available and analyses and arranges the data into meaningful information.

These three books are being reviewed as one; because, in essence, they are merely three separately bound parts of one large book on the state of military aviation in the People's Republic of China (PRC). The three books are encyclopedic in nature; one shouldn't expect to sit down and read them through cover-to-cover. Rather, they are probably the best possible sources for information regarding all facets of the subject matter.

Each begins with a background and history of the subject service. If these do nothing else, they show how far military aviation has moved in the PRC in a relatively short time, particularly in the naval sector. The history is followed with a chapter on aircraft markings and serial number system. The latter is important in that it provides clues to units of assignment and, therefore, organization of the service. The next chapter covers the aircraft, helicopters, and UAVs used by the particular branch. These are done, generally, in narrative form. In other words, the section isn't just a collection of relatively dry tables of data. Further, pretty much all systems—fighters, bombers, transports, trainers, et al.—are covered. In the next chapter Rupprecht discusses the various weapons and stores employed by the service branch. Each volume then covers the aviation training syllabus employed. In the big chapter on the particular service's order of battle (as of the publication date), the reader finds out how the service is organized and, through this, missions and strategies. The final chapter(s) covers other organizations such as the Marine Corps (under the navy), People's Liberation Army Air Force Airborne Corps (under the air force), and paramilitary groups such as the Coast Guard and several law-enforcement-oriented organizations.

All of the text is backed up with hundreds of photos. Because Harpia publications are all printed on glossy paper, these photos are very high-resolution. Also, throughout the books are many excellent maps that show unit locations, ranges of various weapon systems, and the like. Of particular note are inclusion of potential adversaries' bases (U.S., Japanese, etc.); this helps a reader understand why the forces are deployed as they are. Tables of data and organization charts are plentiful and clearly laid out. The bibliography is, of course, relatively short, given the dearth of information provided by the government and the various services. But the index is very detailed, so finding pictures or information on any weapon system or organization is easy.

Given the nature of military equipment and organiza-

tions, much of the information in these books is perishable. But, for now, anyone wanting to know about this vast nation's military airpower and its capabilities will find no better single source than these three volumes.

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

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Winged Brothers: Naval Aviation as Lived by Ernest and Macon Snowden. By Ernest Snowdon. Annapolis MD: Naval Institute Press, 2018. Photos. Notes. Bibliography. Index. Pp. vi, 256. $29.95. ISBN: 978-1-68247-296-5 (e-book: 978-1-68247-295-8)

In his first professional effort, Ernest Snowdon easily weaves the brothers' stories into the fabric of naval aviation's distinguished history. Son of the younger brother, Mac, his own experience as a naval aviator and insight into naval history enables him to turn the two biographies into one readable volume.

The senior Snowden's time in the Navy ranged from the early 1930s (he graduated from the Naval Academy in 1932) to the late 1950s. Before World War II began, he married the daughter of General Henry "Hap" Arnold, who later became commanding general of the U.S. Army Air Forces in World War II. Arnold, an adherent of General William Mitchell's desire to see military and naval aviation consolidated into a third separate branch, accepted his son-in-law without reservation. Ernest Snowden proved to an exemplary leader at the squadron and group level. Heavily involved in the fighting in the Solomon Islands in the southwest Pacific in the war's early years, he eventually received the Navy Cross for his efforts to help defeat the Japanese in the Battle of the Philippine Sea. The air battle became known as the Marianas Turkey Shoot where Naval and Marine Corps aviators decimated the opposing force. The post-war years proved less satisfying. Perhaps the biggest disappointment was his non-selection to command a fleet carrier in the 1950s.

Mac graduated from the Naval Academy in 1946. The Navy's transition from piston power to jet power marked the early years of his career. By the early 1960s, he had spent most of his career in fighter aviation; commanding squadron VF-91 equipped with the Vought F-8 Crusader was a natural progression. Later he would command Carrier Air Wing 5 from aboard *USS Ticonderoga* during her participation in the Vietnam War in 1965. This period marked the beginning of the ill-fated Rolling Thunder bombing campaign, limited air attacks that failed in any way whatsoever to convince the North Vietnamese of the errors of their ways in South Vietnam. Perhaps Mac's greatest contribution was providing the foundation for the Navy's argument that the so-called TFX aircraft program was completely inappropriate for carrier operations. These efforts resulted in the Air Force (and Australia) acquiring the General Dynamics F–111 when the Pentagon was seeking commonality in aircraft design to save money. Mac instead helped the Navy successfully develop the Grumman F–14 Tomcat. He retired in 1974, but then became the first executive director of the Association of Naval Aviation, a post he held until 1986.

An appendix featuring the brothers' career milestones would have been useful. Air Force readers may find the author's comments concerning various positions contrary to the Navy's a bit over the top. At times the work's tone sounds like a public-relations tune for the Association of Naval Aviation. Nevertheless, the brothers' story is certainly worthy of publication. Snowdon has done a fine job of capturing the lives and times of his father and uncle.

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

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Sydney Camm: Hurricane and Harrier Designer, Saviour of Britain. By John Sweetman. Barnsley UK: Pen and Sword Books, 2019. Photographs. Illustrations. Pp. 264. $49.95. ISBN: 978-1-52675-622-0

Sweetman approached this work with an eye for the details that would bring Sir Sydney Camm to life for the reader. While I initially considered the sobriquet "Saviour of Britain" to be a demonstration of hyperbole, by the time I finished the work and could weigh the sum of Camm's accomplishments, I saw the phrase in a different light and a bit closer to the truth.

Even the most novice of military aviation enthusiasts is aware that the Hawker Hurricane's contribution to the British victory in the Battle of Britain is typically under appreciated. The most effective portion of this book addresses Camm's early life and work which prepared him for his work on the Hurricane. Largely self-taught, Camm approached design with very simple goals: "Achieve the greatest strength with the lightest weight." "The simple solution is usually the best solution." "Consider production during design." Despite his success, I was left with the distinct impression that his lack of formal education and his reliance on simplicity contributed to bouts of a lack of confidence in his own work. Perhaps this lack of confidence contributed to an autocratic and dictatorial management style that produced great airplanes at the cost of personal and professional relationships.

Sweetman goes to great length to describe Camm's "Jekyll and Hyde" personality, going so far as detailing Camm's reaction to a daughter's misadventure baking scones to another anecdote centered on the purchase of a turkey too big to fit in the family oven. But, surprisingly, he fails to include any mention of the Meredith Effect and its integration in the Hurricane's design. Sweetman re-

counts Camm's lifelong feeling that the Hurricane would have been an even better aircraft had the wing been thinner but offers no discussion of the myriad advantages of the fighter's thick wing—space for retractable landing gear and room for a variety of armament configurations within the wing. Considering that this same thick wing-thin wing controversy played out on most of Camm's designs, it seems this would have been an area for more attention in the narrative.

Sydney Camm is at its best when describing the breadth of Camm's design work from wood and fabric models to the Harrier prototype and everything in between. Considering the changes in the materials used to breathe life into his designs, Camm seemed to have had an intuitive knack for understanding how to optimize his designs by using the most appropriate materials and production methods. The only time his intuition seems to have let him down was in selecting the best engines to power his designs. Over the decades, Camm held onto his roots at the drafting table. Sweetman describes him making rounds to observe draftsmen and engineers making Hawker Hunter drawings that Camm frequently ripped from the drawing boards and shredded while firing the worker on the spot.

This book is a quality read with a wealth of research into the man, the environment in which he worked, and the decades during which he made such exceptional contributions.

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

Admiral John S. McCain and the Triumph of Naval Air Power. By William F. Trimble. Annapolis: Naval Institute Press, 2019. Maps. Photographs. Notes. Bibliography. Index. Pp. xv, 370. $38.00 ISBN: 978-1-68247-370-2

This is the latest in the *Studies in Naval History and Sea Power* series that covers issues relating to sea power such as strategy, tactics, technology, diplomacy and financing and administration of that power. McCain was a combat commander who had a significant impact on carrier tactics in World War II. His career included numerous staff assignments before and during the war where he learned the intricacies of Washington politics and impacted Navy policies. This book seeks to place McCain in his proper place in history.

Trimble is eminently qualified to write a book both on naval aviation and McCain himself. A professor emeritus at Auburn University, he has written biographies of Glenn Curtis, William Moffett, and Jerome Hunsacker (all naval aviation pioneers), a history of seaplane striking forces, and a history of the Naval Aircraft Factory. McCain was a developer of tactics; he commanded seaplane striking forces during the Guadalcanal campaign; and he was a vocal commentator on, and critic of, the planes the Navy procured to fight the war.

The book is well researched, clearly and concisely written, and provides a reasonable balance of facts with analysis of McCain as a leader and tactician. Trimble strikes a balance between correcting other overly critical historians and becoming an apologist for McCain. He provides a clearer view of McCain as a commander.

McCain was a latecomer in naval aviation circles, one of a group of senior officers who recognized the technology trends in naval warfare and chose to transition into aviation at a later age. He was over 50 when he began flight school. Only Bull Halsey was older when he finished flight training. Despite this late start, McCain threw himself into the business of naval aviation, serving as commander of the *USS Ranger* (the first purpose built U.S. aircraft carrier) and rapidly developing the knowledge and skill to apply naval airpower. However, his first combat assignment was not with carriers; he managed the disparate non-carrier-based aviation assets (patrol, base defense, and transport) assigned to support the Marines on Guadalcanal. Working on a shoestring, he developed tactics and procedures to stretch his resources to the maximum. That he wasn't always successful is evident in the numerous allied naval defeats suffered during that campaign. Some historians have placed the blame squarely on McCain (among others) for failing to ensure adequate patrols were in place to detect Japanese ship movements and prevent surprise. Again while not apologizing for, or excusing, McCain's mistakes, Trimble points out what McCain accomplished with severely limited resource while acknowledging areas for improvement. Perhaps the most relevant assessment of his leadership was the fact that he was trusted by the Marines he supported who believed he was doing a good job.

McCain's larger opportunity came later after a Pentagon tour when he was assigned to the fast carrier task forces devastating the Japanese throughout the Pacific. These forces were evolving from traditional carrier warfare in the open ocean to projecting airpower ashore and dealing with the kamikaze attacks, where even one aircraft getting through the protective Carrier Air Patrol could spell disaster. During this time, McCain working closely with his Chief of Staff Jimmy Thach to develop innovations to better attack the enemy and protect the fleet. One key innovation in the effort against the suicide bombers was what they called the "big blue blanket." This expanded protection of the fleet from the concept of air superiority (maintaining control of the air over your head) to air supremacy (keeping the enemy out of the skies altogether). While the big blue blanket never completely eliminated the kamikaze threat, the ability to smother enemy airfields and often prevent them from ever taking off doubtless saved countless lives and vessels.

Trimble's assessments of McCain's performance are where the book is at its best. On the other hand, he often

falls into a formulaic recitation of statistics—useful information where it explains or demonstrates a point, but repetitive otherwise. Trimble could have placed more emphasis on McCain's priorities and leadership. I would have appreciated more in-depth discussion of the evolution of the blue blanket, discussion of air supremacy vs. air superiority, and McCain's relationships and teamwork with subordinates (Thach) and superiors (Halsey).

In the end, this is a good book on an important topic, particularly as China continues to develop a naval aviation capability, and the U.S. Navy works to refine its role in the 21st century. Today's naval leaders could look to McCain as an example. This book is a good place to start learning more about him.

Golda Eldridge, Lt Col, USAF (Ret), EdD

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"Men Will Come": A History of the 314th Troop Carrier Group 1942-1945. By Mark C. Vlahos. Hoosick Falls NY: Merriam Press, 2019. Maps. Tables. Diagrams. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. 508. $39.95 paperback. ISBN: 978-0-359-95260-1

Mark Vlahos is a retired USAF colonel who served several generations removed from the action described in this book. As a former C–130 driver, squadron commander, and vice wing commander and a member of the Troop Carrier/Tactical Airlift Association member, he has a deep interest in airborne operations. What his writing and research efforts turned out here is the kind of unit history that many outfits produced after the war—when the memories and documentation were fresh. Vlahos had to do a lot of digging to turn out this remarkable history of an extraordinarily busy airlift unit seven decades before.

This is more than just a history of a unit that participated in all of the major airborne drops in Europe in World War II. Airlift, tanker, and recce missions just don't generate the proliferation of books that fighters and bombers do. Vlahos has helped fill in the history of the guys who had to bring the airborne divisions into combat. He has put on paper the gritty scenes of shot-up aircraft during the Normandy drop shown in *Band of Brothers*.

The 314th TCG formed in March 1942 and had four troop carrier squadrons assigned: the 32nd, 50th, 61st, and 62nd. They flew both Douglas C–47 (and similar variants) and Waco CG–4 gliders. Their first combat mission was during Operation HUSKY, the invasion of Sicily. They flew a second drop on D+2 (July 1943). They dropped on Agropoli, Italy, on two successive nights in September 1943. On D-Day, they made drops twice on Normandy, France. They flew into The Netherlands on four different missions during the infamous MARKET GARDEN operation. The group's final operation was towing gliders that participated in the largest single-location airborne operation in history with the Operation VARSITY drop over the Rhine River (March 1945). The group also had the high honor of being visited in Castelvetrano, Sicily, by President Roosevelt (and Generals Arnold, Patton, and Clark) on December 8, 1943 after his meeting with other Allied leaders in Teheran.

Vlahos didn't write this book as a dry history of operations of a distinguished group. He really personalized the story by covering the men (and women) involved as well. It is the story of Col Clayton Stiles, the group commander from almost its inception through the end of hostilities in Europe, and a man who retired from the Air Force Reserve as a Maj Gen. But it is also the story of many of the officers and men as well. Over 100 of these men did not return from the war.

In addition to the hundreds of photographs, Vlahos included the all-important maps of drop zones and operations areas. He included a comprehensive index and 14 appendices. These cover all of the aircraft and crews, details of each of the major operations, glider personnel assigned, and the two Presidential Unit Citations the group earned during the war.

All in all, this is an excellent addition to the air-combat history of World War II in Europe and the significant role that one of the lesser known and recognized combat units played in achieving the victory.

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

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21st Century Power: Strategic Superiority for the Modern Era. By Brent D. Ziarnick, ed. Annapolis MD: Naval Institute Press, 2018. Notes. Pp. 192. $21.95 ISBN: 978-1-68247-313-9

The editor of the 21st Century Foundation Series notes that this series informs the present by collecting and offering strategists and thinkers of the past. This short monograph hits the mark. The topic is important in light of the current nuclear weapons debates as the U.S. begins a multiyear effort to modernize all three legs of the nuclear triad. The 2018 Nuclear Posture Review (NPR) has committed to the on-going B–21 bomber development, a new intercontinental ballistic missile (ICBM, the Ground Based Strategic Deterrent), updated gravity nuclear weapons, a follow-on air launched cruise missile, and the replacement class of ballistic-missile submarine launching platforms.

General Thomas Power, the focus of the monograph. was an influential presence in the maturation of the Strategic Air Command (SAC), the introduction of the ICBM, and nuclear deterrence thought and policy. Power was the third Commander-in-Chief, SAC (CINCSAC), from July 1957 to November 1964. In today's Air Force and, in-

deed, the U.S. military establishment, that long tenure would be considered unprecedented as commander of what is now called a Combatant Command (COCOM).

Readers should be aware of Power's earlier career milestones to gain insight into his collected writings in the volume. In 1948, he became the Vice CINCSAC—General Curtis LeMay's deputy—a position he held for six years. He then served as the Air Research and Development Command (ARDC) commander for three years during the priority development and deployment of the Nation's early ICBMs. In sum, Power served for sixteen years at the leading edge of the strategic nuclear weapons systems development, deployment, and leadership in what is now called the Nuclear Enterprise.

In essence, Power possessed a great deal of gravitas when he spoke and wrote on the topics of deterrence and war fighting during the height of the Cold War. Ziarnick compiles Power's words to the public, internal publications aimed at members of SAC, and testimony to Congressional committees.

To put it directly, Power was a hard liner on nuclear war fighting, deterrence, and SAC's nuclear weapon systems. He was forcefully against the Nuclear Test Ban Treaty in Senate testimony. During a RAND briefing on strategies in nuclear-war fighting, known as Counterforce in the thinking of the day, Power took exception to the briefing. Counterforce would require SAC war-plan execution restraint from striking Soviet cities early in a conflict. Power may have made one of his more forceful positions clear when he said: "Restraint? Why are you so concerned with saving their lives? The whole idea is to kill the bastards. At the end of the war if here are two Americans and one Russian left alive, we win!"

Power may have been the quintessential Cold War warrior of the times, but he also shared his deep understanding of the doctrine and practice of deterrence. While he advocated overwhelming nuclear power, he also clearly understood and articulated its deterrent effect. He told a group of civic leaders when speaking about a nuclear exchange that "… there will be no winners, only losers in varying degrees. Or putting it differently, if man resorts to the use of thermonuclear weapons to settle his differences or accomplish his aims, well then in my opinion, mankind will have reached his highest plateau of stupidity. Now that's our (SAC's) real mission is trying to prevent a war… Deterrence is our mission here…I'm talking about a general nuclear war. We are trying to prevent it through deterrence."

In addition to this work, Ziarnick published a related paper on Power's role in ICBM development and fledgling USAF space operations. The paper is *Tough Tommy's Space Force: General Thomas S. Power and the Air Force Space Program,* published by Air University's School of Advanced Air and Space Studies. In it, Ziarnick frames Power "as a man of remarkable military insight and experience who could—and did—speak intelligently and articulately. And, perhaps most important to today's Air Force, instead of a man intimidated and horrified by the rise of the ICBM in his flying club, Power had the most accurate understanding of the real value of space to the Air Force and the nation. He, more than Schriever, is the true father of the United States Air Force space effort."

Coupled with Power's words in *21st Century Power*, one can gain a complete appreciation of the arguments from his era that may carry wight for some of today's debates on the instruments of warfare, including the evolving cyber arena. We certainly will benefit from revisiting as well as learning—-once again—the lessons of recent history as captured by Ziarnick.

Michael F. Loughran, Colonel, USAF (Ret), former SAC B-52 wing commander

Broken Arrow: How the U.S. Navy Lost a Nuclear Bomb. By Jim Winchester. Philadelphia: Casemate, 2019. Maps. Illustrations. Photographs. Notes. Bibliography. Index. Pp. viii, 271. $32.95 ISBN: 978-1-61200-691-8

This book chronicles the loss, in a very simple and seemingly preventable accident, of an aircraft, pilot, and nuclear weapon off an aircraft carrier during the Vietnam War. Unfortunately aircraft losses during carrier ops, particularly during that time, were not unusual, whether in combat, flying accidents, or the stressful and dangerous business of getting high-performance aircraft off of and on to a moving runway in the middle of the ocean. What makes this accident unique is that the aircraft was loaded with a complete (not armed) nuclear weapon and fell overboard during a routine training exercise onboard ship. There were other Cold War incidents involving the loss of nuclear weapons from aircraft and loss of entire nuclear powered ships (submarines *USS Thresher* and *USS Scorpion*), but Winchester points out that this is the only example of the US Navy losing a nuclear weapon in this fashion.

The book purports to tell the story of what happened and the aftermath. The Navy did in fact have a Broken Arrow (an accident involving nuclear weapons or components). Winchester attempts to make sense of how the ac-

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.)
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Tel. (703) 620-4139
e-mail: **scottlin.willey@gmail.com**

cident occurred and what happened afterward, both the immediate repercussions including the Navy inquiry and the subsequent treatment of the accident by the US military and US and Japanese governments. As investigative journalism goes this is not bad. As history it is flawed.

The book implies there was some sort of criminal conspiracy to prevent knowledge of this very embarrassing and preventable mishap from being made public. The facts Winchester presents simply do not support his implied thesis. They do, however, support his conclusions about poor shipboard safety practices, hurried and perhaps incomplete efforts at gathering and assessing evidence, and a lackluster and not very transparent attempt by the US and Japanese governments to minimize public impact. So what we have in the end is a regrettable and completely preventable accident involving pushing an airplane loaded with a nuclear weapon into the ocean. Incredible—yes. In hindsight, stupid—yes. But a criminal cover-up—no.

So why passable investigative journalism and not good history? Because historians should be held to a higher standard of fact, method, and research; and in these areas this book falls short. The jacket states the book is based on eyewitness and firsthand accounts. Winchester thanks a long list of crewmembers and others who should have firsthand knowledge of the events, but the closest things he has from any of these people in the bibliography are the transcripts of the official inquiry. There is not a single interview cited. He cites information from the lost pilot's diary; but again, nothing is in the bibliography. His account of the 1989 press conference where a US government spokesperson addressed the accident is incredibly detailed (almost as if he'd been there and taken notes), but, again, nothing in the bibliography. The narrative argues for in-depth and comprehensive research, but the documentation doesn't show this. At best, this is shoddy scholarship; at worst it makes one suspect sources and information, especially given his implications of cover-up.

The narrative flows reasonably well but reads as a litany of aircraft accidents and losses and personal injuries to crewmembers both on and off the ship. If Winchester was trying to demonstrate life as a member of a carrier crew is a dangerous business, he succeeds but belabors the point. Along with the details of every incident during the deployment, he provides a short history of the *USS Ticonderoga*. While interesting, it is unnecessary. A similar example is his discussion of the several kamikaze attacks the ship suffered years before. His discussion of the carrier leadership's (captain as well as flying unit) limited experience with, exposure to, and training on nuclear weapons procedures seems accurate and relevant; but Winchester doesn't expand on whether he or anyone else considered this relevant to the accident.

More supporting material in needed. A schematic of the ship's decks would be helpful in understanding what happened, particularly one showing the accident situation. There are a few minimal notes toward the end of the book, but there a number of places where the text would benefit from a well-placed note. The pictures are generally good and relevant. One especially interesting addition was illustrations of the nuclear-specific and general-subject safety flyers routinely posted on board. There were only two maps, but they adequately cover the accident area. It is curious there is a schematic of the B-43 bomb (the weapon that fell overboard) on the book jacket but nowhere in the body of the book. It also seems that long-term environmental effects should have been included in the book.

Ultimately, his conclusions about what led to the aircraft loss are sound: possible brake failure, a short pilot who didn't readjust the rudder/brake pedals after a taller individual had been in the cockpit, or a distracted pilot who missed the signal to apply brakes are all possibilities. The attempt to sensationalize what is still a very disturbing story with lessons to be learned in a variety of circumstances is unfortunate. Given the price, only the more ardent history buffs will probably buy this book.

Golda Eldridge, Lt Col, USAF (Ret), EdD

Compiled by
George W. Cully

June 15-19, 2020
The **American Institute of Aeronautics and Astronautics** will present its annual premier event, the AIAA Aviation Forum and Exposition, at the Reno-Sparks Convention Center in Reno, Nevada. The Institute bills this as "only aviation event that covers the entire integrated spectrum of aviation business, research, development, and technology." More details are at the Institute's website: https://www.aiaa.org/aviation?_ga=2.81927830.1817712024.1549286902-252629489.1507741022.

July 8-12, 2020
The International Womens Pilot Association, better known as **The Ninety-Nines**, will hold their annual meeting on the SS Queen Mary moored in the harbor of Long Beach, California. For registration, see their website at https://www.ninety-nines.org/conference.htm

July 14-16, 2020
The **American Astronautical Society** will host its annual John Glenn Memorial Symposium at the Huntington Convention Center in Cleveland, Ohio. For more information, see the Society's website at https://astronautical.org/events/john-glenn-memorial-symposium/.

September 12-13, 2020
The **Air Force Association** will hold its 2020 National Convention at the Gaylord National Hotel in National Harbor, Maryland. For details, see the Association's website at https://www.afa.org/events.

September 23-26, 2020
The **Society of Experimental Test Pilots** will hold its 64th Symposium & Banquet at Disney's Grand Californian Hotel & Spa in Anaheim, CA. For details, see the Society's website at www.setp.org/annual-symposium-banquet.

September 26, 2020
The **National Aviation Hall of Fame** will celebrate its 58th annual enshrinement at the National Museum of the United States Air Force in Dayton, Ohio. For further news as it develops, see their website at:
www.nationalaviation.org/enshrinement/.

October 6-7, 2020
The **Aviation Engine Historical Society** will hold its annual meeting at the Doubletree Dearborn Hotel in Dearborn, Michigan. The schedule will include visits to the Henry Ford Museum and Greenfield Village. For more details, see the Society's website at http://enginehistory.org/.

October 7-11, 2020
The **History of Science Society** will hold its annual conference in New Orleans, Louisiana. For more details as they become available, see the Society's website at https://hssonline.org/meetings/annual-meeting-archive/.

October 7-11, 2020
The **Society for Military History** will hold its annual meeting at the Sheraton New Orleans hotel in New Orleans, Louisiana. Details regarding paper submission and registration can be found at the Society's website: https://www.historyoftechnology.org/annual-meeting/2020-shot-annual-meeting-7-11-october-new-orleans-louisiana/

October 21-24, 2020
The **Oral History Association** will hold its annual meeting in Baltimore, Maryland. For more details as they become available, check the Association's website at:https://www.oralhistory.org/annual-meeting/.

October 24-25, 2020
The **League of World War I Aviation Historians** will hold its annual seminar in Kansas City, Missouri, with planned visits to the National Museum of World War I and Memorial. For more details as they become available, see the League's website at www.overthefront.com

October 26-28, 2020
The **American Astronautical Society** will host its annual Wernher von Braun Memorial Symposium at the University of Alabama in Huntsville. For additional details, see the Society's website at https://astronautical.org/events/vonbraun/.

In light of the coronavirus pandemic, the 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.

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

Born in Bremen Germany, Bernard A. Schriever (1910 – 2005) immigrated to the U.S. (Texas) in 1917. After graduating from Texas A&M, he joined the Army as an artillery officer in 1932. He would later transfer into the Army Air Corps. During World War II, he served in the Pacific and flew thirty-three combat missions in the B–17. He holds the distinction of being one of the few airmen present on board the *U.S.S. Missouri* to witness the Japanese surrender. In 1954, then Brigadier General Schriever commanded the Western Development Division (WDD). The WDD was responsible for the Air Force space and ballistic missile programs. He would be involved in the development of the Atlas, Thor and Titan missiles. Recognizing the relationship between ballistic missiles and space, he had the WDD lead the research and development for space. The USAF would launch its first satellite in 1958. Schriever finished his military career as a four-star general and as the commander of Air Force Systems Command.

In 1998, retired Gen. Schriever received the unique honor of having an air force base named in his honor when Falcon AFB was renamed Schriever AFB, home for the 50th Space Wing and now part of the U.S. Space Force.

To learn more about **General Schriever** read:

Bernard A. Schriever: Challenging the Unknown https://media.defense.gov/2010/Sep/29/2001329778/-1/-1/0/AFD-100929-007.pdf &

https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/197700/gen-bernard-a-schriever/ & about **satellites and ballistic missiles**:

https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/197684/thor-agena-a/

https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195923/cold-war-in-space-top-secret-reconaissance-satellites-revealed/

The Development of Ballistic Missiles in the United States Air Force, 1945-1960 by Jacob Neufeld

http://media.defense.gov/2010/Sep/24/2001329775/-1/-1/0/AFD-100924-024.pdf

On Alert: An Operational History of the United States Air Force Intercontinental Ballistic Missile Program, 1945–2011 by David N. Spires: https://users.neo.registeredsite.com/4/8/6/12339684/assets/onalert.pdf

New History Mystery

by Dan Simonsen

This issue's quiz:

On December 19, 2019, the United States Space Force was established as a new miltary service. On January 14, 2020, Vice President Michael R. Pence officially swore in U.S. Air Force General John Raymond, then head of Air Force Space Command and U.S. Space Command, as the first Chief of Space Operations. As with many things, the future of the United States Space Force and General Raymond are deeply rooted in a rich history of dedication and hard work of those who came before us. This would include Air Force Space Command and the answer to this edition's question. This World War II veteran, was born in Germany in 1910, emigrated to the United States and graduated from Texas A&M University before joining the U.S. Army. He would ultimately become known as the *father of Air Force missiles and space*. Can you name this person?

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