

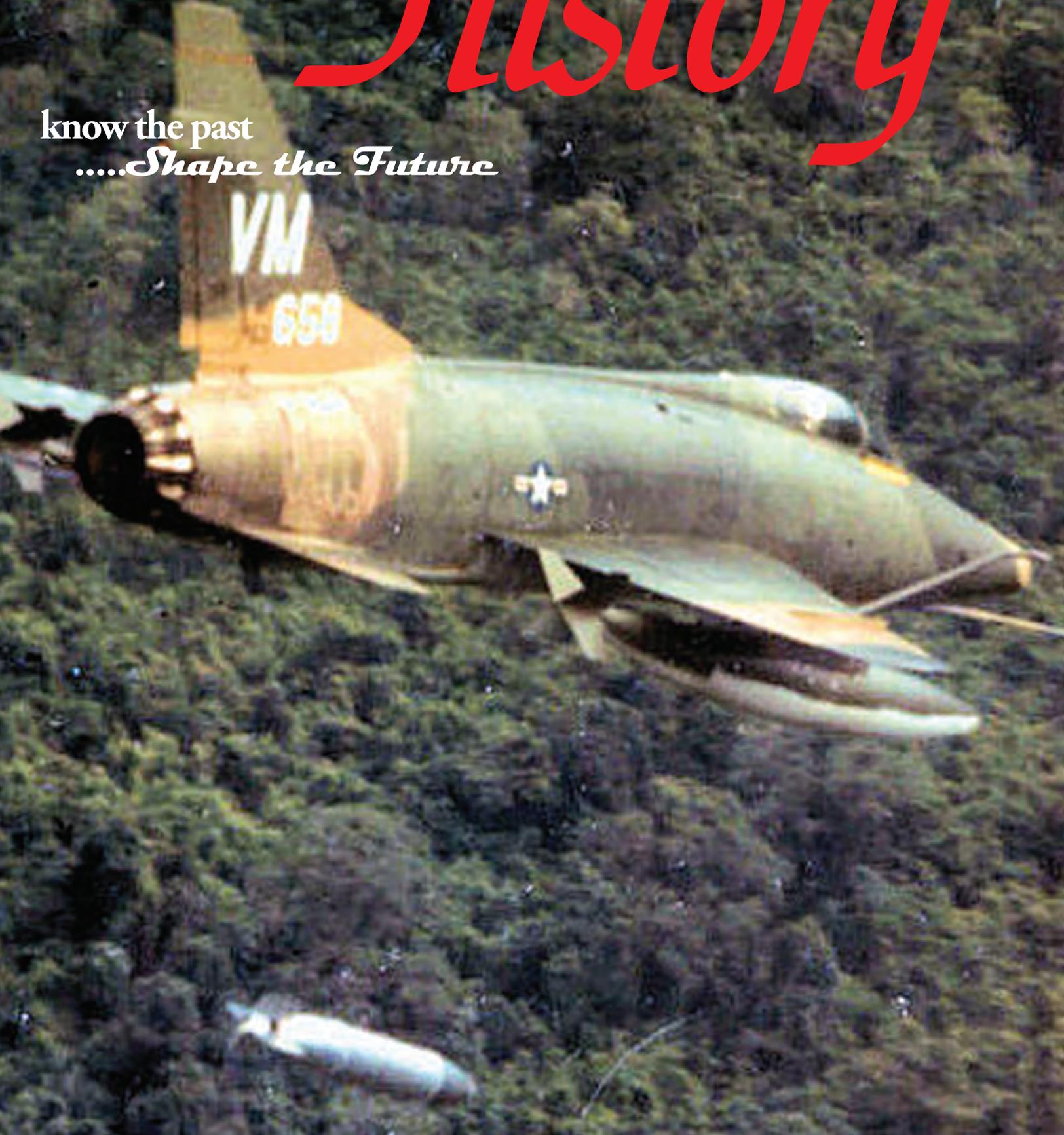
# AIR POWER

WINTER 2019 - Volume 66, Number 4  
WWW.AFHISTORY.ORG

# History

know the past

.....*Shape the Future*



# *2019 Doolittle Award and Awards Banquet Partners*

We gratefully thank our partners for their assistance in producing our annual events. Their help made this year's celebration a resounding success!

*Event Partner*

*Dinner Partner*



***NORTHROP GRUMMAN***

*Reception Partner*



*Table Partners*



# AIR POWER

Winter 2019 - Volume 66, Number 4  
WWW.AFHISTORY.ORG

# History

know the past  
.....*Shape the Future*

## Features

- The Air War Against North Vietnam: the Thanh Hoa Railroad and Highway Bridge (Part Four) **7**  
*Theo van Geffen*
- Strategic Air Command SIGINT Support to the Vietnam War **29**  
*William Cahill*
- An Attempt to Bring Home Flight Office Bruce F. Jepson **43**  
*Jon A. Reynolds*
- 

## Book Reviews

- Stalag Luft I: An Official Account of the PoW Camp for Air Force Personnel 1940-1945* **52**  
By UK Air Ministry Personnel. Review by Gary Connor
- RAF on the Offensive: The Rebirth of Tactical Air Power 1940-1941* **52**  
By Greg Baughen Review by Golda Eldridge
- Democracy in Exile: Hans Speier and the Rise of the Defense Intellectual* **53**  
By Daniel Bessner Review by John Cirafici
- Shattered Dreams: The Lost and Canceled Space Missions* **54**  
By Colin Burgess Review by Rick W. Sturdevant
- Sir Alan Cobham: The Flying Legend Who Brought Aviation to the Masses* **55**  
By Colin Cruddas Review by Steven D. Ellis
- MacArthur's Coalition: US and Australian Operations in the Southwest Pacific Area, 1942-1945* **55**  
By Peter J. Dean Review by Steven Agoratus
- Messerschmitt Bf 109* **56**  
By Robert L. Jackson Review by Gary Connor
- America's Round-Engine Airliners: Airframes & Powerplants in the Golden Age of Aviation* **57**  
By Craig Kodera & William Pearce Review by Scott A. Willey
- An Anxious Peace: A Cold War Memoir* **58**  
By Hans Mark Review by John Cirafici
- A History of the Mediterranean Air War, 1940-1945, Vol. 4, May 14, 1943-June 5, 1944* **58**  
By Christopher Shores & Giovanni Massimello Review by Kenneth P. Werrell
- The Polish Few: Polish Airmen in the Battle of Britain* **59**  
By Peter Sikora Review by Golda Eldridge
- The British Overseas Airway Corporation: A History* **60**  
By Graham Simons Review by Gary Connor
- Reaching for the Moon: A Short History of the Space Race* **61**  
By Roger D. Launius Review by Rick W. Sturdevant

## Departments

- President's Message **4**
- Upcoming Events **62**
- New History Mystery **64**



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

**E-mail: [angelabear@afhistory.org](mailto:angelabear@afhistory.org)**  
**On the Web at <http://www.afhistory.org>**

#### Board of Directors

Lt Gen Christopher D. Miller, USAF (Ret.)  
Chairman  
Lt Gen Nicholas B. Kehoe, USAF (Ret.)  
First Vice Chairman  
Lt Gen Charles R. Heflebower, USAF (Ret.)  
Second Vice Chairman  
Dr. Rebecca Grant,  
Secretary  
Lt Col Steven Gress, Jr., USAF (Ret.)  
Treasurer  
Maj Gen John L. Barry, USAF (Ret.)  
Douglas Birkey  
Col Scott C. Bishop, USAF (Ret.)  
Col Christopher J. Brunner, USAF (Ret.)  
Lt Col (Dr.) Dik Daso, USAF (Ret.)  
Gen Ralph E. Eberhart, USAF (Ret.)  
Lt Gen Robert J. Elder, USAF (Ret.)  
Maj Gen Charles W. Lyon, USAF (Ret.)  
Col Stephen E. Newbold, USAF (Ret.)  
MSgt Keith A. Reed, USAF (Ret.)  
Maj Gen Roger Teague, USAF (Ret.)

#### Emeritus

Maj Gen Dale W. Meyerrose, USAF (Ret.)  
Chairman

#### Editor, *Air Power History*

Richard I. Wolf

#### Editor Emeritus, *Air Power History*

Jacob Neufeld

#### Staff

Lt Col James A. Vertenten, USAF (Ret.)  
Secretary to the Board and  
Executive Director  
Mrs. Angela J. Bear, Office Manager

#### President's Circle

Col William J. Dalecky, USAF (Ret.)  
Col Wray Johnson, USAF (Ret.)  
Lt Col Kenneth W. Sublett, USAF (Ret.)

#### Benefactor

Mr. Darrell Dvorak  
Lt Gen Charles R. Heflebower, USAF (Ret.)  
Lt Gen Nicholas B. Kehoe, USAF (Ret.)

#### Patron Members

Col Gerald F. Christeson, USAF (Ret.)  
Maj Gen Charles J. Dunlap, Jr., USAF  
Dr. John Farquhar  
Lt Col Raymond Fredette, USAF (Ret.)  
Dr. Rebecca Grant  
Dr. Jerome V. Martin  
Lt Gen George D. Miller, USAF (Ret.)  
Brig Gen William L. Shields, USAF (Ret.)  
Brig Gen Wade R. Smith  
Mr John Terino

#### Donations

Mr. Ned E Derhammer  
Maj Gen Charles J. Dunlap, USAF (Ret.)  
Lt Gen Michael A. Nelson, USAF (Ret.)  
Maj Gen John D. Paulk, USAF (Ret.)  
Lt Col Raymond Fredette, USAF (Ret.)  
Col Joseph Marston, USAF (Ret.)  
Col Wray Johnson, USAF (Ret.)

#### Corporate Sponsors

Boeing  
Calvert Systems  
General Atomics  
General Electric Aviation  
Leidos  
Lockheed Martin  
L3Harris Technologies  
Northrop Grumman  
Pratt & Whitney  
Wings over the Rockies Air Museum

# AIR POWER *History*

The Journal of the  
**Air Force Historical Foundation**  
Winter 2019 Volume 66 Number 4

**Editor**  
Richard I. Wolf

**Editor Emeritus**  
Jacob Neufeld

**Book Review Editor**  
Scott A. Willey

**Advertising**  
Jim Vertenten

**Circulation**  
Angela J. Bear

*Air Power History* (ISSN 1044-016X) is produced for Spring, Summer, Fall, and Winter by the Air Force Historical Foundation.

Prospective contributors should consult the **GUIDELINES FOR CONTRIBUTORS** at the back of this journal. Unsolicited manuscripts will be returned only on specific request. The Editor cannot accept responsibility for any damage to or loss of the manuscript. The Editor reserves the right to edit manuscripts and letters.

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

Air Power History  
3043 Sunny Ridge Drive  
Odenton, MD 21113  
e-mail: [airpowerhistory@yahoo.com](mailto:airpowerhistory@yahoo.com)

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

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

#### ADVERTISING

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

Copyright © 2019 by the Air Force Historical Foundation. All rights reserved.  
Periodicals postage paid at Clinton, MD 20735 and additional mailing offices.

**Postmaster:** Please send change of address to the Circulation Office.

Once again, this issue ends up being focused on the Vietnam war, either directly or tangentially.

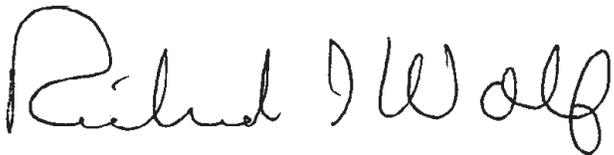
Our lead article this issue is by repeat contributor Theo van Geffen, who has been completing a series on the F-105 and the Thanh Hoa Bridge during the Vietnam conflict. This time his concentration is on some of the munitions developments that accompanied that conflict and helped the efforts to drop the bridge.

Our second article is also from a repeat contributor, William Cahill, who is writing about Strategic Air Command's SIGINT support for the southeast asia conflict. Really interesting stuff in this one.

Our third article is a bit different. It is a first-time contributor, Jon Reynolds, who was a pilot in the Vietnam conflict who found himself a POW from 1965 to 1973. He successfully managed to re-enter the mainstream after his return, receiving a masters degree and a doctorate from Duke in history. He later becoming a brigadier general and an attache to the People's Republic of China. His story takes place in China, and revolves around the remains of a downed World War II pilot. It's a truly original story.

Our departments at the back have shrunk recently as we try to provide as many reviews and articles as we can fit in each issue. In this issue, ninety percent of the magazine falls into those two categories. If there is something you would like us to include in our departments, send us an email with your suggestions. I can be found at the addresses on the facing page.

The President's Message is on the next page, and includes vital information on our recently completed awards function and banquet. We sincerely hope you enjoyed it with us this year. Please enjoy the photographs of the events on pages 5 and 6.



*Air Power History* and the Air Force Historical Foundation disclaim responsibility for statements, either of fact or of opinion, made by contributors. The submission of an article, book review, or other communication with the intention that it be published in this journal shall be construed as prima facie evidence that the contributor willingly transfers the copyright to *Air Power History* and the Air Force Historical Foundation, which will, however, freely grant authors the right to reprint their own works, if published in the authors' own works.

# From the President

Dear Members,

The Foundation has been in purposeful motion the past several months. At the Air Force Association's *Air, Space, and Cyber Conference* in September, we talked with many friends of the Air Force—AFHF members and some potential new members alike—establishing acquaintances that will hopefully swell our rolls in the future. We observed that few active duty Airmen have ever heard about the Foundation, yet they consistently express a desire to learn more about USAF history. Please, never pass up the opportunity to encourage interested people to join and/or contribute!

On a beautiful sunny afternoon in October we conducted our annual Doolittle Award presentation at the Air Force Memorial, followed by a memorable Awards Banquet at Army Navy Country Club. This year's recipient of the Doolittle Award is the 55th Wing of Offutt AFB, Nebraska. The Wing's history dates from the beginning of the Cold War. In the decades since, the men and women of the 55th have contributed to virtually every aspect of global reconnaissance and command and control, making a critical national security difference and earning the respect of their peers and senior leadership. Col Gavin Marks, the Wing's commander, spoke eloquently and passionately about the 55th's vital mission and its various achievements. The Foundation is proud to have recognized them.



At the Awards Banquet we also applauded this year's distinguished annual individual award recipients:

**General Carl A. Spaatz Award - General John P. Jumper, USAF (Ret.)**

**Major General I. B. Holley Award - R. Cargill Hall**

**BEST AIR POWER HISTORY Article Award - David P. Anderson**

**BEST AIR POWER HISTORY Book Award - Colonel (Dr.) Phillip S. Meilinger, USAF (Ret.).**

We were especially honored to host the Air Force's current Chief of Staff, General David L. Goldfein, who set an inspiring tone with his remarks and shared an admiring, humorous introduction for our Spaatz recipient and former Chief of Staff, General John P. Jumper. General Jumper's gracious acceptance regaled the audience with thoughtful observations from his lifetime devotion to airpower. A full house enjoyed the evening, and although Dr. Meilinger was unable to be present in person, all recipients were appropriately recognized. Photos from the Doolittle Award presentation and the Awards Banquet appear on the next two pages.

As we enter the holiday season the Board and staff continue working on several projects intended to honor and amplify the 75th anniversary of the Air Force in 2022, including updates on the Foundation's coffee-table-sized books and work to secure grant funding to begin a "plug-and-play" USAF history course designed to enhance various professional military schools, ROTC, etc. We are excited about these efforts.

In the coming months, you may be asked to complete an AFHF survey. When you do, I urge you to respond—we need to hear your views on future directions for the Foundation. In order to advance our mission to *know the past, shape the future*, we must refine and pursue a collective vision to bring Air Force history to life—for you, serving Airmen, and national security decision-makers. Your input is key to our future success. Stay tuned!

Very respectfully,

A handwritten signature in black ink, appearing to read "Christopher D. Miller". The signature is fluid and cursive, written over a light-colored background.

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

# 2019 Awards Presentation



Members of the 55th Wing gathered in celebration of receiving the Doolittle Award. Lt. Gen. Christopher Miller, AFHF President (far right) looks on as Ms. Jonna Doolittle Hoppes hands over the the Doolittle Award .

## The 55th Wing—2019 Doolittle Award Winner

Members of the 55th Wing gathered in celebration of receiving the Doolittle Award.

Col. Gavin P. Marks, 55th Wing commander.





Gen. David L. Goldfein, USAF Chief of Staff introduces Gen. John P. Jumper, USAF (Ret.), Carl A Spaatz award recipient.



Gen. John P. Jumper, USAF (Ret.), center, receives the Carl A Spaatz award from Foundation President, Lt. Gen. Miller, left, and Gen. David L. Goldfein, USAF Chief of Staff (right).

### 2019 Award Winners

Gen. James H. “Jimmy” Doolittle Award: 55th Wing, Offutt AFB, Nebraska

Gen. Carl A. Spaatz Award: Gen. John P. Jumper, USAF (Ret.)

Maj. Gen. I.B. Holley Award: R. Cargill Hall

Best Air Power History Article: Dr. David P. Anderson, “Air National Guard Participation in the U.S. Strategic Airlift Mission to the War in Southeast Asia: 1965-1971”

Best Air Power History Book: Dr. Phillip S. Meilinger, *Limiting Risk in America's Wars: Airpower, Asymmetrics, and a New Strategic Paradigm*



Lt. Gen. Miller, AFHF President, addresses the Awards Banquet guests.



Longtime Air Force historian R. Cargill Hall receives the Major General I. B. Holley Award for a lifetime of contributions to Air Force History.



Air National Guard Chief Historian Dr. David P. Anderson, receives the award for the best Air Power History article in 2018.

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



The PAVE WAY program used the various ranges and facilities at Eglin. The photo shows an aerial view of a TV monitor and related facilities in May 1968. (Except where noted, all photos by USAF via the author.)

Theo van Geffen

In the period January 29, 1968-April 26, 1972, U.S. aircraft did not carry out any strike or armed reconnaissance sorties against the Thanh Hoa Railroad and Highway Bridge. The main reason was President Lyndon Johnson's decision to restrict the bombing of North Vietnam to south of 19 degrees North on April 4, followed by a total bombing halt on November 1, 1968. Although Gen Creighton Abrams, Commander, U.S. Military Assistance Command, Vietnam (COMUSMACV) had indicated on December 24, 1971, that a strike against the Bridge and the Thanh Hoa Lock with laser guided bombs (LGB) would be added to Operation PROUD DEEP ALPHA (December 26-30, 1971), weather proved to be the big game breaker.

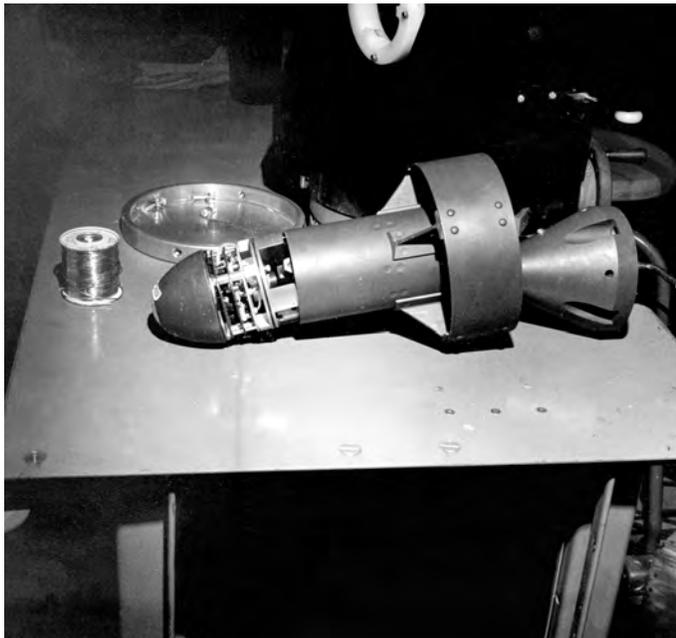
## Laser

Those four-plus years without any U.S. strikes against the Bridge enabled the North Vietnamese to repair and improve it, including the defenses. The U.S., in turn, had not been idle either. After the North Vietnamese had invaded South Vietnam on March 29, 1972, U.S. aircraft returned to North Vietnam in force and with fewer restrictions, employing second generation 'smart' weapons like the PAVE WAY II electro-optical guided bomb (EOGB) and the Walleye II, and new equipment like PAVE KNIFE and PAVE SWORD. In this part, we will look at the development, testing, evaluation, deployment and combat evaluation of those weapons and equipment.

Although a laser (light amplified by stimulated admission of radiation) beam first had been produced in 1960 by Hughes Research Laboratories, part of Hughes Aircraft, it took five years before the Air Force got involved in the subject, but only after the U.S. Army budget to explore the laser's utility for missile guidance had been depleted and the researchers had offered their idea to APGC, Air Proving Ground Center (Air Force Systems Command) at Eglin. However, at APGC it was decided to research the possibility to use laser in relation with general purpose bombs versus with missiles.

## Potential

In a spring 1965 briefing about its mission and organization, the Tactical Air Warfare Center (TAWC) at Eglin informed USAF Chief of Staff, Gen John McConnell, about projects that were being evaluated. One of these projects was the 'Laser Ranging and Computing Gun Sight'. It was explained that terminal accuracy with air-to-ground sighting systems then in the inventory, was unsatisfactory. Basically, the same system and techniques were being employed as had been used in World War II. A TAWC project was evaluating the Hughes laser-range computing gun sight for ground attack. This advanced computer sight was using a laser beam for continuous, automatic slant range inputs to a computer



M-117 LGB seeker element which would follow the beam of light emitted by the laser target designator system.

which would establish the proper attack profile. The laser sight would make many options or ordnance delivery airspeeds and dive angles possible. TAWC was investigating a variety of attack approaches and the optimum tactics to be utilized against well-defended targets. According to TAWC, this laser system had the potential of improving weapons delivery accuracies by as much as 50 percent.

In addition, the Air Force Armament Laboratory (AFATL) at Eglin had already been working on laser technology, while in 1965, the APGC (re-designated as the Armament Development and Test Center [ADTC], on August 1, 1968), had initiated a competitive evaluation of two laser guidance standard bombs, the M-117 and Mk-84. The complete M-117 weapon, for instance, had a modified nose-seeker assembly, a normal bomb case, and an extended tail cone assembly supporting the wing fins and containing a Shrike guidance unit. Its length was 105 inches, wing span 36 inches and the entire package weighed 900 pounds.

*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.*

## Project 1559

A more formal, short and quick test, 'Laser Guided Bomb' was initiated on June 1, 1966 by AFATL, becoming APGC Project 1559Y1/Y2. The operation concept included the demonstration of the feasibility of laser semi-active guidance for conventional munitions, the determination if any improvements in the M-117 Circular Error Probability (CEP) could be attained with laser guidance, and the acquisition of information relative to operational capabilities and limitations of a laser guided bomb modification. Two contracts were let, one to Texas Instruments (TI, effective November 16, 1965), and one to North American Aviation's Autonetics (effective June 3, 1966), respectively Project 1559Y1 and 1559Y2, to fabricate guidance and control kits to attach to the M-117 bomb to give it the capability to home on the radiation from a target marked with a ground-based or airborne laser illuminator. Two bombs with dummy guidance kits, fabricated by TI, were dropped in April 1966. The results were so promising that it was decided to save the third dummy and use it as an additional guided unit.

Captive flights with the first Texas Instruments guided unit were initiated in May and continued in June to solve laser seeker noise problems. In the meantime, Autonetics had started modification of the first of five laser seekers and fabrication of flight control subsystems. By June 30, all seekers had been modified and the control systems fabricated. In addition, the modification of the F-4C Phantom for these tests had been completed.

The guidance and control kit were then mounted in a modified M-117 bomb, while a laser illuminator was mounted on a tower near a suitable ground target. After the bomb's seeker system would have detected the laser energy that was reflected by the target, the latter would provide the signal used for guidance of the bomb. To determine ballistic data, both contractors dropped three unguided bombs each. This process was followed by guided bombs dropped by TI and Autonetics with their performance being compared to the standard M-117 performance.

## Follow-on

By December 15, 1966, eight TI M-117s had been released. In the first four drops, the seeker unit had been installed on the tail fin. Misses were between 78 and 480 feet, the fourth one due to a guidance logic failure. On the fifth release, on October 28, the seeker unit had been moved for the first time to the nose of the bomb. The remaining three bombs were expended in a similar configuration. Misses were between ten and 28 feet. In the eighth drop, on December 15, the target was illuminated with a hand-held unstabilized airborne illuminator from an O-1E. By December 31, two Autonetics M-117s had been dropped with one miss of 975 feet and one of 82 feet. Bombs 3 and 4 were released in January 1967 with 24 and 54 feet misses respectively. Testing was completed on January 23. AFATL retained one M-117 of each of the contractors for follow-on developmental tests.

Although the Tactical Air Command (TAC) and TAWC were not involved in the testing, TAWC, in a January 3



During the final days of TAWC's Operational Test and Evaluation of the M-117 LGB, a 4533rd TTS (Test) pilot is pre-fighting the weapon on the right inboard weapon station of his F-4D Phantom. A second M-117 is on the left inboard station.

message to the Tactical Fighter Weapons Center (TFWC), stated it saw a use for the LGB involving the M-117 750-pound general purpose bomb (GPB) modified for laser guidance. In this case, the FAC would illuminate the target with a laser instead of the standard smoke rocket. According to TAWC such use of the bomb would work better in South Vietnam, but there would be a problem without the FAC to illuminate the target. One proposal was to use B-66s to illuminate the target even though the aircraft would be subjected to excessive ground fire.

APGC/AFATL's request for funds for follow-on testing of LGBs was approved by HQ USAF. Fifty additional laser guidance and control kits were to be tested under Project 3169 with \$500,000 Research and Development (R&D) and production funds being allocated for the engineering tests. Purpose was to accelerate developmental testing, production and deployment. However, the prime contractor still had to be determined.

TAC then designated TAWC as the responsible agent to monitor engineering and developmental testing and to conduct the Operational Test and Evaluation (OT&E) and assigned TAC Test 67-42 on January 24, 1967 with an estimated completion date in the second quarter of Fiscal Year (FY) 1969.

In a joint TAC, TAWC, TFWC, APGC and AFATL meeting on February 15, the participants concluded that (1) the contract should be awarded immediately to Texas Instruments and that further development of the Autonetics bomb should be undertaken if funds would be made available; (2) additional funds should be made available to develop a 2,000/3,000-pound bomb with other guidance principles such as the Hornet Head, coupled with a Wall-eye-modified aircraft; and (3) action had to be taken to provide a high-speed general-purpose aircraft as illuminator for high threat areas.

The operational concept of Project 3169Y1/Test 67-42 was the development of the laser guided bomb. It was to incorporate laser technology that had been collected over the last two years. HQ USAF directed the application to high performance aircraft as a requirement for accelerated development, production and deployment to SEA.

Two LGBs, the M-117 and the Mk-84 (2,000-lb), were to be tested as a joint APGC/TAWC project. Both an engineering and operational approach would be used to demonstrate military effectiveness and tactical value. Active testing was to obtain operational characteristics of the LGB and to evolve preliminary tactics and techniques to deliver these weapons, and procedures for employment in a combat environment. In addition, the project involved the planning and support of the introduction and evaluation of the LGB in SEA.

### SEAOR

The program got a boost after 7th Air Force (7AF) submitted its Southeast Asia Operational Requirement (SEAOR) #100, dated March 30, 1967. It established the need for laser guided munitions to provide accurate weapons delivery from standoff distances. The purpose was to improve the terminal accuracy with a CEP of 30 feet or less when released within the guidance limits of the munitions, while increasing the standoff range of the delivery aircraft (more than seventy percent of all losses over North Vietnam had resulted from defensive fire below 7,000 feet). 7AF further stated, among others, that the guidance system to be developed, had to be compatible with munitions already in the inventory and that there would be no restriction on carriage or delivery, other than those already applicable to the unmodified munitions.

After HQ USAF had approved SEAOR #100, APGC was formally requested through AFATL letter of July 6, 1967 'Request for Flight Testing, Project 3169Y1' to conduct a test of the laser guided bomb. It was also to formulate the requirements of Det One, PAVE WAY Task Force (TF).

After approval of SEAOR #100, the Task Force was established at Eglin in August 1967 to provide a quick response to the SEAOR. PAVE WAY was to be the umbrella for three different guided bomb systems. The LGB was the first under PAVE WAY I. The second system, PAVE WAY II, was the electro-optical guided bomb (EOGB) with the third one, PAVE WAY III, being the infrared guided bomb (IRGB).

In line with the establishment of the Task Force, three Detachments saw the light: Detachment (Det) One for the LGB, Det Two for the EOGB, and Det Three for the Mk-84 IRGB. On February 14, 1969, HQ USAF postponed deployment of the IRGB indefinitely due to the lack of suitable targets and will not be discussed here.

### Modification

Active testing started on September 1, 1967. Initially, the TF included APGC and TAWC personnel, but it was later supplemented with aircrews from the 8th Tactical Fighter Wing (TFW) at Ubon Royal Thai Air Base (RTAB). Test aircraft were provided by the 4533d Tactical Training

Squadron (Test), APGC and the Special Operations Force. (The squadron was designated, organized and assigned to the 33d TFW at Eglin on December 7, 1967. Its mission was to operate in support of tests conducted by TAWC's DCS for Test Operations, including PAVE WAY. The unit was inactivated on April 1, 1971 and replaced by the 4485th Test Squadron, which was activated on the same day and assigned to TAWC.) Furthermore, TAWC performed operation analysis duties, AFATL provided the lasers and APGC all other test support. Lastly, laser and bomb contractors took care of maintenance of their test equipment.

In the meantime, Texas Instruments had developed laser guidance kits, which were composed of laser seeker guidance heads and control sections and an airfoil group, including stabilizing and guidance fins. By aerodynamically tailoring the canards and tail assembly, appropriate matching would be obtained of the kit to standard M-117 and Mk-84 bombs to convert them to LGB configurations. The carrying aircraft would not require any modifications or electrical interconnects. Martin Orlando Corporation was developing a laser target illuminator with design compatibility for the rear seat of the F-4D. APGC was developing an F-4D canopy and beam steering box for adaptation to the Martin laser target illuminator. (Ultimately, the unit laser unit and control box were mounted in the rear cockpit of the F-4D, while the laser power supply was installed in the aft electronics bay behind the rear seat. However, the installation would not fit in F-4Ds configured with LORAN-D or F-4s modified with the new air-to-air IFF system. Modification of an F-4D to laser illuminating aircraft took about 100 man-hours.)

Initial fittings of the M-117 LGB to the F-4 took place in the September 8-12 period. It showed static carriage capability of one each on the left and right outboard pylons, two each on the left and right TERs, and one on the centerline MER.

Seven test sorties were flown in September 1967, including four captive sorties. Configurations were outboard and centerline tanks, two M-117 LGB shapes on both inboard and outboard stations of both inboard TERs. Speed was increased in 25K increments up to 550 KEAS at 10,000 feet. Captive sorties were also made for static dynamics and for the design and tracking feasibility of a

beam steering box. The first (inert dummy) M-117 LGB to be dropped was expended on the 30th from the left inboard pylon of an F-4D. Release conditions were level, 350 KCAS and 14,000 feet. The first release with an airborne illuminator occurred on November 25.

## Review Board

After APGC had held a coordinating conference on APGC Project Directive 3169Y1 on September 12-13, it was distributed in October. In addition, the draft of TAC Test Order 67-42 'Operational Test and Evaluation of Laser Guided Bomb System' passed the USAF/TAWC Review Board and was coordinated with APGC. Test aircraft completed six single and four double ballistic LGB drops to obtain compatibility/certification engineering data. Two captive sorties were flown with instrumented LGBs.

A coordination conference at HQ PACAF was attended in November by PAVE WAY management. The purpose was to brief the project's progress and theater requirements for SEA introduction. Deployment aircrews arrived at Eglin to begin their training. Flight testing continued and included two successful missions to develop proper ECM formation spacing and to identify the formation position of the bombing and illuminator elements. A fit check of the M-117 LGB proved to be compatible with the F-100D's inboard and outboard pylons.

No missions for tactics development were flown on the Eglin ranges in December, as the APGC-assigned

project priority was not high enough. Corrective action by the contractors was initiated after minor problems were discovered in the laser unit and the bomb guidance kit during R&D testing. 7AF identified Ubon RTAB as the deployment base for PAVE WAY Dets One and Two. It was decided to change the deployment date to March 15, 1968. This would enable the aircrews identified for SEA the opportunity to train with the combat laser gun, which arrived in February 1968.

## Steps

In the January- April 1968 period, important steps were taken in the testing of the two PAVE WAY I LGBs prior to the combat evaluation in SEA. They included the installation of a steering box and camera in an F-4D of the 4533d TTS (Test) for indoctrination, training and assessment of target tracking by Det One OT&E aircrews (January). Another of the Squadron's F-4Ds was modified with



When PAVE WAY Detachment One arrived at Ubon RTAB on May 12, 1968, personnel, the four F-4Ds, AGE, and equipment found shelter at the 497th TFS. The Nite Owls performed the combat evaluation of both the M-117 and Mk-84 LGBs, providing four crews. The June 25, 1968 photo shows non-Zot equipped F-4D 68722 of the 497th during the evaluation, configured with two M-117 LGBs on the left inboard station.

first deployment laser and beam steering equipment in the rear cockpit for aircrew proficiency training and for use during guided drops. Four ECM/tactics missions, each flight consisting of four F-4D Phantoms, were flown against a simulated environment (February). TAC designated four SEA Block 33 F-4D replacement aircraft. They were diverted through Eglin for modification to the laser configuration. It was initiated March 25 on two aircraft and completed in April.

The modification mounted the laser beam generator under the canopy rail in the rear seat. The beam would be projected upwards into a canopy-mounted beam steering system and then out the left side of the canopy. The steering box consisted of a four-power telescope and a system of joy stick controlling mirrors. By looking through the telescope, the operator would be able to view a 60-degree cone by manipulation of the joy stick. The steering box would also project the laser beam at the scene viewed in the optical eyepiece. The reflection of the laser beam from the target would provide the guidance signal for the LGB. The steering box became known as the *Zot Box* (*Zot* was the anteater character in Johnny Hart's *BC* cartoon strip).

On March 27, the loading certification conference for the Mk-84 LGB was completed. In April, in addition to one Mk-84 LGB, nineteen BOLT 117s (APGC, 11 and TAC, 8) were expended (both the M-117 LGB and BOLT 117 designations were used, with BOLT standing for BOMB, Laser Terminal). Drops were made in pairs from inboard and outboard stations. The drop on the 11th was through an illuminator installed in an O-1E. The deployment date for Det One personnel and the M-117 LGB was pending confirmation.

### Accomplishments

During testing, LGBs were accurately delivered from standoff altitudes of 9-15,000 feet. The M-117 LGB (Weapon System 212A) was certified for carriage on the F-4 and for multiple release modes; the Mk-84 LGB (WS-212B) was certified for carriage on the F-4. Two Mk-84 LGBs were expended against a moving M-48 tank with impacts being 28 and 17 feet from the tank. This indicated the weapon could guide to moving targets.

With regard to developing a Standard Operating Procedure (SOP), only the one for the Mk-84 was accomplished as a decision had been made to not put the M-117 LGB into production, although it would undergo combat evaluation in SEA. Reasons which contributed to this decision were, among others, the fact that the M-117 was equipped with tail fin controls, which were not as accurate as the canard configuration on the Mk-84's nose. The M-117 was less effective for cratering or penetration due to its thinner skin.

### Tactics

In the meantime, a Project PAVE WAY Tactics Review Panel, composed of TAC and AFSC representatives including recent SEA returnees, was held at Eglin on January 15, 1968. Its purpose was to define tactics to be used in the delivery of the laser-guided bomb. Two of the recommendations included, (1) regardless of the tactics used, four-



A munitions flatbed with a couple of M-117 LGBs on its way to the Ubon flight line during the combat evaluation of the M-117 on June 15, 1968.

ship flight integrity should be mandatory and therefore all tactics should be planned with multiples of four-ship flights; and (2) tactics had to be refined and experience gained in permissive areas prior to flying missions into high-threat areas.

Just before, a cover letter 'PAVE WAY (Annex to TAC Test Order 67-42)' had asked for a review and comments from the TFWC concerning the tests, which materialized in a letter dated March 17, 1968. With regard to the illuminating aircraft, which would undergo prolonged exposure due to the need to loiter where the threat was the greatest, over the target area, TFWC stated that one aspect that might be explored in the evaluation, was the addition of another ALQ-87 or ALQ-71. As the system limited the illuminating aircraft to left turns only, using the extra pod on the outboard shoulder station of the TER would offer pod protection in a left turn. In addition, jinking and SAM breaks by the illuminating aircraft, especially in high-threat areas, should also be considered during the evaluation. It was also remarked that many targets would not lend themselves to left roll-ins.

### Deployment

Although a TAWC February 8, 1968 letter had informed the 8th TFW that Detachment One was scheduled to leave Eglin on March 15, this date proved to be too optimistic once again. TAWC stated it would be desirable to have all project personnel assigned to one squadron during the initial stages of employment.

On May 12, 1968, PAVE WAY Detachment One finally deployed to Ubon, arriving on the 14th. It included the four modified F-4D Phantoms, PCS and TDY personnel with the former to be assigned to the 8th and the latter being at Ubon for 4-6 months. PCS personnel included seven crewmembers, who arrived at Ubon after attending Jungle Survival School, and eight maintenance personnel. TDY personnel numbered nine military personnel and one civilian, including three Air Training Command Training De-

tachment personnel (to train maintenance and load crews), and two APGC PACAF-qualified munitions loaders (to provide an instant loading capability). In addition, three Texas Instrument and two Martin-Orlando tech-reps would be part of the Det. 7AF Operations Order (OPORD) 536-68 'PAVE WAY' showed that 7AF would direct and control the execution of combat missions and exercise operational control through the commander 8th TFW.

The evaluation was conducted under TAC Operations Plan (OPlan) 68-9. It was planned to expend 107 weapons, of which 59 M-117s and 48 Mk-84s. The primary purpose was to determine the feasibility of using a high accuracy weapon against selected pinpoint targets.

The first six weeks of the deployment would deal with the OT&E of the KMU-342/B (M-117). This would be followed in July by the OT&E of the KMU-351/B (Mk-84). The Det was incorporated into the 497th TFS (the *Night Owls* obtained the mission after turning over their MUSCLE SHOALS mission to the 25th TFS which had PCS-ed with its 20 LORAN-D equipped F-4Ds from Eglin on May 28). The 497th provided four crews for the evaluation. Aircrew debriefings, inflight recordings, and with photographs as backup when available, would provide the primary evaluation data.



The 'Zot Box' was the nickname for the steering box of the Martin-Orlando laser target illuminator in the rear cockpit of the four original F-4Ds that deployed to Ubon RTAB for the combat evaluation of the M-117 and Mk-84 LGBs. This patch supposedly shows this 433rd TFS back seater flew 100 Laos and North Vietnam sorties using the ZOT. (Via André Wilderdijk)

## Pickle

The designator aircraft was called *White Lightning* and would fly a left-hand orbit around the target at an altitude of 8-10,000 feet. The back seater had to obtain the target in his telescope, adjust the crosshairs and then illuminate it. While doing this, the second F-4D would roll in from about 20,000 feet, place the aiming index on the target and release the LGB at about 12,000 feet. When doing so, the aircraft commander would radio 'Pickle, Pickle, Pickle', to alert the back seater in *White Lightning* that the bomb had been released and that accurate target tracking was a must to insure a direct hit. As the bomb dropped toward the target, its laser seeker was to guide on the reflected laser energy.

Since two of the aircraft commanders had earlier SEA combat experience, it allowed the project to accelerate its schedule with the first ordnance drop on May 22, only fourteen months after SEAOR #100 had been submitted. The drop involved four M-117s against a railroad bridge, which all resulted in 'gross error', a CEA (Circular Error Average) greater than 500 feet. Initially, the eleventh and finally mission was flown on June 27. Of the grand total of 35 bombs expended, eleven were considered gross error on the basis of known aircrew error (8) or laser masking, and 24 scorable with an average CEP of 30 feet. The weapons system reliability was 91.4 percent with 32 bombs guiding.

Subsequently, one more M-117 LGB mission was added, on August 9. It was to determine the feasibility of a multiple simultaneous release against a single target, a highway bridge. The bombers executed a 3-aircraft formation attack with bomb release on command of the lead aircraft. No problems were encountered. The average miss distance was 130 feet.

## Intensive

Early drops in the evaluation with the M-117 were plagued with target misidentifications by aircraft commanders, failure to hit the delivery basket, and illuminator aircraft getting into a position where they could not illuminate the target. It became clear that intensive mission planning, area familiarization, and delivery standardization were required for success with PAVE WAY. In addition, positive aircrew coordination was mandatory. The illuminator aircraft commander (AC) and pilot in the rear seat had to determine the acceptability of each delivery set-up. The AC was to position the aircraft while the pilot would confirm target acquisition, insure laser operation, and evaluate transition rate to insure the target would remain in view. Upon confirmation, the illuminator aircraft commander would clear the bomber to release. Timing and discipline were critical as the bomber would begin his roll-in simultaneously with the illuminator's initial positioning. By the time the Mk-84 LGB combat evaluation began, crew techniques had been perfected and only one 'pilot error' type would occur.

Four days before the evaluation termination, one of the five original Det One aircraft commanders was lost on a non-LGB night armed recce mission in F-4D 68724, Machete 01. Supposedly unaware of the elevation of the karst



F-4C Phantom 40875 was one of the Air Proving Ground Center's dedicated test aircraft and heavily involved in for example the PAVE WAY/PAVE KNIFE program. Here it shows off with an inert Mk-84 LGB under its right inboard weapon station at Eglin in April 1968.

ridges in the target area, the crew failed to pull out in time. Lt Col Donald Casey, Chief of the 8th TFW Tactics and Techniques Section, and his Weapon Systems Officer (WSO), 1/Lt James Booth, were listed as MIA.

Daylight M-117 LGB test missions were followed by test missions at night, with the first one flown on September 15 by Plymouth flight. Results showed that LGBs could be an effective weapon on selected targets in the night interdiction program.

### Mk-84 LGB

The OT&E of the Mk-84 LGB was initiated on July 7, 1968 when two bombs were released against a ford. The first Mk-84 encountered a fuse malfunction, while the second one had a 75-foot miss distance (photography by RF-4C Phantoms after each mission measured the miss distances). In general, targets included (water) fords, roads, bridges, and ferry slips. In July, twenty-seven Mk-84 LGBs were expended, of which three had guidance malfunctions. Some had illumination problems since the guided bombs impacted at about the same place as the unguided bombs (when one of the guided bombs was released, the aircraft also released unguided bombs, with the difference in the impact being a measure of how much guidance and correction was impacted on the PAVE WAY ordnance). The final Mk-84 was expended on August 2.

Of the thirty-one expended, twenty-nine scored and eight were excluded on the basis of known aircrew error (2) or laser masking. The CEP for the twenty-one Mk-84s evaluated was twenty feet, greatly superior to the thirty feet of the M-117: the Mk-84 was heavier, so more stable in flight, while the guidance system of the M-117 tended to over-control. In addition, it looked like that experience had increased aircrew proficiency. In comparison to the M-117 LGB, it was shown that the Mk-84 laser kit was easier to assemble and to store. The Mk-84's canard design also appeared more responsive to guidance than the

more conventionally configured M-117 kit. Lastly, the Mk-84/KMU-351/B was more cost effective than the M-117/KMU-342/B.

Both combat evaluations showed that LGBs did not home well on targets which were under water like causeways and fords, while it showed that broken seeker heads were caused by flying at high speeds through rain. After completion of the evaluation, PAVE WAY LGBs were immediately included in the interdiction program of North Vietnamese infiltration through Laos into South Vietnam. On August 15, the 7AF commander was briefed on the interim results. The combat evaluation had determined that the laser guided bomb was operationally suitable and effective in Route Package (RP) 1 of North Vietnam.

On September 15, 1968, 7AF Directorate of Tactical Analysis published DOA Working Paper 68/10 'PAVE WAY Utility and Cost Effectiveness in SEA'. It stated for instance that, based upon the small initial sample and using CEA/CEP figures, for specific point targets, more than twenty times as many targets could be hit using PAVE WAY I LGBs than could be hit using 750-pound free-fall bombs in the same number of sorties. PAVE WAY would also involve fewer losses and be cheaper in dollar cost when compared to other systems. With improved accuracy following the initial evaluation, increasing the probability to hit the target per sortie, the contrast between LGB effectiveness and 'dumb' bombs, would be even greater. The report also highlighted the value of the standoff capability of the smart bomb system. With the ability to release ordnance at 10,000 feet or higher, the necessity to descent into the high-threat, low-altitude regions, was largely removed. During the evaluation, PAVE WAY F-4Ds had in general encountered light to moderate 37/57-mm AAA. No extensive 85/100-mm AAA, SA-2 surface-to-air defenses, or MiGs were encountered. None of the Phantoms received battle damaged or were lost. An estimated loss rate of 1.87 per 1,000 F-4D sorties was predicted for PAVE WAY I (and Walleye) missions, should a return to the heavily-defended Route Packs take place. Those Phantoms could be expected to accomplish 156 more sorties before attrition than its counterparts with free-fall munitions. For comparison, the estimated loss rate per 1,000 sorties for aircraft configured with free fall M-117/Mk-84 bombs would be 2.64 (with AGM-12s, 2.93). On the other side, however, the basic cost for a 'normal' M-117 was \$319 and for the first 1,200 M-117s with the KMU-342/B an additional \$7,100 each. For the Mk-84 those numbers would be \$830 and \$7,100 respectively. It was concluded that PAVE WAY had proven to be an important addition to the weapons options available to strike planners.

### Replacement

Although laser illuminator-equipped F-4Ds obtained excellent results with employment of LGBs, a problem affected the PAVE WAY I program: a shortage of illuminator F-4D aircraft. Only four aircraft were assigned to the 433d TFS, which had become the primary 8th TFW unit to employ LGBs after the 497th had transferred it. In December 1969, for example, the unit flew nine LGB sorties a day, di-



F-4D 67512 was another APGC/ADTC F-4D Phantom involved in the PAVE WAY program. The Phantom is configured with two Mk-84 LGBs under each wing prior to an ADTC weapon certification sortie to test the handling qualities for such configuration. (USAF, via Larry Van Pelt)

vided into three flights of three aircraft. To enable each F-4D to carry Mk-84 LGBs, two illuminators were needed in each flight. In order to accomplish this, it was necessary to have an illuminator from each flight meet another LGB flight on its prestrike KC-135.

As a result, TAC requested TAWC in October 1969 to perform an acceptance testing of F-4D and F-4E aircraft modified with the PAVE WAY laser designator AN/AVQ-9 system which was modified with PAVE WAY laser designator units and camera training devices.

To meet TAC's request, TAWC initiated test 69-2D 'PAVE WAY Designator Modification', providing for the acceptance testing of PACAF replacement F-4D aircraft modified with the AN/AVQ-9 system. The new designator put out a stronger and more compact beam than the older laser gun. The purpose of the test was to perform a functional acceptance evaluation to verify that the AN/AVQ-9 system would satisfy specification performance requirements and to determine its operational suitability.

Following installation and successful flight checks of laser equipment in eight F-4Ds and installation of the laser designator camera training devices in three F-4Es, testing was initiated at Eglin on October 7. The first of the F-4Ds made two Mk-84 LGB drops, showing that bombs and designator were compatible. The eighth F-4D was test flown on December 19, 1969, completing test 69-2D. Two of TAWC's conclusions were that the camera training device was operationally suitable to train aircrews in the use of the AN/AVQ-9 system and that it was compatible with the Mk-84 LGB.

Nine days later, components, spares, AGE, and contractor representatives departed Eglin for Ubon. One complete AN/AVQ-9 laser designator was retained at Eglin for future support. In January 1970, the 433d TFS received eight modified F-4D illuminator aircraft.

### M-118 LGB

In a May 27, 1968 message to HQ USAF, 7AF had clearly stated the desire for a guided version of the M-118 3,000-pound general purpose bomb. As a reaction, HQ

USAF directed an evaluation in SEA of the weapon. This resulted in a third bomb being tested for feasibility within PAVE WAY I. It was designated Weapon System 212C. Deployment to SEA was planned for August 1969.

The authority for this ADTC test, Project 3169Y003, came from an amendment dated September 24, 1968, 'Amendment to Development Directive 69-1, Laser Guided Bomb'. On November 11, Texas Instruments, Inc. received a contract to design and develop a laser kit for the bomb. After its receipt, an accelerated Category I/II DT&E followed in the March 28-September 8, 1969 period. Thirty-three data collection missions were flown. On the first of thirteen drops, on May 12, 1969, the M-118L achieved eighty percent of its design maneuverability. During the drops, both ground and airborne laser illumination was used to assess the weapon guidance capability, while three missions were used to obtain data on captive flights. All test objectives were accomplished. A median bomb CEP of 21 feet was achieved with adjustment for no-test items.

TAWC's involvement was TAC Test 67-42A 'PAVE WAY 118L'. Close ADTC/TAWC coordination was accomplished to achieve a limited Cat III test during ADTC's airborne laser illuminator phase of the test. This resulted in a joint message recommending immediate deployment of the weapon to SEA for a combat evaluation.

TAC's and AFSC's September messages prompted USAF on the 22nd to direct deployment of the M-118L to SEA to achieve an initial operational capability (IOC) at Ubon by October 15. Delivery tactics were to be essentially the same as the Mk-84 LGB. Only seventeen KMU-370A/B kits and associated alignment test equipment were to be deployed: aircrews, F-4D illuminator aircraft, twenty M-118 bombs with associate hardware, etc. were already in place.

PAVE WAY TAC OPlan 9 was supplemented by authority of TAC's October 2 message. The OT&E was to begin on October 15, 1969 and run for about for about 30 days. A TAWC team would deploy TDY to Ubon to evaluate the weapon under actual combat conditions and to determine its suitability for inclusion in the War Readiness Materiel (WRM) inventory. The effectiveness of the M-118 LGB would be determined with data being obtained through aircrew debriefing, pre-strike photography and target damage assessment. In addition, on October 15, 7AF published OPORD 534-70.

### Combat environment

The combat evaluation of the M-118/KMU-370A/B LGB was conducted by a joint AFSC/TAC/8th TFW team, including six F-4D aircraft commanders and four laser operators. It was conducted during daylight hours by the 433d TFS against targets in the semi-permissive environments of STEEL TIGER and BARREL ROLL in Laos. Special store loadings were defined to keep center of gravity limits within those prescribed for the F-4D when carrying M-118s. Usually, a LGB team consisted of four F-4Ds, with two Phantoms carrying two M-118Ls each, and two for flak suppression and photo chase. The (additional) illuminator aircraft would fly a standard designa-

tor pattern. Major objectives included, (1) to refine delivery and target illumination tactics as required; and (2) to determine the adequacy of procedures and checklists for buildup, maintenance, loading, and aircrew operations. The standard illuminator system that had been used in the evaluation of the M-117 and Mk-84 LGBs was also used in the M-118 LGB OT&E. On October 13, the kits arrived at Ubon and two days later, the 433d TFS expended their first bombs.

A total of five missions were flown. The release of the fourteenth M-118L on October 25 ended the flying portion of the OT&E. With the successful release of this weapon, sufficient data were deemed available to terminate the evaluation effort. In addition to the M-118Ls, 14 Mk-82 ballistic bombs were expended. One Mk-82 was released with each M-118L to ascertain whether the latter was delivered within the guidance envelope or failed to guide. Targets included two roads, two caves, and four bulldozers.

Eight deliveries were direct hits, while two bombs did not guide. The first due to obscuring clouds and the second due to a collision with a Mk-82 spotter bomb. One guidance kit was found to be defective, while the remaining two were being held for another contingency. The CEA for all bombs released was 23 feet with a system in-flight reliability of 100 percent. The average bomb release altitude was 11,200 feet AGL.

According to the evaluators, aircrew coordination between the bombing and laser designator aircraft was found to be critical for a successful guided bomb delivery; aircrew training in PAVE WAY procedures and techniques were deemed essential for proper coordination. The experience level of the aircrews participating in the evaluation was considered above average. The M-118L



F-4D 68815 was one of the original four Block 33 F-4Ds which were modified as PAVE WAY laser designators. The modification mounted the laser beam generator under the left canopy rail in the rear seat as can be seen on this photo by A1C Calvin Cruce. The aircraft, of the 433rd TFS is configured with two Mk-84 LGBs. The Satan's Angels took over the LGB mission from the 497th TFS.

had demonstrated a bombing accuracy equivalent to that of the Mk-84 LGB in SEA. However, it was also determined that the Mk-84 was superior to the M-118 as an interdiction weapon due to the harder casing and greater road cratering effects of the former. As a result, the evaluation team recommended that a single aircraft capability, that could provide both laser target designation and weapons release during the attack maneuver, be developed. Other examples of recommendations were, (1) the M-118L should be used on a selective basis against such targets as AAA sites, vehicles, and known truck parks; and (2) the KMU-351/B and KMU-370A/B laser kits should be coded for easy identification to prevent interchanging the components.

As to the effectiveness of the M-118 LGB the Wing history stated,

*The effectiveness was documented against two vehicles parked on the adjacent sides of a road. After the strike the only identifiable materials left of one truck after a direct hit were three tires. A third vehicle about 50 feet farther down the road was rolled away by the blast and considered destroyed although it was still identifiable.*

The PAVE WAY section of the 408th Munitions Maintenance Squadron assisted in the evaluation. One problem that had been apparent was the quality of the deployed kits. Several proved to be incomplete, requiring parts to be ordered to make the kit complete for evaluation. One of the recommendations was to design a trailer to transport the detector-computer-control groups from checkout area to the flight line.

### **Mk-82 LGB**

On September 9, 1969, 7AF/DCS Plans sent a message to PACAF indicating a strong need for the prompt development and deployment of both a high-speed and low-speed version of the 500-pound laser guided bomb. He also requested the possible F-4 loading configuration and the IOC date. A fourth laser guided bomb was tested at Eglin and introduced at Ubon for combat evaluation in Southeast Asia, the 500-pound Mk-82/KMU-388/B. The weapon would be used by the F-4D and B-57G TROPIC MOON III.

For the F-4D, final coordination of ADTC's Project Directive for the F-4/Mk-82 LGB was accomplished on June 29, 1970. The aircraft/weapon carriage certification was limited to the right inboard TER only due to the large number of bombs necessary for a complete aircraft certification. Testing by ADTC was to begin on July 6 and to be completed on August 10. TAWC would monitor testing. Further TAWC involvement (testing and deployment) was dependent on HQ USAF's program decision.

With regard to the Mk-82 LGB OT&E, CSAF advised 7AF that 106 Mk-82 LGB kits would be available for the SEA evaluation. PACAF proposed that this project be conducted within the scope of the existing B-57G combat evaluation.

In October 1970, the 13th Bombardment Squadron, Tactical, introduced the B-57G TROPIC MOON III in SEA



On September 9, 1969, 7AF/DCS Plans sent a message to PACAF, indicating a strong need for the prompt development and deployment of both a high-speed and low-speed version of the 500-pound laser guided bomb. He also requested the possible F-4 loading configuration and the IOC date. The message must have been heard in Washington, DC as final coordination of ADTC's Project Directive for the F-4/Mk-82 LGB was accomplished on June 29, 1970. DT&E was begun eight days later. The photo of ADTC F-4C 40869 with two Mk-82 LGBs on the left inboard pylon was taken at Eglin on July 28, 1970.

for its 90-day combat evaluation. The unit was initially attached to the 8th TFW, but was assigned on October 31. The B-57G was the first weapon system in SEA that was capable of delivering an LGB at night without assistance from a second aircraft. Combat sorties were normally flown at night and in the STEEL TIGER area of Laos.

The first night combat sortie was flown on October 17. The Mk-82 LGB was introduced in November with thirty-one bombs expended, resulting in excellent results as a truck killer. Infrared video interpretation resulted in a CEA of 10 feet for those delivered without system or pilot failures. On January 14, 1971, the evaluation was completed. A total of 101 Mk-82 LGBs were expended and the resultant BDA was 63 trucks and one boat destroyed, and one truck damaged.

## PAVE WAY II

The electro-optical guided bomb (EOGB) was, like the laser guided bomb, developed in response to 7th AF's Southeast Asia Operational Requirement of March 30, 1967.

HQ USAF message 82981 of August 1967, which included interim Development Directive Number 67, directed APGC to evaluate KMU-353/B (Mk-84 2,000-pound electro-optical guided bomb, WS213B). Furthermore, AFATL sent APGC a September 26, 1967 letter, 'Request for Testing, Project 1815, Electro-Optical Guided Bomb (PAVE WAY)'. The test, Project 1815D 'Evaluation of KMU-353/B (electro-optical guided bomb)', was conducted by APGC. TAC Test 67-48, 'Electro-Optical Guided Bomb' was TAWC's portion in the project. It was assigned on September 26, 1967 and terminated on January 6, 1969. The sys-

tem incorporated off-the-shelf components, i.e., Mk-1 Mod glide bomb (Walleye) actuator and auto pilot, Mk-84 Mod 1 general purpose bomb (GPB), and Hornet tracker. The EO guidance and control kit would be compatible with F-4Ds that were Walleye-modified. A joint AFSC/TAC Task Force was directed to accelerate development, production, and SEA evaluation.

As with the M-117 and Mk-84 LGBs, the Mk-84 modified with the KMU-353/B EOGB kit, would be tested as a joint APGC/TAWC project, using both an engineering and operational approach to demonstrate military effectiveness and tactical value. The kit consisted of a nose section that housed the TV camera and guidance section and a tail section with fins that guided the bomb. The TV picture showed on both front and rear seat cockpit monitors of the F-4D. The tracking gate, a small square superimposed on the TV picture, was bore-sighted to the gun sight. While on the attack pass, the aircraft commander would place the gun-sight on the target. The weapon systems officer would then superimpose the tracking gate over the target and lock on. Once the AC had confirmed a good lock-on, he would release the weapon and maneuver away from the target. The TV would continue to self-track the area under the tracking gate until impact.

Active testing was to obtain operational parameters of the EOGB and to evolve preliminary tactics and delivery techniques, and procedures for employment in a combat environment. In addition, the project involved the planning and support of the introduction and evaluation in SEA.

## Ballistic

The first F-4D static fit test with the ballistic EO bomb was completed at Eglin on December 7, 1967. Clearance problems between the landing gear door and bomb fin were corrected with the bomb fin being machined to provide the required clearance. On December 18, the second static fit test was successful. F-4D and Mod Mk-84 compatibility flight tests were initiated later that month.

In January 1968, the back-to-back EO compatibility sorties using a ballistic EO shape were completed. However, a lack of range support and F-4Ds precluded completion of any of the ballistic drops. Except for the aircrews coming from PACAF, all others were in place and being checked out by the 33d TFW. Four ballistic drops were completed in February, while eight tactics development sorties were flown using F-4Ds of the 33d. On the 29th, a static ground drop to determine system ability to retain lock was accomplished successfully.

March saw the final five ballistic drops completed, using APGC aircraft, plus eight captive sorties flown. One test drop was accomplished on the 18th with all captive passes being successful with no break locks. Separation was good with the weapon tracking for 7.5 seconds until pitch signals to the auto pilot became too severe and a break lock occurred after which the weapon went unguided. Det Two personnel received two days of ground training in the EO system at North American Rockwell Corp. By the end of the month, Walleye ground school had

been completed at Air Training Command's Field Training Detachment at Eglin, while all five aircrews present had completed training at Nellis. For further training, one Walleye was returned to Eglin. In April, training sorties were completed and all aircrews were operationally-ready in both the Mk-84 EOGB and Walleye. That month witnessed three Mk-84 EOGB launches, twelve captive sorties, of which two in support of APGC. In addition, two Walleyes were launched successfully.

TAC, AFSC and USAF decided to delay deployment of three aircrews, one intelligence officer and two munitions specialists until June 1. Several other deployment dates were considered, but proven not to be feasible either. In the meantime, the EOGB maintenance school began on May 20 and was completed on June 21. Testing continued in June. For instance, APGC flew ten captive sorties, while another ten were lost to range cancellations, maintenance and weather. Two sorties were flown by TAC F-4Ds, utilizing EO and Walleye captive weapons.

### Major

During the course of the DT&E, it was decided to make a major change by the substitution of a 5-inch lens optical system for the 3-inch copy. Accordingly, separate sections evaluated the effectiveness of the two basic systems in the tests. In July, eight comparative evaluation sorties were flown between the two systems. In addition, two sorties were flown for a comparative evaluation of the 5-inch improved lens versus the Walleye, plus one sortie with a Holloman F-4D, utilizing Texas Instrument displays for a comparative evaluation. No launches were accomplished that month.

On August 1, a reorientation of the OT&E was initiated with the improved optics. The original 3-inch lens was changed to a 5-inch lens at production item #31. 3-inch lens systems prior to #31 were improved electronically by under-scanning and increased vidicon voltage. The same improvement was incorporated in the 5-inch lens system. Two sorties were flown on Eglin's Range 72 for captive evaluation of the improved 3-inch and 5-inch improved lenses.

In the August-September time frame, six weapons were expended against 'targets' like buildings and a bridge with an average miss distance of 14 feet, two with basic and four with 3-inch electronically modified (EM) systems. Greatest slant range was 47,000 feet. In addition, there were 16 captive flights, while 29 sorties were cancelled, including ten sorties for aircraft non-availability and six due to test item air abort. On September 18, the pit drop of unit #9 was accomplished successfully.

In September, TAWC proposed a October 4, 1968 completion date of the test and recommended deployment of Det Two to Ubon in November with SEA testing to begin on December 15. Enough production quantities would be procured to satisfy SEA testing until the scheduled completion date of March 15, 1969.

CONUS testing of the Mk-84 EOGB was completed on October 25. It was followed by data reduction. A total of 169 sorties were flown in support of the entire test program,



Two technicians test the electro-optical system for a Mk-84 2,000-lb bomb at Eglin in May 1968.

with 117 sorties lost due to non-scheduled range requests, weather, test item non-availability and maintenance. Twenty weapons were expended with five failures. The average miss distance was 20.4 feet.

Although not all test objectives could be fully accomplished, it was concluded, among others, that (1) the Mk-84 EOGB was a highly accurate weapon system; and (2) the tracker's target resolution was better by about 50 per cent than that of the existing cockpit monitors.

In October, TAWC proposed December 3 as the new deployment date with the start of SEA testing on January 5, 1969. By November 30, the decision for the SEA deployment was still pending, although TAWC regarded January 1969 as most probable.

Det Two finally deployed on January 15, 1969. An in-flight evaluation against targets in a permissive environment in Laos, like caves, fords, and small bridges, assembly procedures, ground handling and maintenance would all be subject of a close analysis.

Two of the test objectives were (1) the establishment of acquisition and lock-on ranges after visual identification of representative targets; and (2) the determination of the terminal accuracy of the EOGB and obtaining a baseline for evaluation of the EOGB's terminal accuracy compared with the Walleye.

### Requalified

All guidance units of the Mk-84 EOGBs had to be hand-built. The first checkout captive sorties were flown on January 28, 1969 by the 435th TFS, which also had introduced the Walleye to South East Asia. The first actual sortie was to have taken place on February 7, but the F-4D aircrew RTB-ed due to low fuel and a release malfunction. The first Mk-84 EOGBs were successfully expended the next day against a causeway and ford in Laos. It has

to be noted that the first fourteen releases were made with the 3-inch lens. Because of this, they were not considered part of the formal combat evaluation. Their circular error average (CEA) was 34.8 feet.

To use the 5-inch lens, aircrews had to be requalified. This took place in the February 2-21 period, in which fourteen weapons were expended with a CEA of 34.8 feet. The formal evaluation was initiated on the 22nd with release of four Mk-84 EOGBs by two F-4Ds against a North Vietnamese cave storage complex near Ban Ban in Laos.

On April 5, 1969 the combat evaluation was completed. A total of 37 sorties were lost (postponed) due to weather. Thirty-five weapons were expended with 29 being scorable, of which nineteen were direct hits. The circular error average was 6.9 and the CEP zero feet. There were conditions that imposed constraints, as had been the case earlier with the Walleye. For instance, small targets and poor visibility in the target area reduced the bombing altitude or even forced the aircrews to abort the mission and the opportunities to gather quantitative data were limited by combat conditions. In addition, excessive weapon buildup time and low battery reliability were also faced.

7AF staff was briefed about the results on April 14 and 7AF/CC the following day. Six days later, the PAVE WAY II Combat Evaluation Interim report was coordinated and submitted to PACAF. It was concluded that the Mk-84 EOGB was, within design limitations, an exceptionally effective weapon to strike hostile, pin-point targets in permissive weather and could be considered one of the most effective non-nuclear weapons in the inventory. It was recommended to procure the weapon in quantity.

## CSAF

After completion of the OT&E, the Chief of Staff of the Air Force, Gen John McConnell, on April 25, 1969 sent the contributing agencies a message stating,

*The operational results obtained under PAVE WAY II are commendable and have provided a significant addition to the USAF weapons inventory. All participating commands are congratulated for an outstanding job, exceedingly well done.*

The second and operational phase of the combat evaluation was initiated on April 6 and lasted through August 30, 1969. Thirteen Mk-84 EOGBs were expended, all guiding, with eleven direct hits and a CEA of 3.5 feet.

However, during the introduction of the weapon, PACAF had identified a major limitation, the F-4D's TV monitor, a mode of the AN/APQ-109 radar. When the aircraft's monitors were used, picture quality was seriously degraded from that of the Mk-84 EOGB optics and electronics. The time and distances required to lock on and expend the bomb after the attack had been initiated, were directly affected by the quality of the video picture.

The evaluation's success resulted in a May 24 decision to procure 468 electro-optical guidance kits versus the original 284 kits. In a July 30 message 'EO Guided Bomb' to AFSC, HQ USAF reconfirmed the interest in the program

and in the introduction schedule of the production KMU-353/B guidance kit. AFSC was to initiate a production and engineering program to provide KMU-353/B kits, containers and Aerospace Ground Equipment (AGE) to improve maintenance and reliability. Arrival was slated for May 1970 with an evaluation to follow.

In the meantime, (1) twenty-five service test models of the KMU-353/B would be maintained at Ubon for possible contingency operations against for instance North Vietnamese power plants and bridges, while (2) aircrews would stay proficient and insuring the F-4D aircraft's launch system reliability by continuing to expend Walleyes.

## Production

ADTC Project 213BY001, 'Production Qualification of the Mk-84 EOGB' was conducted to demonstrate the performance of the EOGB system after undergoing production engineering. It was initiated on December 1, 1969 and terminated on January 13, 1970.

Examples of testing objectives were, (1) to conduct pit drops to demonstrate successful operation of the guided bomb during release and separation from the F-4D; and (2) to observe and note susceptibility of the KMU-353A/B system to interference from the QRC-353-3, AN/ALQ-71 and AN/ALQ-87 ECM pods. Nine production Mk-84 EOGBs were expended, with two failing to guide, six guiding and impacting within eight feet of the target, and one doing similarly, but 27 feet from the target. On January 29, 1970, the Aeronautical Systems Division recommended deployment of the production Mk-84 EOGB to SEA.

In the meantime, TAC had directed TAWC to perform the OT&E of the production version of the Mk-84 EOGB: TAC Test 69-2K/TAWC Project 0041 'EO Guided Bomb Testing'. Involved were not only the Mk-84, but also the M-



In this May 1968 photo, a pilot is pre-flighting an Mk-84 EOGB on the left inboard of his F-4D Phantom prior to a test sortie from Eglin.



One of the few APGC aircraft that was camouflaged at that time, F-4D 67741, was involved in the DT&E of the Mk-84 electro-optical guided bomb. In this May 1968 photo, the Phantom is taxiing out for a sortie

118 EOGB. The test plan was approved by HQ TAC in early January 1970. Planned deployment was March 1, 1970.

In early February, 7AF received informal information through ASD's Det 6 at Tan Son Nhut, indicating there might be some difficulty meeting the planned March 1 deployment date due to the on-going testing schedule. 7AF then sent a February 9 message to PACAF, stating that the deployment, as scheduled, was supported. 7AF also told PACAF that each day delay beyond that day would lessen the opportunity to provide meaningful combat evaluation due to the imminence of the Southwest monsoon season and deteriorating weather conditions over the primary target areas. 7AF finished its message by stating that efforts to meet the March 1 deployment date should receive priority.

Eleven days later, a 60-day slippage in the deployment was confirmed in a meeting at HQ USAF with representatives of AFSC/TAC and PACAF. TAWC began its portion of EOGB testing on May 19 and completed it on the 21st, with four weapons expended. The next day test results were forwarded to TAC, thus completing the Mk-84 EOGB portion of TAC Test 69-2K.

The evaluation team deployed to Ubon on June 1. Establishment of facilities for weapon buildup, checkout, and maintenance were completed on the 10th. The airborne portion was initiated on June 11 and completed eight days later. Twenty-one sorties were fragged, of which ten were postponed due to weather. Twenty-five production Mk-84 EOGBs were deployed, of which seventeen were expended against fords, a bridge and caves. Fourteen were direct hits. The team's conclusion was that the production Mk-84 EOGB was an effective weapon to strike hostile pinpoint targets.

Two of the six recommendations made, were (1) the purchase and installation of high resolution television monitors for use with the electro-optical weapons should be expedited; and (2) TAC's EO training program should

train pilots designated for assignment to EOGB-equipped wings, on the Mk-84 EOGB system to assure adequate and readily available replacements for aircrews selected to deploy to units possessing this weapon.

With regard to maintenance six recommendations were made as well. Three examples were, (1) the overall weapon reliability had to be improved, (2) a tester to evaluate aircraft weapons system and video was required, and (3) the delay in flight line checkout time caused by moisture was unacceptable and had to be eliminated.

### Delay

Due to the delay between the completion of the Mk-84 EOGB Cat III and the beginning of M-118 EOGB testing, TAC re-designated the test number to TAC 71A-035T, 'EO Guided Bomb OT&E'. TAWC's 0041 designation was not changed. TAC asked TAWC to amend the test order to reflect the required M-118 EOGB resources. The weapon, used essentially the same system as the Mk-84 EOGB. However, it contained approximately twice the explosive weight. On February 17, 1971, the test order was approved and TAC ordered testing to begin on March 23 upon receipt of M-118 guided bomb certification.

In the meantime, ADTC had started its DT&E of the weapon. For instance, ADTC had completed compatibility testing which required five sorties. No weapons were expended for Cat II testing in both January and February, 1971, but the first of the scheduled three drops was accomplished on March 17. This was followed by one release each on the following two days, completing Cat II testing.

TAC Test 71A-035T was to determine the operational suitability of both the M-118 EOGB and the Sony monitor (as stated before, during its SEA introduction in April 1969 and later in June 1970, PACAF had identified a major limitation of the Mk-84 EOGB, the F-4D's television monitor. Plans were made to install scan converters to correct that problem, but they were not to be operational until 1972). As an interim improvement, CSAF directed that a supplemental TV monitor be installed in the rear cockpit of 27 F-4D EO-capable aircraft at Ubon and Bitburg AB, Germany. As a result, a Sony monitor was selected.

TAWC initiated its OT&E on March 30, 1971. The test team was augmented by personnel of the 4485th Test Squadron. A captive sortie to confirm ECM compatibility was flown on April 6 and was followed by one more captive flight and three live drops. With the live drop of the third M-118 EOGB on May 3, OT&E was completed.

It was concluded that both the M-118 EOGB and the Sony monitor were suitable for employment with the F-4D Phantom after implementation of the recommended changes. TAWC evaluators noted for instance that the weapon had the same accuracy as the Mk-84 EOGB, aircrews and ground personnel who had experience with the Mk-84 EOGB were able to perform successful operations with the M-118 EOGB without additional training, and the aircraft's ALQ-87 ECM pods did not interfere with the operation of the Sony monitor picture or the EOGB optical system. However, a number of deficiencies were also found.

Examples were, (1) the reliability of the weapon's guidance kit was only 67%, as at times the sun washed out the Sony monitor picture and made it difficult to see without shielding; and (2) not all EO-capable F-4Ds could carry two M-118 EOGBs.

Recommendations in this respect were, (1) installation of a Sony monitor that would allow simultaneous operations of the monitor, ECM controls and LABS; (2) development of filters or sunshades for the Sony monitor; and (3) F-4Ds capable of carrying two M-118 EOGBs should be identified by tail number.

## SHED LIGHT

Two events led to the development and SEA introduction of the PAVE SWORD laser seeker pod. The first event was the July 1966 establishment by CSAF of the SHED LIGHT (Night Tactical Air Attack) program. It was a requirement to improve night tactical mission performance through a centralized high priority development and operational application effort. AFSC's Limited War Office became responsible for the development management of the various specialized systems, while TAWC was designated by TAC as the executive manager and responsible for the OT&E of TAC's SHED LIGHT efforts.

The second event was the initiation by PACAF and 7AF on September 14, 1966 of SEAOR #57 'Laser Target Designator System (LTDS)'. The rationale for this SEAOR were the existing operational limitations and deficiencies in operations in SEA. It called for an improved system for the Forward Air Controller (FAC) to identify and mark targets for destruction by fighter aircraft. The LTDS was to be a concept to demonstrate the feasibility (night or day) of using an airborne (restricted ground operation), handheld, or permanently mounted laser gun system to propagate and direct a narrow laser beam to mark a specific target in a combat environment. The seeker in the attack aircraft would automatically look for the laser spot on the ground, lock onto it, and then slave the gunsight pipper to point at the spot on the ground. For this purpose the strike aircraft's gun had to be modified.

APGC Project 1619 PAVE ARROW (project 73B of SHED LIGHT) was recommended as a solution to SEAOR #57, after which it was validated, approved and funded (\$5,750,000). '1619' initially proposed a procurement of twelve Autonetics illuminators and twenty Martin seeker pods for testing and qualification in SEA. The project was designed to enable an F-100D Super Sabre through a seeker/display system to identify and strike a target covertly by a stabilized laser illuminator carried in an O-1E FAC aircraft.

## Requirement

Project 1619YK03 'Laser Designator/Seeker System, PAVE ARROW' was conducted under the authority established by AFATL letter of September 15, 1967 'Request for Test Support, Project 1619, Task 1, Airborne Laser Designator Seeker Laser Target Designator System'. The project would be a joint APGC/TAWC Cat II and III test, which was to consist of ten Autonetics stabilized illu-



This April 1968 photo shows an airborne TAWC F-4D Phantom with a Mk-84 modified with the KMU-353/B EOGB kit on the left inboard weapon pylon. In that month TAWC F-4Ds dropped three Mk-84 EOGBs and flew twelve captive sorties, of which two in support of the APGC DT&E.

minators (Korad laser) to be installed in O-2A aircraft and twenty Martin-Orlando seeker pods to be installed on F-100D aircraft. The Martin pod would utilize the AIM-9 Sidewinder 1-A seeker head installed in a SUU-11A pod on the centerline pylon. The target lock-on of the seeker head would be displayed by the reticle of the Ferranti gunsight of the F-100D. Both the illuminator and seeker pod were under contract. Testing was scheduled to start on February 1, 1968.

## Revision

Active APGC testing was begun on June 5 with two of its F-100Ds and one TAC O-2A, which had been modified to carry the Stabilized Laser Illuminator (SLI). The first of the two F-100Ds that would be provided by TAC for the test was modified at Eglin in May, while a second arrived on June 1 for modification. By August 31, a second O-2A had received the laser modification.

TAWC's OT&E portion of the joint test (TAC Test 67-47) was initiated on August 26. In September, Phases I (TAWC aircrew orientation) and II (development of tactics) were completed, while Phase III (practice ordnance delivery) was initiated. On October 23, a joint AFSC/TAC status review conference was held. It was decided to extend the completion date to December 31, which was later extended to the January-March period.

By the end of the year, Phase III and IV (live ordnance delivery) had been completed. Three Phase V (modified M-117 delivery) and one Phase VI (night, using flares) missions were remaining. Cat III testing was suspended pending resolution of technical problems encountered with the seeker pod detectors.

In a January 15, 1969 joint AFSC/TAC meeting it was concluded (1) to support testing through January, (2) to terminate OT&E that very same day, (3) to cancel SEA deployment actions, and (4) to prepare the final report.

During flight testing, PAVE ARROW had experienced numerous problems, including technical deficiencies and unsolved tactical limitations, and at its completion, the pod was returned to the contractor for re-work. The contractor then incorporated fixes to correct the deficiencies. In addition, the PAVE ARROW pod was modified for carriage by an F-4D. The fixes resulted in an improved version of the original pod. It was returned to Eglin in August 1969 for additional flight testing.

Concurrently, SEAOR #57 was revised. The required operational capability specifically stated that day and night strike aircraft had to be provided with the capability to attack laser designated targets without overt target marking. A laser commanded attack display was to allow the pilot to acquire and track a laser designated target. The revision also proposed specifically to equip F-4D aircraft with PAVE ARROW as an interim solution. This was proposed to allow F-4D aircraft to take full advantage of the covert marking capability of present laser designator aircraft and to enhance delivery accuracy of LGBs.

### Authority

PAVE ARROW follow-on flight testing was conducted in two independent phases. The first phase's purpose was to demonstrate its capability, integrated with an F-4D to provide a night weapon delivery system in the dive toss bomb mode without visual acquisition of the target.

ADTC conducted its part of the testing, 1619Y005, under authority of the 'ASJT Program Introduction Document Number 1, PAVE ARROW' of May 21, 1969. Flight testing took place in the September 3, 1969-August 5, 1970 time frame. One of the test objectives was to demonstrate the compatibility of the PAVE ARROW follow-on seeker pod (on November 1, 1969, the PAVE ARROW title was changed to PAVE SWORD) and the F-4D aircraft to include, but not be limited to electro-magnetic (EMI), electrical and structural compatibility.

ADTC equipped one of its F-4Ds with the improved PAVE ARROW pod on the right inboard pylon. The aircraft's gunsight was modified (deleting the radar scope in the front cockpit) to present two reticles, one fixed along the radar boresight and the other movable reticle slaved to the laser seeker head. The F-4D would perform a dive toss bomb delivery maneuver after seeker lock-on to the designated target. As previous testing had shown that the O-2 was inadequate for operation in adverse weather and at night, a TAWC C-123K, which had been modified for TAWC's involvement in the testing would designate the target. (This test, TAC Test 69-17 'Night Laser Bomb Delivery', had been assigned to TAWC on June 13, 1969 after HQ USAF had directed TAC to conduct a test to determine the feasibility of tracking and destroying a moving target at night, using laser guided weapons and covert acquisition [see later].)

Compatibility flight check and 13 sorties for system operation using a ground-based laser was accomplished by December 31, 1969. The seeker was not susceptible to interference. The Phantom expended 49 BDU/33 practice bombs during daytime to establish base line data for the



Then Capt Larry Van Pelt was the primary APGC/ADTC test pilot for the DT&E of the AN/AVQ-14 PAVE ARROW laser spot seeker. He also participated in TAWC's OT&E, which included the O-2A Skymaster and its laser target designator. The photo shows Capt Van Pelt prior to a PAVE ARROW sortie with F-100D Super Sabre 53504. (USAF, via Larry Van Pelt)

dive toss computer. The F-4 and seeker system were evaluated during daytime VFR, delivering inert ordnance. If successful, the system was to be evaluated in a non-visual night environment using inert ordnance.

### Mini-Pod

At the end of the dive toss phase of the PAVE SWORD flight testing, TAWC, with TAC concurrence, proposed to test a 'mini-pod' PAVE SWORD seeker system as an aid to release laser guided munitions exclusively. TAWC favored this configuration over the modified gunsight configuration, because (1) it was the only way to provide SEAOR #57 capability by the next monsoon season, (2) the mini-pod did not dedicate an aircraft to a special mission, and (3) the mission could be accomplished at considerable savings in time and money. In the proposal, the existing ADI cross-pointer needles on the instrument panel in the front cockpit would be used, eliminating the extensive gunsight modification and permitting delivery of laser guided ordnance using the ADI needles and a release light, instead of the gunsight reticles and a dual needle meter, for steering and release information. The consequence of TAWC's proposal was the addition of a level bomb objective to ADTC's project. The Phase II portion of the flight testing had the specific objective to demonstrate the capability of the PAVE SWORD mini-pod configuration to deliver LGBs (day VFR) in a level delivery mode against a stationary target.

All test objectives in the dive toss and level bomb phases were accomplished, although it was decided after the first five drops to eliminate drops using a wind compensated PAVE SWORD delivery system, as had been scheduled. Those five drops had shown that the wind-compensated reticle in the system proved to be too unstable to be used effectively. After ADTC's demonstration of the performance capabilities of the PAVE SWORD system, TAWC was requested to evaluate the results and to make recommendations regarding a SEA deployment.

## Night

In TAC Test 69-17 (later 71A-072T)/TAWC 0009) 'Night Laser Bomb Delivery', assigned to TAWC on June 13, 1969, a Mk-84 LGB would be dropped from an F-4E Phantom on a moving target at night, which was identified by a strike controller in a C-123K Provider. The strike aircraft was furnished with offset information and laser guidance for the bomb by the FAC. The test was of an exploratory nature and conducted in two phases, the first of which was a quick look to determine the feasibility of an integrated system using existing assets. Phase II would be planned to build on the knowledge gained during Phase I and to take advantage of improvements in equipment capability that would improve the concept significantly.

TAC and TAWC officials quickly moved to get the program underway and by July 31, 1969 TAC approved an abbreviated OT&E test plan. The modification of the C-123K (40713) was completed September 24. After receipt of the formal program document in early September, Phase I test sorties were initiated on September 24, and completed on December 17. Eight Mk-84 LGBs were expended on stationary or moving targets, all during night operations. In the meantime, Phase II planning was in progress.

Although it was proven that the main objective could be attained, three major deficiencies were noted during the OT&E. Examples were that the strike aircraft, in this case the F-4E, could not be consistently positioned to bomb within the parameters of the LGB trajectory. Also, that more stability was required for the laser operator aboard the C-123K to designate a small target accurately during the time required for the weapon to complete its trajectory. It was recommended that the delivery aircraft be augmented with an aid, such as a laser seeker, to assist the crew in locating the laser-designated spot. Also, to mount the laser designator package in a more stable aircraft and stabilizing it by a rate-aided-gyro.

In the first six months of 1970, the first effort of Phase II was completed. It involved the modification of tactics used in Phase I. The purpose of the next effort in Phase II was to investigate the capability of the modified system installed on the F-4D to deliver laser guided munitions effectively at night against targets designated by an airborne laser designator installed in an AC-123K BLACK SPOT aircraft. This pod was being flight tested by ADTC and by July 1, 1970, one live drop was remaining. A total of fifteen TAWC missions were scheduled with ten inert Mk-84 LGBs to be expended. This effort was also conducted in response to 7AF Required Operational Capability (ROC) 3-70 of February 15, 1970. The ROC stated a need for strike aircraft to possess the capability to covertly acquire and attack laser-designated targets with LGBs.

## Compatibility Test

The PAVE SWORD system consisted of a laser seeker pod installed in an SUU-11 pod that could be mounted on an in-board pylon of an F-4D, and further consisted of a control panel mounted in the rear cockpit, steering displays in both cockpits, and lock-on and release lights for both cockpits. To determine if the PAVE SWORD pod could be mounted in the F-4D's ei-



The AN/AVQ-14 PAVE SWORD laser seeker pod was used in combat operations with the laser designator of the AC-123K BLACK SPOT and AC-130A/E Spectre gunship, especially during night operations. Their crews would direct the laser beam onto a target, which position was radioed to the F-4D's crew. The reflected laser energy would then be picked up by the Phantom's PAVE SWORD pod. The pilot would follow the steering needles in the cockpit and release his Mk-84 LGB, which was then guided by the laser designating aircraft to the proper point in space for the bomb to release and to fall into the 'basket'. The photo shows a PAVE SWORD pod attached to the right forward AIM-7 Sparrow missile well of an F-4D at Ubon.

ther forward AIM-7 Sparrow well, ADTC accomplished a compatibility test to evaluate both physical fit and flight characteristics. The test, Project 5221W033, was responsive to AFATL's Munition Compatibility Office letter of October 2, 1970 'Test Request for the PAVE SWORD Pod in Either Forward Missile Well of the F-4 Aircraft'. Testing was initiated on November 13, 1970 and completed four days later.

The right forward missile well was used exclusively as an ECM adapter for the left forward AIM-7 well was not available at the time of the testing. Contractor-provided instrumentation was installed in the pod, which recorded strain, stress, and vibrational data to verify adequacy of the structural design of the pod. All objectives were accomplished. It was concluded that the PAVE SWORD pod physically fitted in the right forward missile well of the F-4D when used with centerline and ECM adapters, provided two modifications would be made, (1) countersink four bolt heads on bracket assembly, and (2) trim 1/16 inch from forward edge of aircraft panel 115R.

In the meantime, TAWC's test plan for the OT&E had been submitted to HQ TAC and subsequently approved. After acceptance of the pod for OT&E, active testing was initiated on August 10. If the OT&E of this pod would be successful, the remaining PAVE ARROW pods would also be modified to the PAVE SWORD configuration and deployed to Ubon. Active testing of the second effort and of Phase II was completed on October 15, 1970.

## Deployment

As a result, TAWC recommended the system to be introduced to SEA immediately. This was accepted and the

initial deployment of five PAVE SWORD passive laser receiver pods to Ubon took place on November 23. A three-man TAWC/ADTC introductory team arrived the same day for a period of 30 days. Maintenance was contracted for a period of six months. In December, the pods were mounted in a forward missile well of five F-4D aircraft.

However, many problems were encountered upon arrival of the equipment, resulting in a delay of 4-6 weeks. 7AF was of the opinion that no additional seeker pods should be deployed to SEA until irregularities had been corrected. In addition, some delay was also encountered in getting fraggged for missions by 7AF, due to aircraft being required for higher priority combat operations.

After specialized training for selected F-4D aircrews and shake-down sorties had been accomplished, the introduction phase of the system was initiated with the first mission on February 3, 1971. Cash flight, consisting of three F-4Ds of the 433d TFS, was to escort an AC-130 with call sign Spectre 12. While Cash 02 was escorting the gunship, a 37mm gun opened fire at the Spectre. After locating the gun site, the AC-130 crew directed its laser beam into the site. Cash 02 was informed of its position. After it had been hit by some of the Spectre's 20mm rounds, Cash 02 rolled in, followed his steering needles and released his Mk-84 LGB, which was guided by the Spectre (reflected laser energy would be picked up by the F-4D's PAVE SWORD pod. By using steering needles in the cockpit, the laser energy would guide the pilot to the proper point in space for the bomb to release and then to fall into the 'basket' while the AC-130 Spectre lased the target until the bomb exploded [during the introduction, both the AC-123K and AC-130A were used as laser designators; eventually, all AC-130A/Es in SEA were configured with a laser designator]) into the gun site, destroying it.

Through February 19, a total of 25 Mk-84 LGBs were delivered by F-4D escort aircraft against AAA sites and truck targets, which were designated by laser equipment aboard AC-130s.

### Additional

In February, the 8th TFW requested an additional seven pods be deployed to Ubon to increase the number of PAVE SWORD pods to twelve, the total number available under the program. 7AF and PACAF concurred.

Certification of the pods, completion of initial combat tactics, including coordination with the AC-130, were accomplished on February 20, 1971. Combat evaluation was concluded on March 10. One of the conclusions was that the terminal accuracy of the Mk-84 LGBs that guided was 44 feet for the targets designated by the non-autopilot-equipped AC-123K and less than 25 feet for those targets designated by the autopilot-equipped AC-130.

Following the evaluation, TAWC's recommendations included that the PAVE SWORD AN/AVQ-14 be viewed as an interim solution only and no follow-on buy of the system be made. Also, that the PAVE SWORD laser-seeker system be employed in conjunction with the AC-130, PAVE NAIL, and PAVE KNIFE. By June 30, six of the seven additional pods had been flight checked and shipped to Ubon, with one pod remaining to arrive.



The Air Force Armament Laboratory title adorns the AN/AVQ-10 PAVE KNIFE pod on ADTC's F-4C 40875. AFATL developed the high-performance stabilized laser illuminator pod, while the Aeronutronics Division of Philco-Ford in Newport Beach, CA built it. The Phantom is at Marine Corps Air Station El Toro near Santa Ana which was closest to Newport Beach. The first sortie by Capt Larry Van Pelt with the pod occurred in June 1968 after the pod had first been mounted on '875' by the Philco Ford technical team with support of APGC ground support personnel. (USAF, via Larry Van Pelt)

### Flexibility

Operational Requirement #100 not only established the requirement for laser guided munitions, but also stated the need for a self-contained laser designator system for high-performance tactical aircraft.

Ever since the PAVE WAY I laser guided weapons were employed in SEA in 1968, the continuing success of the program had resulted in a high confidence in the operational employment and in the accuracy of the laser guided munitions principle. However, two F-4D aircraft were involved to expend the LGB: the one configured with the weapon and the one illuminating the target.

In order to improve the potential of the F-4D weapon system, to overcome the operational limitations of the existing PAVE WAY illuminator system and to give the attacking aircraft the flexibility to use evasive maneuvers prior to and immediately after bomb delivery, the Air Force Armament Laboratory developed a high-performance stabilized laser illuminator pod, which was dubbed AN/AVQ-10 PAVE KNIFE. The Aeronutronics Division of Philco-Ford in Newport Beach, CA built the pod. The system was pod-mounted with control and monitor equipment in the F-4D's aft cockpit. It was carried on the inboard armament pylon of the aircraft. In addition to an auto-stabilized and very narrow beam laser designator, it used a range finder and a slewable gyro-stabilized closed circuit low-light level TV (LLLTV) camera which was bore-sighted with the laser to project a magnified picture to the rear cockpit with automatic or manual tracking for complete 360° area coverage beneath the aircraft. Ninety milli-joules laser illumination upon command was provided through a common video/laser aperture. Aiming of the beam for tar-

get illumination was accomplished either by manual control, using an existing control handle in the rear cockpit, or by automatic tracking circuits in the TV camera which would lock on a target that had sufficient optical contrast. As the head was slewable, the illuminator aircraft was no longer restricted to flying a left turn while illuminating the target for another F-4D.

PAVE KNIFE, project 102 of SHED LIGHT, was designed to interface with the existing weapons release computer and the radar system of the F-4D. The system would also be compatible with the scan converter modification (a Modification Request [MR] was published on June 16, 1969, followed eight days later by a Modification Program Directive [MPD]. Total cost would be \$10.5 million, which was predicted on the modification of the Walleye scan converter. Modification was to begin in the spring of 1970 and be completed by July 1971) and use it when available in time. The F-4D PAVE KNIFE was to be used in high threat areas as a self-contained laser delivery system as well as in a hunter-killer role. The system would enable one aircraft to acquire, laser designate, and then strike a target or, to acquire and laser designate for another strike aircraft.

### Phase I

Two versions of the PAVE KNIFE system were to be tested. The Phase I system contained a stabilized laser illuminator system with automatic tracking and night viewing capability for use on high-performance aircraft. APGC Project 1559Y011 was conducted in response to AFATL February 16, 1968 letter 'Flight Test Support for Project 1559, Task 157, High Performance Airborne Laser Illuminator'. To be evaluated was, among others, the performance of PAVE KNIFE on an F-4C testbed aircraft and to demonstrate compatibility with laser guided munitions. Then Capt Larry *Stick* Van Pelt was in charge of, and did all the DT&E flying. The first sortie with the pod occurred in June 1968 at Marine Corps Air Station (MCAS) El Toro, CA after the pod was first mounted on an F-4C (40875) by the Philco Ford technical team with support of APGC ground support personnel. At El Toro, as the base was conveniently close to Philco Ford's Newport Beach plant. *Stick* flew five local sorties in the 20-27 June period to ascertain proper pod functioning and integration with the rear cockpit controller and display. For further F-4 systems integration modifications, *Stick* flew the pod back to El Toro on October 20, returning the F-4C to Eglin the following day.

The pod was ready for pick up on November 26, *Stick* picked it up and returned to Eglin the next day, followed by further DT&E to evaluate the fully integrated system. *Stick*,

*During the DT&E, I also flew in the back seat on a few occasions to familiarize myself with the complexity of integrating PAVE KNIFE with other systems in the Phantom. After lock-on, the system worked perfectly and easily, using the hand controller to keep the target centered in the scope. Strange sensations as the pilot maneuvered the F-4: everything in the scope remained steady while the sun light shifted around in the cockpit and Gs were pulled. The senses were challenged!*

According to Capt Van Pelt there was close coordination between the DT&E and OT&E aircrews to familiarize them with the system and to answer any questions.

Active testing took place in the July 9, 1968-January 6, 1969 period. The first release by PAVE KNIFE was made on October 12. Of the four scheduled LGB releases by using dive-bomb delivery, only two took place (by daylight): an inert M-117 against a tactical target and a live Mk-84 against a drone tank. The two night inert M-117 releases were cancelled due to the marginal performance of the TV system in near darkness. Thirty-seven sorties were flown. One of the conclusions was that the PAVE KNIFE pod acquired and tracked stationary and moving targets. TAWC was not actively involved in Phase I system testing.

In the Phase II system, PAVE KNIFE would be integrated with the weapons delivery system of the F-4D, specifically the AN/APQ-109 radar, the AN/ASN-63 inertial navigation system and AN/ASQ-91 weapons release computer set (WRCS).

### Phase II

A contract for the (Phase II) Tactical Configuration Program, was signed on January 6, 1969 with Philco-Ford. At that time, the planned eight-week test, using one F-4D/one laser pod, was expected to start about June 15 with about thirty sorties and twelve bomb drops. Customary slippages occurred, but by June 30, the integration work had been completed. This pushed the start date back to July 11, 1969.

ADTC Project 1619Y004 was conducted in response to February 12, 1969 AFATL letter 'Continuation of Project



The builder of the AN/AVQ-10 PAVE KNIFE pod was the Aeronutronics Division of Philco-Ford in Newport Beach, CA. After additional integration modifications, Larry Van Pelt and Gene Stephens flew their F-4D 67793 in late November 1968 to MCAS El Toro to pick up the pod. (USAF, via Larry Van Pelt)

Directive 1559Y011'. Its primary purpose was the evaluation of the added features of the system and demonstration of the capability of delivering laser guided munitions using the dive-toss and offset-bomb modes of the WRCS. Problems were encountered in the laser ranger and offset bomb mode of operation, which warranted adjustments made by the contractor and resulting in requested extensions of Cat II testing by the Aeronautical Systems Division. ADTC completed Cat II testing of the AN/AVQ-10 PAVE KNIFE system on January 13, 1970. Testing resulted in seventeen conclusions, with the following four being mentioned, (1) PAVE KNIFE operators were able to successfully identify all tactical type targets which were acquired by the pilot in the F-4 optical sight and track them until the TV resolution limits had been reached or until the line of sight was interrupted by an aircraft store; (2) no interference was found with PAVE KNIFE from QRC-335, AN/ALQ-71 and AN/ALQ-87 ECM equipment; (3) the pod was operated successfully on both the F-4D's inboard and centerline fuselage stations; and (4) the system was compatible with M-117, M-118, and Mk-84 LGBs.

### Approval

TAC Test 69-16 'Pave Knife' was assigned to TAWC on July 24, 1969 with an estimated completion date in the third quarter of FY 70. By the end of August, the Test Order had been approved by the TAWC Review Board and was awaiting TAC approval. In addition, the draft operational concept was completed and also awaiting TAC approval. TAWC planned to begin the OT&E with a pre-production PAVE KNIFE system in or about November. Due to the Cat II extensions, OT&E was readjusted to January 1970 and later to March 25, which proved not being feasible either.

A contract to procure six PAVE KNIFE limited production systems was let November 19, 1969. These were basic systems, which were not integrated to the WRCS and would not have a laser range capability. First item delivery was anticipated in November 1970 and the sixth by late February 1971.

On December 31, 1969, TAWC's involvement was still in the planning process. The Test Order had been approved. An amount of \$313,000 had been funded for further pod refurbishment (expected completion date was June 1, 1970), spares, AGE and contractor support of the OT&E. In June 1970, TAWC was finally able to change its involvement from 'planning' to 'active' by designating it as 'TAWC 0008'.

The purpose of the OT&E was to determine tactical capabilities and operational characteristics and evaluate the capability of the system in the permissive and non-permissive combat delivery role. Some specific objectives included the determination of the visual acquisition (TV) limits for tactical targets under day and night attack modes, and the investigation of the capability of the system with other aircraft subsystems, and of the air-to-air aircraft recognition capability of the LLLTV systems. The capability to point the PAVE KNIFE system with the F-4D radar was removed prior to the test.



Eglin in the second half of the sixties witnessed the development and evaluation of numerous interesting aircraft and weapon programs. As an author you sometimes come across photos taken at Eglin, which 'blow your mind'. This is one of them. The AF caption reads the aircraft is an ADTC F-100D, carrying a Mk-84 with the KMU-351 kit on the inboard weapon pylon.

### Conclusions

The March 25 start date of the 12-week OT&E was not feasible, as acceptance flight testing of the refurbished basic integrated PAVE KNIFE system was completed by ADTC at El Toro on June 19 only. Eight sorties were flown with an ADTC F-4D. They demonstrated that the system refurbishment and changes repeatedly operated as predicted: the combination of target acquisition distance, integrated system pointing accuracy and optical magnification demonstrated definite combat potential.

On May 29, 1970, two TAWC officers visited El Toro for a PAVE KNIFE conference. OT&E was finally initiated at Eglin on June 22, followed by the first OT&E F-4D sortie on July 6. TAC was assisted by the 33d TFW, 4533d TTS (Test) and by ADTC personnel. The system performed satisfactorily during the initial evaluation of the basic system, which took place without WRCS integration. One Mk-84 LGB was released in a hunter-killer tactic, with the PAVE KNIFE F-4D illuminating the target, a stationary 2½-ton truck. The score was 18 feet. In August, twenty scheduled sorties were lost to weather, resulting in the OT&E running behind schedule.

On June 30, the production of the six limited production systems was on schedule. First item delivery was anticipated in the second week of November and the sixth and final unit in late February 1971.

TAWC completed the OT&E of the pre-production PAVE KNIFE system on September 22, 1970. The final report was approved by TAC in January 1971. It was concluded, for example, that (1) the AN/AVQ-10 system permitted continuous target designation while the aircraft was performing limited high-G maneuvers, thereby reducing aircraft vulnerability; (2) the WRCS integration allowed accurate level flight releases on any visual target, a capability that was lacking in the F-4D weapons system; and (3)

the system offered a wide variety of tactical options (it could be employed as a lead FAC designator in self-contained or hunter-killer roles and the PAVE KNIFE F-4D could be employed in standard ECM pod formation and should be employed in a lead aircraft). However, there were deficiencies as well, which limited system performance. They were related to, for instance, temperature sensitivity of the laser transmitter and the location of the TV monitor controls.

As a result, TAWC recommended that, among others, immediate action be taken to procure additional PAVE KNIFE systems that would be integrated to the F-4 WRCS, that laser subsystem performance be improved to insure a 25 percent maximum range increase in laser range receiver performance, that aircrew training be developed for the AN/AVQ-10 system, that laser protective visors be procured for aircrews, and finally that the prototype PAVE KNIFE pod be utilized to demonstrate feasibility of the helmet-mounted sight for off-boresight pod cueing.

### Combat

After test order, 71A-071T/TAWC 0008 'Pave Knife Limited Production', had been approved by HQ TAC on December 21, 1970, the start of the OT&E followed on January 6, 1971 at MCAS El Toro. On January 11, HQ TAC approved the SEA evaluation plan for 'PAVE KNIFE Limited Production'. One month later, the OT&E was successfully completed by TAWC.

As a follow-up to the OT&E, TAWC personnel, with the assistance of the 433d TFS, 8th TFW, and other specialists and technicians, performed a combat evaluation of the PAVE KNIFE system in the SEA environment for a six-week period. Its purpose was to determine the capability of the system to deliver LGBs on a target under actual combat conditions.

After area clearances had been processed, on March 3, 1971, personnel and equipment (including five pods), assigned to TAWC's combat evaluation team, departed Eglin for Ubon RTAB. A sixth PAVE KNIFE F-4D was scheduled to deploy to Ubon by April 14. Its pod, being used to train contractor maintenance support personnel, would deploy in June. The first combat sortie was flown on March 17. Through April 3, 39 sorties had been flown with 115 attacks made. BDA included, among others, two 37mm guns destroyed, 51 secondary explosions, and 1,087 meters of roads cut. The final of the 104 combat evaluation sorties was flown on April 28. Targets were predominantly interdiction points like fords and roads.

The conclusion in the final report was that PAVE KNIFE was a highly accurate and flexible bomb delivery system. Aircrew training was adequate and previous experience in laser guided weapons was desirable but not required. Aircrew integrity and good crew coordination were regarded to be extremely important in the effective use of the system.

The implementation of the team's recommendations would significantly increase the system's capability and utility. They included, for example, the establishment of a PAVE KNIFE aircrew training program within the 8th TFW, refurbishment of a PAVE KNIFE prototype for use



This is another of such a 'blow your mind' photo. Although Texas Instruments (TI) only received a contract to design and develop a laser kit for the M-118 3,000-lb bomb in November 1968, some sort of testing must have taken place at Eglin earlier. The photo shows an APGC F-105D Thunderchief at Eglin on April 6, 1967 with a M-118 'laser guided bomb' on its centerline. Note the TI logo on the bomb

in aircrew training and evaluating system improvements, to take immediate action to solve the TV camera bomb flash damage problem, and that periodic in-shop calibration of the AN/AVQ-10 be performed during regular aircraft phase inspection.

As to the evolution of the Laser Guided Bomb system, the thirteen students of the Air Command and Staff College and authors of the monograph 'Interdiction of the Ho Chi Minh Trail' stated,

*The evolution of the LGB system from the limited 'White Lightning' to the maneuverable Pave Knife proved to be the most significant development in fighter weapon systems of the entire war.*

### Sources

Histories:

- Tactical Air Warfare Center (TAWC)
- Air Proving Ground Center (APGC)/
- Armament Development and Test Center (ADTC)
- 7th Air Force
- 8th Tactical Fighter Wing

CHECO Report #253, 'Second Generation Weaponry in Southeast Asia'

AC&SC Research Project 'Interdiction on the Ho Chi Minh Trail'

Thompson, Wayne, *To Hanoi and Back, the USAF and NVN, 1966-1973*

### Thanks to

George Cully

My long-term friend Col Larry *Stick* Van Pelt, also for letting me use the Tale 'Runaway Tank' from his book 'Flying Tales'

The Air Force Historical Support Division

The Air Force Historical Research Agency



## *Runaway Tank*

by Col Larry *Stick* Van Pelt

The laser guided bomb was one of the most monumental munition developments ever achieved at Eglin Air Force Base ... a bomb that would guide itself to a spot on the ground illuminated by a laser. Simultaneously with that development was the invention of an airborne laser target designator pod, an amazing device I was intimately involved with. The pod, known as "Pave Knife," was carried on an F-4 fighter aircraft and could very accurately point a laser at a precise spot on the ground from a great distance while the airplane was maneuvering. I was the project/test pilot for Pave Knife. Both the pod and the laser guided bomb (LGB) matured at about the same time. With Pave Knife and LGB working together, a 2000 pound bomb could be dropped on a very small target while the aircraft remained at a relatively safe distance from the target area, several thousand feet in the air. There remained one question however. *Could we hit a moving target??*

The answer to that question was eagerly pursued by

the test folks at Eglin, who had also just developed the capability of remotely driving an Army tank. The test plan began to take shape. Pave Knife would orbit over the tank ... pointing its laser beam on the tank turret ... the remote tank would race across the test area, and another F-4 would release a 2000 pound LGB towards the general target area. To make the test more interesting ... and assess damage effects ... we would drop a live bomb, full of explosives. This was going to be exciting. I could hardly wait, for I would have the best view of the entire episode.

The day of the test finally arrived ... a beautiful day, with no clouds to obscure our laser (and my view). As I looked down on the test area (range C52 ... a few miles east of Eglin, where nearly all high explosive tests were conducted) I could see the tank ... engine running and ready to roll. All of the ground cameras were set up and ready to film the event at close range. The test engineers and ground controllers were all huddled together in the range tower. I could tell by their radio calls they were very excited about this first of its kind type of test. The bomb-carrying F-4 was in loose formation behind me as we orbited at 15,000 feet.

*It was time for the show to begin.* I entered a dive ...



2,000 pound laser-guided bomb.

pointing Pave Knife at the target allowing Gene Stephens, my back-seater (and very capable test navigator/weapon system operator (WSO)), to acquire and begin tracking the tank on his video display using a hand controller. As soon as Gene said “*I’ve got it!*” I pulled up and began orbiting the target. With Pave Knife tracking the tank precisely, Gene pulled the trigger on his hand controller and began lasing the target. The lase was good ... the tracking was good ... so I gave the go-ahead for the tank to begin moving. Pave Knife was working perfectly ... tracking the 25-mph tank as if it were standing still. I immediately cleared the other F-4 to roll in and drop his bomb.

I was in a perfect position to view the entire operation. I watched as the big bomb came off the F-4 and was even able to see the LGB do its characteristic wiggle in flight ... indicating it was tracking toward the laser spot (on the center of the tank turret). The bomb sped directly towards the tank at nearly supersonic speed.

**The impact was spectacular !!** The bomb hit just in front of the tank ... but the huge erupting fireball completely encompassed the Army machine. I couldn’t help but think “*That poor tank didn’t have a chance.*” Very quickly an enormous dirt cloud (at least 100 feet in diameter) covered up both tank and fireball. I could hardly wait for the dust cloud to clear so I could observe the devastation. *But then — to my utter amazement ... the tank came roaring out of the dust cloud ... as if nothing had happened !!* I was stunned!! How could anything survive the intense destructive explosion I had just witnessed?!

I immediately called the ground controllers and test engineer on the radio ... “*Stop that tank ... It’s still moving!*” But they were already on top of it. They knew it was still going ... **BUT ... they were unable to stop it!!** They soon found out they had *no control whatsoever!!* A great panic ensued, as evidenced by all the chatter on the radio. **We have a runaway tank!!** ... Where will it go?? It turned out the antenna on the tank (used to receive the remote driving commands) was designed so that if it was knocked off (de-



“Pave Knife” Laser target designator.

stroyed) ... the tank would stop. And if the antenna was still intact the remote controllers could simply give the stop command. All those plans were foiled when the antenna was just knocked over ... so neither function could occur.

There wasn’t much I could do, but I did want to stick around as long as I could ... to see what damage this runaway tank was going to inflict. I didn’t want to miss the unscheduled, but now most epic grand finale.

I circled overhead and watched as it ran over a few expensive camera locations ... just missing an expensive radar site ... and clipping several other test targets. These obstacles didn’t deter the determined runaway. The concern rapidly escalated however ... as the uncontrollable tank was *headed straight for a nearby town.* We all recognized the peril of this development, as the only thing between the tank and the town was a lightly wooded area ... no problem for a robust Army tank.

Fortunately, the wooded area happened to be muddy ... from a recent rain. When the tank got into the mud it slowly began digging deeper and deeper tracks until it finally came to a stop with its tracks still going round and round and round ... digging a grave-like hole deeper and deeper ... a fitting resting place for this renegade.

While the runaway tank was crossing the range and heading toward the nearby town, the range control people jumped in a helicopter ... clasp a remote-control box ... and chased the tank trying to get it to take a stop command. But that effort did not work. The runaway tank adventure was finally terminated when the helicopter landed and one of the controllers jumped out ... climbed into the now stuck-in-the-mud tank ... and shut it down.

The well thought out test plan had obviously not considered such a post-mission excursion ... and extracting a tank from the mud hole presented a whole new set of challenges.

Other than that ... we did answer the question “*Could we hit a moving target?*” But all of us learned maybe a more significant lesson ... *those tanks are pretty tough!!*

# Strategic Air Command SIGINT Support to the Vietnam War



RC-135C serial 63-9792 parked on the ramp at Offutt AFB, Nebraska in June 1967. By this time the 55th SRW had seven RC-135C aircraft in inventory and the following month would see the first RC-135C deployment to OL-2 in the Far East at Kadena Air Base, Okinawa, Japan

William Cahill

America's brief return to isolationism after the Second World War was dramatically ended by the Korean War. After the Korean Armistice, the Eisenhower administration was convinced that China and the Democratic Republic of Vietnam (DRV—North Vietnam) were integral parts of a monolithic international communism in lock step with Moscow—the “Sino-Soviet Bloc regimes”.<sup>1</sup> Communism world-wide needed to be watched and engaged—and what better instrument to use than air power.

USAF Operating Program Guidance for Fiscal Year 1953 stated the focal point of a future air war was the “heartland of the USSR” and involved attacks against “war sustaining resources” and Soviet bomber assets.<sup>2</sup> Under the guidance of General Curtis LeMay, Strategic Air Command (SAC) had become singular in focus: the organization existed to execute the SAC Emergency War Plan (EWP), its planned execution of this future air war. The Korea War validated the plan's base doctrine—the necessity of reconnaissance forces to find targets. Within this framework, SAC viewed its electronic reconnaissance mission in two phases: pre-hostilities and wartime.<sup>3</sup> The need for pre-hostility electronic reconnaissance drove the equipping of the 55 Strategic Reconnaissance Wing's (SRW) 343 Strategic Reconnaissance Squadron (SRS) with Boeing RB-50G aircraft specifically designed for the worldwide signals intelligence mission.

In summer 1951 RB-50G aircraft arrived in the Korean theater on a 90 day rotational basis, operating as Detachment 3 of the 91 SRS at Yokota Air Base (AB), Japan and subordinate to Far East Air Forces (FEAF) in support of the Korean conflict.<sup>4</sup> When hostilities ended in Korea SAC acted quickly to regain control of its assets. In SAC's view of the world, SAC bomber and reconnaissance forces deployed to the Far East would fall back under SAC control for use in SAC operational plans in the event of open hostilities; this idea was backed by a Joint Chiefs of Staff decision that exempted SAC forces from theater control.<sup>5</sup> The RB-50Gs continued their stay in the Far East at Yokota AB after the Korean War as Detachment 3 of the 343 SRS, monitoring Chinese and Soviet forces as the Cold War heated up. When the 55 SRW started its transition to RB-47s in April 1954, the RB-50Gs and the signals intelligence (SIGINT) mission transferred to the 97 BW who continued to support the existing overseas detachments. On July 1, 1956 the 55 SRW took over the SIGINT role from 97 BW as wing conversion to the RB-47H was mostly complete. The 55 SRW promptly resumed operations at Yokota AB with the newly-christened Operating Location 2 (OL-2) supporting a temporary duty (TDY) RB-47H and its crew along with a pair of KC-97Gs from the wing's air refueling squadron.<sup>6</sup> The first aircraft and crew arrived July 3, 1956 on a 90 day rotation from the 55 SRW's home station of Forbes Air Force Base (AFB), KS, with support personnel on 179 day TDY orders.<sup>7</sup>

The RB-47H was ordered in 1953 as a replacement for SAC's RB-50G electronic intelligence (ELINT) aircraft. Boeing

built 32 of the aircraft with deliveries to the 55 SRW at Forbes AFB starting in August 1955. OL-2 RB-47Hs were principally tasked with missions along the China Sea gathering ELINT against China and north to the Sea of Japan for missions against the USSR and the Democratic People's Republic of Korea (DPRK—North Korea). These missions were conducted under SAC's peacetime aerial reconnaissance CASTLE GATE Operations Order (OpOrd), with tasking authority changing to the BOX TOP OpOrd in 1961. Mission tasking came from Headquarters SAC through Second Air Force to the 55 SRW, with mission "take" processed by Detachment 3, 544th Reconnaissance Technical Squadron, also located at Yokota AB.<sup>8</sup>

In 1964 the Joint Chiefs of Staff (JCS) established a Joint Reconnaissance Center (JRC) which served the purpose of providing a single focal point for sensitive peacetime reconnaissance. Through the JRC, the JCS would direct reconnaissance operations during periods of tension prior to open hostilities. SAC's Strategic Reconnaissance Center (SRC) acted as a clearing house and coordination center for SAC, directing and controlling SAC's reconnaissance fleet to collect intelligence data essential for SAC's EWP. Within SAC, organization for reconnaissance followed command lines, e.g., the commanders of the Second, Fifteenth and Sixteenth Air Forces, and Third Air Division. Subordinate to them were the forward area (OL) commanders who were designated to command the reconnaissance forces overseas. In the western Pacific, Detachment 1, Third Air Division oversaw SAC presence—in this case, predominantly 55 SRW and 5147 Strategic Wing (SW) aircraft deployed to fly reconnaissance missions.<sup>9</sup> Unfortunately for SAC planners, the only war that was heating up was not covered under the EWP.

### US National Interests—1960

After the neutralist Laotian Government collapsed in December 1960, a new Laotian Government asked the United Nations for aid against an invasion from the Democratic Republic of Vietnam (DRV—North Vietnam) or Communist China. Alarmed over the possible introduction of foreign troops, President Eisenhower requested more intelligence on the matter and directed the Central Intelligence Agency (CIA) to deploy U-2 aircraft.<sup>10</sup> In October 1961 four RF-101C reconnaissance aircraft from the 15 Tactical Reconnaissance Squadron arrived at Tan Son

*William Cahill is a retired Air Force intelligence officer who contracts for DoD in the Washington D.C. area. An Intelligence Weapons Officer with squadron and wing-level experience, he has also served on the Air Staff and in an inter-agency capacity outside of DoD. Mr. Cahill is a graduate of San Jose State University and has MS degrees from Embry Riddle Aeronautical University and the National Defense Intelligence College. Mr. Cahill has been published in Air Power History, FlyPast, the USAF Weapons Review and C4ISR Journal.*



The RC-135M replaced the RB-47H as SAC's SIGINT workhorse in Southeast Asia. Shown here is serial number 62-4132 on the ramp at Greenville, TX, the spiritual home of the RC-135 airframes. (*Big Safari Program Office.*)

Nhut to provide imagery collection over the Republic of Vietnam (RVN-South Vietnam) and Laos.<sup>11</sup> Joining the U-2 and RF-101 imagery platforms were SIGINT aircraft dedicated to the fight in Vietnam—C-130B-II communications intelligence (COMINT) aircraft assigned to the 6091 Reconnaissance Squadron (RS). The 6091 had traded in its worn out ex-SAC RB-50G aircraft for the C-130B-II in October 1961 and was responding to orders from its higher headquarters in Hawaii, Pacific Command. The deployment, named HILO HATTIE, flew 37 operational missions from Tan Son Nhut AB, RVN, between July and December 1962 before re-deploying to Yokota AB, Japan.<sup>12</sup>

Declassified reports documenting the start of SAC ELINT collection have yet to be unearthed. Sorties of duration capable of reaching the Tonkin Gulf from Yokota AB started as early as January 1960 and appear to have been executed every 2-3 months as a southern extension of existing missions flown along the south Chinese coast. The missions were long, lasting eleven to twelve hours and requiring air refueling from the OL-2 tankers. OL-2 may have flown two or three Tonkin Gulf 'extension' missions in October 1963; though unlikely tied to the event, this was one week prior to CIA U-2 flights re-commencing after the 1963 typhoon season and would have given the US the opportunity to ensure air defenses such as the SA-2—a known threat to the U-2—were not in place in the DRV.

Newly sworn in President Lyndon Johnson, more concerned with a domestic political agenda, was thrust into a war he did not want to fight. Torn between abandoning the conflict to the Vietnamese to pursue a domestic agenda and the desire to not be scorned by history for letting an Asian nation fall to communism he chose the latter course of action.<sup>13</sup> In early January 1964 Johnson ordered increased reconnaissance and clandestine operation efforts against the DRV as he and his advisors had diminishing faith that the RVN could fight the war on



RC-135M operators' compartment looking forward, home to linguists of the 6990 Security Squadron for hours on end during missions over the Gulf of Tonkin. (*Big Safari Program Office.*)

their own.<sup>14</sup> As the Department of Defense ramped up Op Plan 34A, the DoD covert action campaign against the DRV, there was a commensurate increase in reconnaissance missions in the region.

Starting in January 1964 SAC was likely flying one Gulf of Tonkin extension mission per month, but OL-2 was limited in the number of sorties it could generate and still keep an eye on SAC's primary targets of China and the Soviet Union. On February 7, 1964 Pacific Command Commander (CINCPAC) Admiral Harry Felt requested the JCS provide SAC U-2s to aid in supporting Op Plan 34A. The requested 4080 SRW U-2s and personnel arrived at Bien Hoa AB, RVN on March 5, 1964 and set up OL-20. With U-2 imagery supporting Op Plan 34A operations, the National Security Agency (NSA) was under 'considerable pressure' to increase COMINT coverage in Southeast Asia.<sup>15</sup> The 6091 RS returned with two C-130B-II aircraft for a short two week TDY to Bangkok, Thailand in March 1964 under the name QUEEN BEE Charlie before returning permanently on July 12, 1964 as QUEEN BEE Delta. The C-130s flew one to two Tonkin Gulf missions per day with four assigned aircraft, initially flying from Ubon Royal Thai Air Force Base before moving to Da Nang AB, RVN.<sup>16</sup> Planners saw this robust mix of SIGINT more than adequate for the air defenses arrayed against the US in early 1964. US intelligence assessed the DRV air defense system as little more than an odd collection of twenty-some World War Two-era surveillance radars and anti-aircraft artillery (AAA).<sup>17</sup> What was not known to the majority of the intelligence community was that the North Vietnamese has been working with the Soviet Union and China since the 1950's to train a cadre of pilots. By early 1964 the Vietnamese Peoples Air Force (VPAF) had trained and thirty six MiG-17F 'Fresco A' fighters and MiG-15UTI trainers in China waiting for the right moment to fly south.

## The Fight Expands

In May 1964 JCS Chairman General Maxwell Taylor directed CINCPAC Admiral Felt to launch an interdiction program called YANKEE TEAM against DRV supply lines in Laos. To support Pacific Fleet tasking against this target set, US Navy's VQ-1 squadron started flying EC-121M SIGINT aircraft from Don Muang Airport, Thailand and Da Nang AB, South Vietnam and deploying single aircraft EA-3B detachments to Navy carriers operating in the South China Sea.<sup>18</sup> On August 2, 1964 US Navy destroyer USS Maddox, collecting SIGINT and patrolling off the DRV, was attacked by three DRV Navy torpedo boats. An apparent second attack two days later spurred Congress to pass the Gulf of Tonkin Resolution, which granted President Johnson the authority to assist any Southeast Asian country whose government was considered to be jeopardized by "communist aggression." Retaliatory air strikes were flown against targets in the DRV on August 5th.

Reconnaissance forces were now under pressure to produce more intelligence on which to base additional US reaction strikes. In May 1964 responsibility for DRV overflights transitioned from CIA U-2s to SAC U-2s; once this occurred Headquarters SAC was likely under pressure to ensure it had an accurate accounting of North Vietnamese air defenses to ensure the safety of the 4080 SRW pilots and the SRC tasked OL-2 accordingly. Starting in August 1964 the OL-2 RB-47 was flying two to three Tonkin Gulf extension missions per month and OL-2s area of responsibility had officially been expanded to include this territory. Since the DRV had transferred its fighters from training bases in China to Phuc Yen Airfield near Hanoi after the US air strikes, the Tonkin Gulf was viewed as a "sensitive area" needing fighter escort.<sup>19</sup> If the mandatory fighter CAP, usually provided off a US Navy carrier, could not be provided due to weather—not an uncommon occurrence in South East Asia—the RB-47H missions were recalled prior to reaching the Gulf.<sup>20</sup>

On August 14, 1964, the OL-2 RB-47H deployed to Kadena AB, Japan with a KC-135 for a "special project," likely a dedicated ELINT survey of the DRV. Launching out of Kadena on August 16, the RB-47H flew an 11:40 sortie in the Gulf of Tonkin and recovered at Clark AB. A planned sortie on August 20 was cancelled in the air when the designated fighter escort could not be provided due to weather. The RB-47 redeployed back to Yokota AB on August 22 for continued OL-2 operations.<sup>21</sup> OL-2 RB-47Hs continued to fly their eleven hour sorties from Yokota Air Base through at least December 1965 and possibly through March 1966, but their days were numbered. The fight was turning tactical and near daily support was required for the growing number of air strikes going into the DRV—a mission not suited for the one RB-47H and accompanying crew at OL-2. In March 1965 the United States began air strikes into the DRV under Operation ROLLING THUNDER. US Navy VQ-1 SIGINT assets stepped up their efforts from the year prior to support the expanding air war, with VQ-1 EC-121Ms flying two missions per day over the Gulf of Tonkin to warn Navy strike packages of air defense activity.<sup>22</sup>



Two RB-47H aircraft, serial numbers 53-4295 and 53-4296, were modified to work with Ryan Model 147D/E drones and designated “LONG ARM” aircraft. RB-47H serial # 53-4296 is seen parked on the ramp at Offutt AFB, Nebraska in June 1967, prior to its last deployment to OL-7 on June 27. This was the last deployment of an RB-47 to the Pacific.

A SAC U-2 imaged the first SA-2 surface to air missile site under construction in North Vietnam on April 5, 1965 with additional missile sites being discovered in July. This new threat, coupled with the proliferation of fire control radars for AAA, required a tactical electronic reconnaissance asset to help Seventh Air Force monitor VPAF’s growing air defenses. One option studied was increased use of the OL-2 RB-47Hs to support Tactical Air Command (TAC) strikes, but the idea likely met much resistance from Offutt AFB and went nowhere.<sup>23</sup> TAC then turned to its own RB-66C ELINT aircraft that had recently flown missions off the coast of Cuba. The first two RB-66Cs deployed from TAC’s 363 Tactical Reconnaissance Wing at Shaw AFB, SC to Tan Son Nhut AB, RVN in April 1965.<sup>24</sup> Additional RB-66C aircraft (re-designated EB-66C in late 1965) were deployed as were EB-66B jamming aircraft.<sup>25</sup> The EB-66 would maintain a presence in Southeast Asia (SEA) through the end of the war, flying orbits over the Gulf of Tonkin and Laos in support of TAC ROLLING THUNDER strikes into North Vietnam as well as supporting interdiction efforts in Laos. With VQ-1 covering Navy strikes and RB-66s watching over USAF strikes SAC’s support requirements were minimal. The 55 SRW appears to have stopped flying missions in the Gulf of Tonkin by April 1966 if not earlier. As one airframe was pulled from the conflict, another was added in the form of one of SAC’s newest C-135-based reconnaissance aircraft, the KC-135A-II OFFICE BOY.

Three KC-135A-II aircraft were operated by the 4157 Strategic Wing (SW) at Eielson AFB under the COTTON CANDY and later BURNING CANDY OpOrds. First delivered to SAC in December 1962, the three aircraft were equipped with COMINT intercept equipment operated by 14-20 Air Force Security Service (AFSS) personnel as well as ELINT gear operated by two SAC Electronic Warfare Officers (EWOs). The first deployment to OL-2 came in Oc-

tober 1964 when a jet and two crews deployed to Yokota AB for a series of fourteen missions flown over a five month time period for a “one time operational commitment.”<sup>26</sup> Initially tasked to fly off the Soviet Union near the Kamchatka and Chukotskiy Peninsulas, in February 1965 CINCPAC Admiral Ulysses S Grant Sharp directed the aircraft to fly in Southeast Asia. CINCSAC General John Ryan, upset at the aircraft being pulled into a tactical fight and not contributing to Single Integrated Operational Plan (SIOP—the follow on to the EWP) support—as well as loss of control of his asset—responded by pulling the aircraft out of the region in order to concentrate on the Soviet Union.<sup>27</sup> At the end of August 1965 the JCS directed SAC to resume the operations in the region with 4157 SW aircraft returning to OL-2. During this period of competing priorities, the KC-135A-II OFFICE BOY aircraft were starting to go through an upgrade to the RC-135D RIVET BRASS configuration. When the 4157 SW aircraft returned to Yokota AB in August 1965, they appear to have started to fly missions over the Gulf of Tonkin. Though documentation is sparse, 4157 SW crews issued flash reporting for the discovery of new SA-2 sites in DRV in November and December 1965 as well as noting Spoon Rest acquisition radar activity in DRV in March 1966.<sup>28</sup>

As opposed to OL-2 operations where 55 SRW RB-47s and crews rotated every 90 days from Offutt AFB, the RC-135D aircraft shuttled weekly to Yokota AB from Eielson AFB. In March 1966, the 55 SRW RB-47Hs stopped flying missions of a duration that would allow them to fly the Tonkin Gulf extension to their usual southern China mission. The 4157 SW sustained RC-135Ds deployments to OL-2 through May 1967, likely continuing to fly missions in the Tonkin Gulf until 55 SRW RC-135C aircraft arrived at OL-2 to replace RB-47Hs.<sup>29</sup> The continued presence of the RIVET BRASS aircraft in Southeast Asia demonstrated the priority the SRC placed with this mission, as the 4157 SW was only operating two RC-135D aircraft starting in July 1965 as the airframes rotated through TEMCO for upgrade and while at the same time training replacement aircrew.

### LONG ARM operations

Beyond the deployed 55 SRW and 4157 SW aircraft tasked with flying perimeter reconnaissance of the communist bloc, Yokota Air Base often hosted SAC SIGINT aircraft tasked with collecting technical intelligence. The 55 SRW routinely deployed ERB-47H technical ELINT aircraft, but the focus of the collection was normally China or the Soviet Union, not the DRV. Starting in 1965, though, a series of technical collections flights targeting the DRV did occur in the Gulf of Tonkin.

Due to risks to crews and international policy, SAC reconnaissance aircraft were directed to not operate within range of surface-to-air missile (SAM) sites. Nevertheless, there was a continuing need to collect ELINT data from the electronic emitters operating in conjunction with the SAM sites—specifically the SA-2 command uplink, missile transponder, and proximity fuse signals. Project LONG

ARM surfaced as a concept to fly an expendable Ryan Model 147 drone within lethal range of a hostile SA-2 SAM site and, perhaps, even be “killed” by a SAM. The drone would relay ELINT received by its sensors to specially-configured RB-47Hs flying nearby but outside of the lethal range of the SAMs. Ryan developed two Model 147D drones for the purpose, taking a standard imagery intelligence Model 147C drone and equipping it with radar receivers as well as a travelling wave tube to augment the radar cross section. The Model 147Ds and the two modified RB-47H aircraft—serial numbers (s/n) 53-4295 and 53-4296, designated “LONG ARM” aircraft—were ready to go for an operation over Cuba in December 1962 but the action never materialized. The two drones were then put in storage at Eglin AFB, FL for future use.<sup>30</sup>

In October 1963 the operation was back on and Headquarters USAF directed SAC to prepare a concept of operations and an initial statement of requirements. SAC complied, acquiring three Model 147E drones—essentially an updated 147D but with a CIA-supplied ELINT receiver—and bringing its modified RB-47Hs back into the proper configuration as well as training personnel. On January 8, 1964, the JCS directed SAC to cease work on the LONG ARM Project and to hold it in abeyance until further notice with the Model 147E drones being delivered direct to storage. In early 1965 CINCSAC General Thomas Power requested Headquarters USAF approval of periodic testing of the Model 147E drones and the RB-47Hs. Air Staff forwarded the concept to the JCS, who granted approval for the tests and requested a new operational plan for the deployment to Southeast Asia. After three months of test flights in Arizona, California and Florida the system was working reliably enough for overseas deployment.<sup>31</sup>

SAC used Model 147 SIGINT drones against the DRV in two separate but related efforts. The first was JCS-directed Project Left Hook, a combined SAC, PACOM and NSA operation that used the older Ryan 147D drones to locate SA-2 sites for follow-on attack by fighter aircraft. The 55 SRW stood up OL-7 at Clark AB in the Philippines in early August 1965 with LONG ARM RB-47H s/n ‘296 arriving August 14. The Ryan 147D drones were launched by 4080 SW DC-130s out of OL-20 at Bien Hoa, RVN—the first on August 20, 1965, the second on August 31. Both drones were knocked down by ground fire with little to show for their effort. The LONG ARM RB-47H was in place for the first mission but had to abort the second for an HF radio failure. With both drones expended, the project was terminated. LONG ARM RB-47H s/n ‘296 was replaced by s/n ‘295 and operations rolled into Project United Effort using the Model 147E drones. Six RB-47 sorties, named OLD BAR, were flown by the end of September, likely training and telemetry check missions to ensure the Model 147Es could pass data to the RB-47Hs. The first operational mission took place on October 16, 1965 but the North Vietnamese failed to engage the drone and it was recovered. The second and third United Effort missions, flown on October 20 and November 5, were deemed a partial success. Though both drones were lost, they did capture some SIGINT data but not the critical fuzing signal. RB-

47H s/n ‘296 deployed to OL-7 in November 1965, but operations were temporarily halted while the sole remaining Model 147E was returned to the US for rework. It was not until February 13, 1966, on the fourth mission, that the signal was successfully captured, the Model 147E relaying critical signals before it was destroyed. With no remaining Model 147E drones and the required signals captured, OL-7 stood down on April 6, 1966 and the LONG ARM RB-47s deployed back to Forbes AFB.<sup>32</sup>

It appears additional Model 147 drones were produced as a follow-on to the Model 147E, though little declassified documentation exists to support this. Documentation does exist, though, on movement of the LONG ARM aircraft in late 1966 and into 1967. On September 27, 1966 one LONG ARM RB-47H arrived at OL-7, joining maintenance personnel who had arrived three days earlier. The first three missions revealed technical difficulties with the telemetry on an unknown variant of the Model 147 drone. A total of five OLD BAR missions were flown between October 5 and November 10 along with a flight to Bien Hoa AB to do telemetry checks with the Model 147s. In early January 1967 LONG ARM RB-47H s/n 53-4295 was retired to the bone yard at Davis Monthan AFB, leaving s/n ‘296 to soldier on as SAC was directed by HQS USAF to maintain an operational LONG ARM RB-47 until a replacement was identified. On June 20, 1967 LONG ARM RB-47H s/n ‘296 deployed to OL-7 for OLD BAR/RIVET BUSH missions after a telemetry check at Davis Monthan AFB with the 4080 SW, returning to Forbes AFB on August 7 when OL-7 was de-activated.<sup>33</sup> This was the last deployment of an RB-47 to the Pacific, as OL-3/Eielson AFB, AK closed in May 1967 and OL-2 RB-47 operations standing down June 26, 1967.<sup>34</sup> The replacement for the RB-47H was the RC-135C, SAC’s newest ELINT collection platform.

## Enter the BIG TEAM

BIG TEAM was the unclassified nickname for the fleet of 10 reconnaissance RC-135C aircraft that would assume the peacetime ELINT perimeter reconnaissance mission of the RB-47Hs.<sup>35</sup> Due to the advanced technology and sheer bulk of its systems, the RC-135C was late becoming operational. Deliveries started to the 55 SRW in January 1967, with RB-47Hs flying to the bone yard as new aircraft arrived. The phase down of the RB-47 had actually started the year prior, with only eight RB-47Hs remaining in inventory by the time the RC-135Cs arrived.<sup>36</sup> The transition between airframes continued as the wing concentrated on training new combat crews and moving out of Forbes AFB, KS. By the end of June 1967 14 of 17 combat crews were trained and seven RC-135Cs were on the ramp at Offutt AFB, NE, the new home of the 55 SRW.<sup>37</sup>

A week after the last RB-47 left OL-2, the first RC-135C deployment arrived in the Far East at Kadena Air Base, Okinawa, Japan. Eight missions were flown in theater in July 1967 as the crews became familiar with the new area of responsibility. Originally tasked under the BURNING EYES OpOrd, re-named BURNING PIPE after February 15, 1968, the RC-135C provided SAC the



Small gathering celebrating the completion of the 1000th COMBAT APPLE sortie at Kadena AB, Japan, July 5, 1969. Depicted are, left to right, Lt Col Doyle Larson, 6990 SS commander; Lt Col Bob Nicholl, 82 SRS commander; and Major Vic Prislusky, aircraft commander of crew E-03. (Doyle Larson.)

ability to do in-depth technical ELINT collection against the various Soviet signals of interest emanating from the DRV. The RC-135C aircraft performed rotations through OL-2 similar to the RC-135D deployments of the 4157 SW, with aircraft often flying a mission en route from Offutt AFB before recovering at Kadena AB. The crew would then fly three to four sorties before returning to Nebraska. Tasking for RC-135C aircraft in 1967 likely contained some Gulf of Tonkin missions, but evidence has not been found to confirm these sorties. As the RC-135C was making itself comfortable in the western Pacific, another SAC C-135 based reconnaissance platform was also arriving in town—the RC-135M RIVET CARD.

### RIVET CARD and the new Mission

Though the C-130B-II was able to handle the airborne COMINT mission for Southeast Asia for the first few years of the war, an updated platform with increased capability was needed. After a transition period between September 1967 and February 1968, the SEA COMINT mission was passed to SAC RC-135M reconnaissance crews and the C-130B-II aircraft returned to Yokota AB.<sup>38</sup>

The RC-135M was the result of a 1965 USAF response to a Director, National Security Agency (DIRNSA) requirement for additional OFFICE BOY aircraft.<sup>39</sup> After DoD approval, Big Safari Program Office directed the conversion of six Military Air Transport Command C-135Bs into RC-135L OFFICE BOY II aircraft. A January 1967 USAF Security Service (USAFSS) conference on long-term requirements for worldwide SIGINT collection pointed to the need for the new OFFICE BOY II to deploy to support the growing war in Asia.<sup>40</sup> After examining many options, DIRNSA concurred with the USAFSS and provided recommended changes in the basing concept of the OFFICE BOY II to the Chief of Staff, USAF.<sup>41</sup> By March 1967 the

choices of SEA basing of the OFFICE BOY II fleet, now designated RC-135M RIVET CARD, were rapidly diminishing as the USAF pushed additional forces into theater to support the growing war. Clark AB was initially selected but was changed by HQS SAC to Kadena AB, home of the 4252 SW and episodic deployment site of RB-47s in theater. In summer of 1966 SAC started to assign personnel to Yokota AB, home of the Third Air Division, in preparation for the delivery of its new RC-135Ms, with aircraft starting to arrive in May 1967. Once aircrews were checked out, the unit was organized as Detachment 1, Third Air Division. Late in the June 1967 the unit was tasked as an Airborne Communications Reconnaissance Platform (ACRP) in the Gulf of Tonkin to provide warning information to Seventh Air Force strikes into the DRV and Electronic Order of Battle and defense analysis information on the DRV, southern China, and all areas visible from an orbit in the Gulf of Tonkin to HQS SAC planners.<sup>42</sup> On July 1, 1967, the USAFSS stood up the 6990 Security Squadron at Kadena AB under Lt Col Doyle Larson to provide airborne linguists to support the RC-135M program.<sup>43</sup>

Concurrent with the arrival of the third RC-135M aircraft, on August 25, 1967, Detachment 1, Third Air Division was re-designated the 82 SRS with Colonel Marvin Morss as commander. On the same date, Detachment 1 of the 82 SRS stood up at Kadena AB to aid in the eventual transfer of the squadron to Okinawa. With a new designation and mission name came new tasking; although procedures for all RC-135M reconnaissance flights were included in SAC's BURNING CANDY OpOrd, missions in SEA were contained in the COMBAT APPLE Fragmentary Order.<sup>44</sup> The 82 SRS commenced COMBAT APPLE missions on September 12, initially staging out of Kadena AB with crews TDY from Yokota AB. Ten missions were flown that month, with tempo increasing to daily missions by October 20. On October 5, 1967 the squadron was ordered to permanently move to Kadena AB, with the move completed by January 2, 1968 when the squadron was formally assigned to the 4252 Strategic Wing.<sup>45</sup>

The 82 SRS would reach its assigned strength of six airplanes by January 20, 1968 and ramp up to twice daily missions providing 24 hour coverage of the DRV by January 1969. The increase of 30 missions per month in January 1968 to 50 missions per month in July was limited by aircrew availability as the 82 SRS had to act as its own type conversion and training unit. On average, during the first year the squadron was flying ten training missions per month to qualify combat crews. The importance of these missions to SAC was reinforced with tanker priority. In January 1968 two COMBAT APPLE missions were cancelled due to lack of tanker support; SAC admonished Third Air Division for not ensuring "adequate and timely support" for the missions. By February 10 a new plan was in place that provided two tankers for each COMBAT APPLE sortie.<sup>46</sup>

By 1968 SAC assets in theater, including the 82 SRS, fell under two chains of command—SAC and Seventh Air Force. Both commands had to order a mission to go before the aircraft could take off. Likewise, reporting of intelli-



82 SRS crew S-01. Left to right are Aircraft Commander Major Benny Allen, Co-pilot Capt [unknown], N-1 Captain John Gaunt, N-2 Capt [unknown], R-1 Maj Lloyd Navarro, R-2 Capt Robb Hoover, R-3 Maj Bruce Carr. The initial 82 SRS crews would work through many challenges learning how to operate the new RC-135M aircraft on long duration eighteen hour plus missions over the Gulf of Tonkin. (Doyle Larson.)

gence from the mission—both while airborne and post-mission—followed a similar bi-furcated route to both SAC and PACOM ELINT centers. The initial COMBAT APPLE orbit, F701, was placed at the northern end of the Tonkin Gulf, with the southern anchor point just off the North Vietnamese town of Vinh and the northern point off Haiphong, flown at FL350 between 30 and 40 miles off the coast of DRV.

On July 25, 1968 the VPAF launched three MiG-21 aircraft that flew into the Gulf of Tonkin; the closest point of approach to the RC-135M was 30 NM, with two escorting USN F-8H Crusader fighters tracking the MiGs and positioning themselves between the adversaries and their target. Though deemed as an intercept by the 4252 SW, Pacific Fleet (PACFLT) viewed it as a possible threat and not an intercept attempt. In reviewing the incident, PACFLT advised SAC against operating special mission aircraft such as the RC-135M north of 20 degree North longitude due to proximity of MiG bases and the small number of escort aircraft available. On August 8 SAC restricted operations to south of the 20 degree North longitude, resulting in revised Track F702.<sup>47</sup> By early 1969 a dog-leg section running south from Vinh to the DMZ was added and the track designated F708. The RC-135Ms were tasked with twelve hour missions on these orbits, resulting in sorties that lasted about eighteen and a half hours due to the three hour transit time to Kadena AB. The initial missions were on station 7 AM to 7 PM local time and would launch out about 3:30 to 3:45 in the morning with a refueling by two tankers around noon time. The daylight hours were referred as “prime collection time” due to the communist air defense activity countering American strikes into the DRV. A typical mission would collect between thirty and forty priority signals—either early warning or height finder, SA-2 associated, or air intercept radars associated with the

MiG-17 or MiG-21, though collection could approach sixty signals during high activity days.<sup>48</sup>

As the 82 SRS settled into a routine, it became apparent that modifications were required to help make the 12 hour station times more amenable to the crews. Procedures were put in place to allow pilots to be out of position and rest during the long missions, especially before an aerial refueling; issues were also identified with inadequate “crew sanitation facilities” for the long missions and an incinerator toilet was recommended.<sup>49</sup> After discussions about having inflight stewards for meals on the long duration missions, the 4252 SW decided it was best to prep the galley pre-flight, clean it post-flight, and provide prepared meals (totaling 638 pounds per sortie to include 250 pounds of water and ice, 60 pounds of milk, 45 pounds of coffee, 42 pounds of frozen dinners, and 56 pounds of boxed lunches).<sup>50</sup>

## Other SIGINT

In January 1968 the 55 SRW RC-135C aircraft TDY to Kadena AB were tasked under the BURNING SUN OpOrd, a unique mission OpOrd separate from the peripheral reconnaissance BURNING EYES tasking. It was an ELINT mission from Kadena AB to meet tactical requirements in SEA and targeted Fan Song radar abnormalities emanating from the DRV. Seven BURNING SUN missions were flown in January, with at least five over the Gulf of Tonkin.<sup>51</sup> Missions continued through the end of March when the BURNING SUN OpOrd was combined with BURNING EYES under the new BURNING PIPE OpOrd.<sup>52</sup> BURNING PIPE covered “reconnaissance missions flown over SEA by the 55 SRW” and continued through 1968, though coming at a cost to the 55 SRW. The 343 SRS, the parent squadron for the RC-135C, lost 19 combat ready EWOs during the first eight months of 1968 with no inbound replacements. This coupled with the long-lead time required to train a RC-135C EWO and SAC’s policy of giving preferential manning to B-52 crew positions and overseas locations such as the 82 SRS was wreaking havoc with 55 SRW manning. The wing was also suffering critical losses of trained maintenance personnel. These combined manpower challenges impacted overseas sorties, as Kadena AB RC-135C sorties - flown against China and DRV - dropped from a high of 15 in December 1967 to five by May 1968, a tempo that continued through August. Up to this point, the OL-2 55 SRW operations were flown by aircraft TDY from Offutt AFB. Normally a RC-135C would depart Omaha on a 24-30 hour flight which would include flying an operational mission before landing at Kadena AB. From Okinawa it would fly one or two ‘local’ missions of 12 to 20 hours duration to include missions in the Gulf of Tonkin tied with a China peripheral reconnaissance mission. The crew would conclude the TDY with another peripheral reconnaissance mission on the return to Offutt AFB.<sup>53</sup>

The RC-135C presence at Kadena AB changed in October 1968. On October 19 one ‘specially configured 55 SRW RC-135C aircraft’ arrived for what was to be a 90

day deployment supporting six sorties per month. In January 1969 the deployment was extended indefinitely and upped to eleven sorties per month with support provided by a small 55 SRW maintenance detachment, though aircraft appeared to be swapped on a weekly basis with crews continuing to provide the long-endurance inbound and outbound missions when deploying a new tail. Though intended for peripheral reconnaissance, the RC-135C did support SEA mission requirements. By December 1968 the RC-135C had flown some 80 missions in the Gulf of Tonkin working SA-2 signals. BURNING PIPE missions continued to be flown in the Gulf of Tonkin in 1969, with the RC-135C averaging five missions per month off DRV through September 1969. The RC-135C stopped flying missions in the Gulf of Tonkin in October 1969 and solely focused on peripheral reconnaissance sorties.<sup>54</sup>

The 55 SRW would also rotate other 'special' C-135 aircraft through Kadena, some of which would see tasking over the Gulf of Tonkin. One such mission was COMBAT LION, which utilized BUSTED JAW KC-135R s/n 55-3121 for a precision ELINT collection mission. At least five missions were flown over the Gulf in October 1969 before the mission terminated on October 14, though some missions may have been flown in the prior months. The SCOPE RIDGE 'specially-configured' KC-135R mission was activated in January 1969 with an expected operational period of March and April 1969, though the aircraft appears to have stayed at Kadena for a 120 day TDY. It is unknown if this aircraft flew any missions over the Gulf.<sup>55</sup>

Though SAC usually relied upon the 55 SRW 'special' -135 airframes to go after new and interesting radar signals, the persistent coverage of DRV by the RC-135M gave the 82 SRS the opportunity to assist in the collection of unique ELINT. In October 1968 three COMBAT APPLE missions were tasked to support Project 'Fresh News,' a joint services effort to determine operating characteristics and location of modified Fan Song radars operational in North Vietnam.<sup>56</sup> 'Fresh News' continued into November, receiving support from five COMBAT APPLE missions.

### APPLE continues

COMBAT APPLE missions continued unabated with only weather having minor impacts on flight operations. By January 1969 the 82 SRS peaked at 62 operational missions per month, but would slide back to 50 missions per month in June and sustain that level for most of the remainder of the conflict. In July 1968, National Security Advisor Henry Kissinger was briefed that an increased emphasis on COMINT collection on North Vietnamese logistics activity in Laos would help analysts to better characterize the scale and scope of the DRV activity in RVN. Kissinger directed the CIA to prepare a comprehensive plan for monitoring enemy performance under a possible bombing halt.<sup>57</sup> To support monitoring this DRV activity, in September 1968 PACAF requested the 82 SRS conduct a test to determine the utility of orbiting over Laos and compare its collection against what was available from the F708 orbit in the Gulf of Tonkin. The new orbit over Laos,



The crew of RC-135M serial number 62-4139 poses after completion of the 1000th COMBAT APPLE sortie, July 5, 1969. Joining the crew are Lt Col Doyle Larson, 6990 SS commander and Lt Col Bob Nicholl, 82 SRS commander. (Max Moore.)

designated F802, was a simple racetrack orbit running from the DMZ to a latitude just north of the North Vietnamese town of Vinh. Five missions were flown during the month before operations switched back to F708.<sup>58</sup>

The 82 SRS' routine changed dramatically on November 1, 1968. Driven by the desire to keep peace talks going, the Johnson Administration halted the ROLLING THUNDER bombing campaign against the DRV. SAC SR-71 GIANT SCALE and Ryan Model 147 BUMPY ACTION missions continued to fly up north, three to five missions per month for the SR-71 and near daily missions for the Model 147s. These missions, monitoring DRV airfields, SAM sites, ports, and other areas of interest, would create a spike in VPAF activity for the otherwise dull COMBAT APPLE missions over the Gulf of Tonkin and SAC schedulers did their best to ensure the overflight missions were covered by RC-135M missions.<sup>59</sup> Joining the RC-135M over the Gulf were SAC U-2s, now re-rolled into the SIGINT mission since the threat environment over the DRV drove imagery collection to either the untouchable SR-71 or the expendable Model 147 drone.

RC-135M flight operations over Laos in track F802 started again on March 21, 1969. Up until this point, the 82 SRS had been flying two missions per day in F708, the Gulf of Tonkin track. Now there would be one mission per day per track, with both flown in the 'prime time' of collecting from 7 AM to 7 PM local. When Navy fighter escort was not available for track F708 due to bad weather, both missions were flown in the Laos track.<sup>60</sup> The Laotian orbit tied in with the post-ROLLING THUNDER priorities of the intelligence community in Washington. While a portion of the DRV air defenses in Hanoi could be monitored from F802, the focus of the Laotian track was the People's Army of Vietnam's (PAVN's) General Directorate of Rear Services, the DRV organization responsible for running supplies down the "Ho Chi Minh Trail."<sup>61</sup> The priority tasking of the RC-135M against a political/ground combat oriented unit was a first for a SAC SIGINT platform.

Even with tasking winding down, unit strength at the 82 SRS maintained steady at six aircraft and twelve



An upgrade of the KC-135A-II OFFICE BOY aircraft, the RC-135D RIVET BRASS was operated by the 4157 SW (later re-designated 6 SW) from Eielson AFB, Alaska. RC-135D aircraft and crews supported SAC efforts in Southeast Asia from 1965 through 1967. In 1969 and 1970 the 6 SW was tasked to provide one RC-135D with two front end crews to help support the COMBAT APPLE mission when RC-135M aircraft rotated through depot maintenance in Texas. RC-135D serial number 60-0357 is seen parked at an unknown airfield. (HQ SAC via Bill Strandberg.)

crews.<sup>62</sup> Often one RC-135M was back at Greenville, TX for depot maintenance, reducing the number of aircraft at Kadena down to five. Routine maintenance also took a toll on available aircraft; with an average of 3.5 aircraft available, the 82 SRS still managed to fly 50 sorties in September 1968.<sup>63</sup> On December 9, 1968 HQS SAC approved deploying one RC-135D from the 6 SW to Kadena AB with two front end crews and support material to augment the recon aircraft fleet from February 1969 through January 1970 while RC-135Ms were undergoing modification work at the depot in Texas. Coverage was apparently not consistent, but it appears that episodically an RC-135D aircraft would rotate to Kadena AB from Eielson AFB, normally for a one month deployment providing missions every third day. With less powerful engines than the RC-135M, the RC-135Ds would require an additional dedicated tanker sortie for the usual COMBAT APPLE long-duration missions.<sup>64</sup> The shorter duration deployments were altered in early 1970 when a modification program was scheduled for the RC-135M. In February of that year, HQS SAC directed the augmentation of the COMBAT APPLE force with an RC-135D from the 6 SW.<sup>65</sup> A permanent RC-135D presence was maintained at Kadena AB at least through September 1970.

### Vietnamization and the Changing War

As the new decade started operations continued to evolve. The war had reached a new phase with the Nixon administration's 'Vietnamization' policy in full swing, with the US focused on diplomacy and transitioning the war to the RVN. For the COMBAT APPLE mission, this translated to priority being given to ELINT collection to monitor VPAF reaction to SR-71 and Ryan 147 drone missions. When these reconnaissance assets were not active, the 82 SRS EWOs focused on looking for existing threat radars

and searching for new threat emitters such as the SA-2C or SA-3. As part of the expanding 'Vietnamization' policy, from November 1969 through April 1970 ARC LIGHT B-52s were tasked to support Operation COMMANDO HUNT interdiction missions in Laos. This expanded to supporting Laotian military ground operations combating PAVN forces in April and May 1970. In reaction to the expanded B-52s operations, the VPAF moved SA-2s and AAA fire control radars to threaten the B-52 operations. COMBAT APPLE missions helped monitor both VPAF radar activity as well as ascertain USAF ECM effectiveness, with route F802 being modified on March 2, 1970 to not interfere with ARC LIGHT routing and bombing patterns.<sup>66</sup>

One of the unique missions performed by the RC-135M crews was supporting the Son Tay prison of war camp raid of November 21, 1970. COMBAT APPLE had two tasks in support of the strike group: MiG warning and monitoring the Task Group's communications. Because of the night timing of the mission, the usual daylight tasking of the Gulf of Tonkin track had to be slowly shifted in the weeks prior to the raid in order to protect security of the mission and not reveal intentions to the North Vietnamese.<sup>67</sup> On April 1, 1970 SAC re-designated units in theater, with the 4252 SW becoming the 376 SW and Third Air Division becoming Eighth Air Force.

With the wind down of the war, priority dropped for SAC reconnaissance forces in the Pacific. A 1970 reduction in personnel by SAC impacted 376 SW operations by reducing maintenance and support staff. The 82 SRS was below strength in certain positions to include cleared personnel; for example, of six authorized Cryptographic Equipment Systems Repair personnel, only one was assigned. The manning cuts continued, with the 376 SW losing 12 intelligence personnel assigned to ELINT branch as well as others assigned to target intelligence branch, impacting ELINT reporting procedures.<sup>68</sup> These factors, coupled with a decreased interest in the DRV, likely lead to the decline of COMBAT APPLE missions towards the end of 1971, with only 109 missions flown in the last three months of the year. The turn of the year was not better, with only 104 sorties flown for the first three months of 1972—though this would soon change. The PAVN launched a major attack across the Demilitarized Zone (DMZ) into the RVN on March 30, 1972. The JCS responded by directing attacks against logistics targets in the southern portion of the DRV starting on April 2. The bombing area drifted incrementally northward until May 9, when Operation LINEBACKER was initiated against DRV ports and industrial targets. This bombing campaign continued until October 23 when it was suspended in hopes of keeping the Paris peace talks moving.

### LINEBACKER

Concurrent with the bombing campaign, in April 1972 SAC increased the orbit time of COMBAT APPLE sorties to permit 12 hours daily in the Tonkin Gulf; sometime in the intervening years it had been shortened. As the total flight hours for the 82 SRS were not increased, time allot-

ted to the Laotian orbit was reduced. In late April and early May, COMBAT APPLE missions detected a substantial increase in SA-2 signals from the DRV as well as the possible deployment of a new SAM system. In order to obtain data about these new threats, on May 12 HQS SAC changed the COMBAT APPLE collection plan to concentrate solely against threat emitters. The RC-135M continued at its pace of two missions per day, supported by six RC-135M aircraft at Kadena AB—though at times due to depot work the number of airframes would dip to five - with a concurrent drop to fifty operational and ten training sorties per month.

An RC-135C became available for tasking because of a suspension of operations against the USSR for a pending visit by President Nixon. At the request of the Defense Intelligence Agency and NSA, the JCS tasked SAC to deploy an ELINT aircraft to help with collection under Operation BUSY PENNY, SAC OpOrd 60-72-12. On May 18, 1972 an RC-135C deployed to Kadena AB and flew two missions, concentrating on nine specific radars north of Hanoi and Haiphong. This aircraft was replaced by an RC-135U (COMBAT SENT I) on May 22, which searched for new threat radars as well as gathered precise signal measurements against a variety of early warning radars. COMBAT SENT I was the first of three RC-135C aircraft modified for scientific and technical ELINT collection by E-Systems, Inc. of Greenville, TX in 1971. The RC-135U flew four missions in the Gulf of Tonkin before the aircraft redeployed to Offutt AFB on June 1.<sup>69</sup> Later that summer an RC-135C deployed to Kadena for a planned BURNING PIPE peripheral reconnaissance mission. In August 1972 the RC-135C was again tasked under BUSY PENNY to target new surface to air missile signals in the Route Package 6 region of the DRV. Eight BURNING PIPE sorties in the Western Pacific were cancelled to enable seven BUSY PENNY sorties to be flown in the Gulf of Tonkin between 6 and 23 August 1972.<sup>70</sup>

Operation LINEBACKER concluded on October 23. By November 1972, RC-135Ms were flying daily Gulf of Tonkin missions on the new F710 track, a dog leg orbit up into the Gulf from DMZ to off of Haiphong, from 8 PM to 8 AM local time and ten missions per month in F711 (a parallelogram south of the DMZ) from 5 AM to 5 PM local time. The orbit over Laos had apparently been dropped. The Priority 1 ELINT search requirement for EWOs of the 82 SRS was threat radars with Priority 2, a tasking from the PACOM ELINT Center, being the identification and location of ground control intercept radars.<sup>71</sup>

### The Eleven Days of Christmas

On November 30, CINCPAC Admiral Noel Gayler informed subordinate units there was a strong possibility bombing against the DRV would renew in the near future. At HQS SAC, the 544 Aerospace Reconnaissance Technical Wing's Analysis Division reviewed its DRV electronic order of battle and prepared to take rapid updates from data gathered by future COMBAT APPLE and U-2 OLYMPIC TORCH missions. The new operation, named LINE-



RC-135C serial number 64-14842 parked at an unknown airfield. Even after the arrival of the RC-135M aircraft at Kadena AB for the COMBAT APPLE mission, the RC-135C still played a critical role in helping identify new and modified radar signals emanating from North Vietnam in 1968 and 1969. The RC-135C would be called for one final time to Southeast Asia in 1972 to support Operation LINEBACKER. (HQ SAC via Bill Strandberg.)

BACKER II, was initially restricted by President Richard Nixon to three days. Based on their understanding of the threat from LINEBACKER, SAC's plan called for all tasked B-52s to approach Hanoi at night in three distinct waves; COMBAT APPLE mission planning would take this into account. Prior to the beginning of the operation, the SRC directed Eighth Air Force and the 376 SW to reduce reconnaissance missions requiring refueling support from Kadena AB-based KC-135s in order to enable the tankers to concentrate on refueling B-52s and the RC-135Ms.

During LINEBACKER II, the COMBAT APPLE crews would provide direct threat warning of SAM and MIG threats to airborne aircraft via secure UHF radio.<sup>72</sup> Supporting SAC SIGINT collection missions were SAC U-2s, tasked with providing 9-10 hours of SIGINT collection over the Gulf of Tonkin on Route Z-108.<sup>73</sup> The concept of providing direct threat warning to fighter aircraft was far from the SAC mission but proved the flexibility brought on by experienced crews with solid training. Throughout the operation, COMBAT APPLE flew a consistent schedule of one day of missions in both tracks F710 and F711, followed by two days of single missions in F710. The double days started on December 16 and continued on the December 19, 22, 25 and 28. One noticeable change was the extension of the daily mission, usually flown at 8 PM to 8 AM local time, to 7 PM to 7 AM local time at the request of Seventh Air Force to better support strike operations.

Stimulated by the waves of B-52s flying over Hanoi, the DRV air defenses came alive. On December 18, the first night of LINEBACKER II, COMBAT APPLE EWOs noted heavy DRV radar activity. The second night brought slightly reduced activity, half of which was the T-8209, a new India-band radar thought to be SAM associated. By the third night, December 20, during peak periods of US activity COMBAT APPLE EWOs were reporting thirteen search radars, six AAA fire control radars, and two SAM



The RB-47H introduced SAC SIGINT to the Gulf of Tonkin via brutally long twelve hour missions from Yokota AB, Japan as early as January 1960. RB-47H-1-BW serial number 53-6245 is seen parked on the ramp at an unknown airfield, likely Forbes AFB, Kansas, then home of the 55 SRW. (HQS SAC via Bill Strandberg)

radars active at the same time. While on station in the Gulf of Tonkin, the RC-135M pilots reported seeing SAMs fired in the distance followed by an explosion, likely associated with the shoot down of B-52G Quilt 03. With heavier than anticipated bomber losses, SAC struggled through the first three days before changing tactics for the fourth night when it became apparent the air campaign was going to continue beyond its initial timeline.

December 21 witnessed another intense electronic barrage of active radars and US jamming along with the reappearance of the new T-8209 signal. COMBAT APPLE pilots again witnessed SAM detonations, fireballs and surface explosions associated with the demise of B-52Ds Scarlet 03 and Blue 01. As strike times started to shift, Seventh Air Force requested the COMBAT APPLE missions times adjust accordingly resulting in a 14 hour station time on December 23 and a 13 hour time on track on December 24. Though a 36 hour bombing halt was in effect over Christmas, the 376 SW flew its two required RC-135M sorties, though EWOs recorded minimal radar activity as the VPAF had no targets to shoot at. Post-Christmas the bombing campaign plodded on, with RC-135M pilots witnessing more SAM launches and explosions and EWOs furiously copying signals.

On December 27, CINCPAC notified HQS SAC that the ELINT collectors supporting LINEBACKER II were overloaded and requested BURNING PIPE/BUSY PENNY missions to be flown during strikes to help improve collection in the extremely dense signal environment. CINCPAC also requested SAC accelerate a COMBAT SENT deployment scheduled for February 1973. Within hours of receipt of the message, HQS SAC tasked the 55 SRW with immediate double phase inspections of

the aircraft that would deploy and identification of two crews for deployment. Though it was determined that it was neither beneficial nor practical to advance the deployment date of the COMBAT SENT, the RC-135C deployed the afternoon of December 28, spurred on by tasking from the JRC. The RC-135C had left town with tasking emphasis on chasing the now ubiquitous T-8209 signal that had been operational during all strikes since December 22. That evening, the COMBAT APPLE crew on orbit over the Gulf of Tonkin noted a reduced signal environment though the pilots witnessed a further eight SAM launches. The second mission, initially tasked to fly in track F711, was diverted to F710 by Seventh Air Force command elements three hours into station time. The next afternoon, December 29, the bombing was scheduled to stop at 2359Z, with overflight north of the 20th parallel restricted to SR-71 and AQM-34L imagery reconnaissance assets after 0000Z. The COMBAT APPLE mission that evening logged few signals as the last B-52 bombing missions provoked minimal electronic response though seven SAM launches were visually observed.<sup>74</sup> Even after the bombing halted, the RC-135M crews continued to fly in the Gulf of Tonkin orbit to monitor DRV activity. As LINEBACKER II was wrapping up, the RC-135C that departed Offutt AFB on December 28 arrived at Kadena for additional BUSY PENNY tasking. Eight BUSY PENNY sorties were flown in the Gulf between January 6 and 13, 1973 targeting the T-8209 signal.<sup>75</sup>

## The End

The Paris Peace Accords were signed on January 27, 1973, ending US involvement in the wars in Southeast

Asia. According to the treaty, the United States would stop “all military activities against the territory of the Democratic Republic of Vietnam by ground, air and naval forces, wherever they may be based.”<sup>76</sup> In addition, the United States would “respect the independence, sovereignty, unity and the territorial integrity of Vietnam.” The 82 SRS con-

tinued to fly reconnaissance in the region to help determine DRV compliance with the ceasefire, reducing to a pre-LINEBACKER II tempo from February through June 1973, averaging 37 sorties per month.<sup>77</sup> For SAC SIGINT crews, the Gulf of Tonkin had become just another peripheral reconnaissance mission. ■

## NOTES

1. John Paton Davies, “Two Hundred Years of American Foreign Policy: American and East Asia,” *Foreign Affairs*, January 1977
2. Deputy Chief of Staff, Operations; Director of Plans. OPG 52-2. Feb 1, 1952. Box 30, Entry 337 – Deputy Chief of Staff, Operations: Director of Plans, Executive office, records branch, RG 341, National Archives.
3. Strategic Air Command. History of Strategic Air Command, 1 July 1954 – 30 June 1956, Volume 1. N.d., “Medium Reconnaissance Force” section page numbers redacted. Air Force Historical Research Agency, K416.01 V.1, 1 Jul 54 – 30 Jun 56, Maxwell AFB, AL.; Headquarters USAF. Message to Commander ATRC. Nov 4, 1954. No subject. AFOOP OPS-6-8 Reconnaissance Folder, Box 72, Entry 345 (1954) – Air Force – Operations; Operations subject numeric files, 1954, RG 341, National Archives.
4. 91st Strategic Reconnaissance Squadron, Photo. Unit Historical Report, 1 September through 30 September 1951. N.d., p. 9. Air Force Historical Research Agency, K-SQ-RCN-91-HI, Sep 1951, Maxwell AFB, AL.
5. LeMay to Briggs. Personal message from CG SAC to CG FEAF BC. 28 February 1951. Curtiss LeMay Papers, B9994, Box 197, Manuscript Division, Library of Congress
6. Hays, Geoffrey. Boeing B-50 (Steve Ginter: Simi Valley, 2012), pp. 110-111; Deputy Chief of Staff, Operations; Director of Operations and Commitments Division. Memorandum to Directorate of Requirements. Mar 31, 1954. Subject: RB-50G Aircraft. Box 78, Entry 345 (1954) – Air Force – Operations; Operations subject numeric files, 1954, RG 341, National Archives; Strategic Air Command. History 1 July – 31 December 1956, Volume 1. N.d. Air Force Historical Research Agency, K416.01, Jul-Dec 1956, Maxwell AFB, AL.; Strategic Air Command. History 1 January 1957 – 30 June 1957, Volume 1. N.d. Air Force Historical Research Agency, K416.01-68, Jan - Jun 1957, Maxwell AFB, AL.
7. 55th Strategic Reconnaissance Wing. History, July-August 1960. N.d. Air Force Historical Research Agency, IRIS 451024, Maxwell AFB, AL.
8. 55th Strategic Reconnaissance Wing. History, January 1960. N.d. Air Force Historical Research Agency, IRIS 451018, Maxwell AFB, AL.
9. Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 100A. 15 April 1966, pp. 5-6. FOIA to ACC/HO by Robert Hopkins; Historical Study No. 99A. 8 October 1965, p.1. FOIA to ACC/HO by Robert Hopkins.
10. Pedlow, Gregory and Welzenbach, Donald. “The CIA and the U-2 Program, 1954-1974,” p. 221. Center for the Study of Intelligence, Central Intelligence Agency, 1998. Redacted copy, available at CIA FOIA Reading Room; Chairman, Committee on Overhead Reconnaissance. Memorandum for Col James E. Mahon, Joint Chiefs of Staff. X November 1960. Subject: Photographic Coverage of Laos-North Vietnam. CIA FOIA Reading Room, CIA-RDP79B01709A002300010007-0.
11. Robert Futrell, *The United States Air Force in Southeast Asia: The Advisory Years to 1965*, (Washington: US Government Printing Office, 1981), 75.
12. Air Command and Staff College. Air University Designated Study #7 – Volume III, Reconnaissance. 15 June 1968. Air Force Historical Research Agency, K239.0321-7 V.3 C.1, IRIS 1103688,

Maxwell AFB, AL; Dean, Joseph L. Project CORONA HARVEST, 1 March 1964 – 30 August 1967. 22 September 1967. 6988 Security Squadron, United States Air Force Security Service. Vietnam/Southeast Asia Collection, Box 1, CORONA HARVEST 64-67 folder, National Security Archive.

13. Johnson’s decision to “go big” in Vietnam was a turning point in the war; his reluctance to immerse himself into the details of what would become the defining event of his administration was due to his interests in domestic affairs and penchant for listening to those who agreed with him. His principal advisors in the area, Secretary of Defense McNamara, Secretary of State Rusk and State Department planner Walt Rostow, paid little attention to the counsel of Ambassador Maxwell Taylor and DCI John McCone and promised Johnson a positive outcome of events. See Harold Ford’s Episode 2 in *CIA and the Vietnam Policymakers: Three Episodes, 1962-1968*, (Langley: Center for the Study of Intelligence, 1997) for more details.

14. Earl Tilford, *Setup: What the Air Force Did in Vietnam and Why*, (Washington: US Government Printing Office, 1991), 81.

15. 05 Jun 1972 Interview with Lt Gen Gordon A. Blake, USAF (Ret.); NSA Gulf of Tonkin History of Southeast Asia

16. Air Command and Staff College. Air University Designated Study #7 – Volume III, Reconnaissance. 15 June 1968. Air Force Historical Research Agency, K239.0321-7 V.3 C.1, IRIS 1103688, Maxwell AFB, AL; Dean, Joseph L. Project CORONA HARVEST, 1 March 1964 – 30 August 1967. 22 September 1967. 6988 Security Squadron, United States Air Force Security Service. Vietnam/Southeast Asia Collection, Box 1, CORONA HARVEST 64-67 folder, National Security Archive.

17. Defense Technical Information Center, *Project RED BARON II, Air-Air Encounters in Southeast Asia, Volume 1, Overview of the Report*, Report, January 1970, A-1.

18. Department of the Navy, Fleet Air Reconnaissance Squadron ONE, *VQ-1 Unit History, 1 April 1964 – 30 September 1964*, 2.

19. Istvan Toperczer, *MiG-17 and MiG-19 Units of the Vietnam War* (Botley: Osprey Publishing, 2001), 12; 55th Strategic Reconnaissance Wing. Quarterly History, April-June 1965, Vol I. N.d. Air Force Historical Research Agency, IRIS 451076, Maxwell AFB, AL.; 55th Strategic Reconnaissance Wing. Quarterly History, October-December 1964, Vol I. N.d. Air Force Historical Research Agency, IRIS 451070, Maxwell AFB, AL.

20. 55th Strategic Reconnaissance Wing. Quarterly History, October-December 1964, Vol II. N.d. Air Force Historical Research Agency, IRIS 451071, Maxwell AFB, AL.; 55th Strategic Reconnaissance Wing. Quarterly History, January-March 1965, Vol I. N.d. Air Force Historical Research Agency, IRIS 451073, Maxwell AFB, AL.; Dean, Joseph L. Project CORONA HARVEST, 1 March 1964 – 30 August 1967. 22 September 1967. 6988 Security Squadron, United States Air Force Security Service, p. 11. Vietnam/Southeast Asia Collection, Box 1, CORONA HARVEST 64-67 folder, National Security Archive.

21. 55th Strategic Reconnaissance Wing. History, July-September 1964, Volume I. N.d. Air Force Historical Research Agency, IRIS 451067, Maxwell AFB, AL.

22. Alfred Price, *History of Electronic Warfare, Volume III*, (Washington: Association of Old Crows, 2000), 15. Cited hereafter as “Price, Vol III”

23. Burch, Robert. Project CHECO Report: Tactical Electronic

Warfare Operations in SEA – 1962-1968. Pacific Air Forces. 10 February 1969, p.27. Call # 717.0413-51. Air Force Historical Research Agency, Maxwell AFB, AL.

24. Moore, Courtland. EB-66C Out of Country Electronic Reconnaissance. Air University. Report. 1968, p. 19. Call # K239.042-3655, Air Force Historical Research Agency, Maxwell AFB, AL

25. Moore, Courtland. EB-66C Out of Country Electronic Reconnaissance. Air University. Report. 1968, p. 20. Call # K239.042-3655, Air Force Historical Research Agency, Maxwell AFB, AL

26. 55th Strategic Reconnaissance Wing. Quarterly History, October-December 1964, Vol II. N.d. Air Force Historical Research Agency, IRIS 451071, Maxwell AFB, AL.; 55th Strategic Reconnaissance Wing. Quarterly History, January-March 1965, Vol I. N.d. Air Force Historical Research Agency, IRIS 451073, Maxwell AFB, AL.; 4157th Strategic Wing. History, Oct-Dec 1964. N.d. Air Force Historical Research Agency, K-WG-4157-HI, IRIS 461113, Maxwell AFB, AL.

27. Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 99A. 8 October 1965, p.16. FOIA to ACC/HO by Robert Hopkins; Robert Hopkins, *The Boeing KC-135 Stratotanker: More than a Tanker* (Manchester, UK: Crecy Publishing, 2017), p. 244

28. Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 100A. 15 April 1966, p. 27. FOIA to ACC/HO by Robert Hopkins.

29. 55th Strategic Reconnaissance Wing. Quarterly History, October-December 1965. N.d. Air Force Historical Research Agency, IRIS 451080, Maxwell AFB, AL.; 4252nd Strategic Wing. History, April-June 1967, Volume 1. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461381, Maxwell AFB, AL.

30. William Wagner. Lightning Bugs and other Reconnaissance Drones (Fallbrook: Aero Publishers, Inc, 1982), p. 46; Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 100A. 15 April 1966, p. 31. FOIA to ACC/HO by Robert Hopkins.

31. Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 99A. 8 October 1965, pp. 29-35. FOIA to ACC/HO by Robert Hopkins; 55th Strategic Reconnaissance Wing. Quarterly History, January-March 1965, Vol I. N.d. Air Force Historical Research Agency, IRIS 451073, Maxwell AFB, AL.; 55th Strategic Reconnaissance Wing. Quarterly History, April-June 1965, Vol I. N.d. Air Force Historical Research Agency, IRIS 451076, Maxwell AFB, AL.; William Wagner. Lightning Bugs and other Reconnaissance Drones (Fallbrook: Aero Publishers, Inc, 1982), p. 48

32. 55th Strategic Reconnaissance Wing. Quarterly History, July-September 1965, Vol I. N.d, pp. 15-16. Air Force Historical Research Agency, IRIS 451078, Maxwell AFB, AL.; 55th Strategic Reconnaissance Wing. Quarterly History, October-December 1965. N.d. Air Force Historical Research Agency, IRIS 451080, Maxwell AFB, AL; 55th Strategic Reconnaissance Wing. Quarterly History, April – June 1966. N.d. Air Force Historical Research Agency, IRIS 451082, Maxwell AFB, AL.; Col Marvin Morss. AFHRA Interview about RC-135M operations in Vietnam, 1966-1967. 1 November 1968. Air Force Historical Research Agency, K239.0512-393 Reel 1, IRIS 904393, Maxwell AFB, AL.; Office of Special Activities, CIA. Memorandum for Record. Subject: LONG ARM Drone Modifications. 19 August 1965. CIA FOIA Reading Room; Alfred Price, *The History of US Electronic Warfare*, Volume III, (Washington: Association of Old Crows, 2000), pp. 57-59; Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 100A. 15 April 1966, pp. 31-32. FOIA to ACC/HO by Robert Hopkins.

33. 55th Strategic Reconnaissance Wing. Quarterly History, October-December 1966, Volume 2. N.d. Air Force Historical Research Agency, IRIS 451085, Maxwell AFB, AL.; 55th Strategic Reconnaissance Wing. Quarterly History, April – June 1967, Volume 2, Appendix I. N.d. Air Force Historical Research Agency, IRIS 1106980, Maxwell AFB, AL.

34. 55th Strategic Reconnaissance Wing. Quarterly History,

April – June 1967, Volume 1. N.d. Air Force Historical Research Agency, IRIS 451086, Maxwell AFB, AL.

35. Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 99A. 8 October 1965, pp. 21-22. FOIA to ACC/HO by Robert Hopkins.

36. 55th Strategic Reconnaissance Wing. Quarterly History, April – June 1967, Volume 2, Appendix I. N.d. Air Force Historical Research Agency, IRIS 1106980, Maxwell AFB, AL.

37. 55th Strategic Reconnaissance Wing. Quarterly History, April – June 1967, Volume 1. N.d. Air Force Historical Research Agency, IRIS 451086, Maxwell AFB, AL.

38. Air Command and Staff College. Air University Designated Study #7 – Volume III, Reconnaissance. 15 June 1968. Air Force Historical Research Agency, K239.0321-7 V.3 C.1, IRIS 1103688, Maxwell AFB, AL; Dean, Joseph L. Project CORONA HARVEST, 1 March 1964 – 30 August 1967. 22 September 1967. 6988 Security Squadron, United States Air Force Security Service. Vietnam/Southeast Asia Collection, Box 1, CORONA HARVEST 64-67 folder, National Security Archive.

39. Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 99A. 8 October 1965, pp. 24. FOIA to ACC/HO by Robert Hopkins.

40. Air Command and Staff College. Air University Designated Study #7 – Volume III, Reconnaissance. 15 June 1968. Air Force Historical Research Agency, K239.0321-7 V.3 C.1, IRIS 1103688, Maxwell AFB, AL; Dean, Joseph L. Project CORONA HARVEST, 1 March 1964 – 30 August 1967. 22 September 1967. 6988 Security Squadron, United States Air Force Security Service. Vietnam/Southeast Asia Collection, Box 1, CORONA HARVEST 64-67 folder, National Security Archive.

41. Headquarters Strategic Air Command. Reconnaissance: History of SAC, Jan-Jun 1965; Historical Study No. 100A. 15 April 1966. FOIA to ACC/HO by Robert Hopkins.

42. Col Marvin Morss. AFHRA Interview about RC-135M operations in Vietnam, 1966-1967. 1 November 1968. Air Force Historical Research Agency, K239.0512-393 Reel 1, IRIS 904393, Maxwell AFB, AL.

43. Dean, Joseph L. Project CORONA HARVEST, 1 March 1964 – 30 August 1967. 22 September 1967. 6988 Security Squadron, United States Air Force Security Service, pp. 36-37. Vietnam/Southeast Asia Collection, Box 1, CORONA HARVEST 64-67 folder, National Security Archive.

44. 4252d Strategic Wing (SAC). 1-31 March 1969 Narrative and Supporting Documents. Call # K-WG-4252-HI. Air Force Historical Research Agency, Maxwell AFB, AL; Strategic Air Command. History of SAC Reconnaissance Operations, FY 72; Historical Study No. 125, Vol I. 18 April 1974. Call # K416.01-125 V. 1. Air Force Historical Research Agency, Maxwell AFB, AL.

45. 4252nd Strategic Wing. History Narrative and Supporting Documents, November 1967. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461391, Maxwell AFB, AL; 4252nd Strategic Wing. History Supporting Documents, December 1967. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461393, Maxwell AFB, AL.

46. 4252nd Strategic Wing. History Narrative, Volume I, February 1968. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461396, Maxwell AFB, AL.

47. 4252nd Strategic Wing. History Narrative, Volume I, June-August 1968. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461403, Maxwell AFB, AL.

48. Col Marvin Morss. AFHRA Interview about RC-135M operations in Vietnam, 1966-1967. 1 November 1968. Air Force Historical Research Agency, K239.0512-393 Reel 1, IRIS 904393, Maxwell AFB, AL.

49. 4252nd Strategic Wing. History Narrative and Supporting Documents, March 1968. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461399, Maxwell AFB, AL.

50. 4252nd Strategic Wing. Narrative and Supporting Documents, Vol I, December 1968. N.d. Air Force Historical Research Agency, IRIS 461412, Maxwell AFB, AL.

51. History and Research Division, Headquarters Strategic Air Command. History of SAC Reconnaissance, July-December 1967. September 1968. Air Force Historical Research Agency, IRIS 1118700, Maxwell AFB, AL.; 4252nd Strategic Wing. History Narrative and Supporting Documents, January 1968. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461394, Maxwell AFB, AL.
52. 4252nd Strategic Wing. History Narrative, Volume I, February 1968. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461396, Maxwell AFB, AL.
53. Bailey, Bruce. "The RB-47 & RC-135 in Vietnam." Unpublished, 1995.
54. Col Marvin Morss. AFHRA Interview about RC-135M operations in Vietnam, 1966-1967. 1 November 1968. Air Force Historical Research Agency, IRIS 904393, Maxwell AFB, AL; Maj Richard Scuderi. AFHRA Interview about RC-135C operations in Vietnam, 1968. 29 September 1970. Air Force Historical Research Agency, IRIS 904408, Maxwell AFB, AL; 4252nd Strategic Wing. History Supporting Documents, Vol VI, July-September 1969 (IRIS 461429), History, October 1969, Volume I, III (IRIS 461430, 461432), History Narrative, February 1969 (IRIS 461417/461418), History Narrative, March 1969 (IRIS 461420/461421), History Supporting Documents, April - June 1969 (IRIS 461423); all Air Force Historical Research Agency, Maxwell AFB, AL.
55. 4252nd Strategic Wing. History Supporting Documents, Vol I-II, January 1969; History, October 1969, Volume I – Narrative and Appendices. N.d. Air Force Historical Research Agency, IRIS 461414-15, 461430, Maxwell AFB, AL.
56. 4252nd Strategic Wing. History Supporting Documents, Vol II, October 1968. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461409, Maxwell AFB, AL.
57. Special Assistant for Vietnam Affairs, Central Intelligence Agency. Memorandum for Dr. Henry Kissinger, Assistant to the President for National Security Affairs. 18 July 1968. Subject: Intensified Collection Program Targeted Against the Logistics Network Used by North Vietnam to Support Communist Activity in South Vietnam. CIA FOIA Reading Room, CIA-RDP80T01719R000300080002-2; Deputy Director, Central Intelligence Agency. Memorandum for Chairman, Critical Collection Problems Committee of USIB. 16 August 1968. Subject: Intelligence Contingency Planning for Vietnam Theater. CIA FOIA Reading Room, CIA-RDP79M00098A000300040031-1.
58. 4252d Strategic Wing (SAC). 1-30 September 1968 Narrative and Supporting Documents. Call # K-WG-4252-HI. Air Force Historical Research Agency, Maxwell AFB, AL.
59. Col Marvin Morss. AFHRA Interview about RC-135M operations in Vietnam, 1966-1967. 1 November 1968. Air Force Historical Research Agency, K239.0512-393 Reel 1, IRIS 904393, Maxwell AFB, AL.
60. 4252d Strategic Wing (SAC). 1-31 March 1969 Narrative and Supporting Documents. Call # K-WG-4252-HI. Air Force Historical Research Agency, Maxwell AFB, AL; Col Marvin Morss. AFHRA Interview about RC-135M operations in Vietnam, 1966-1967. 1 November 1968. Air Force Historical Research Agency, K239.0512-393 Reel 1, IRIS 904393, Maxwell AFB, AL.
61. Deputy Director, Central Intelligence Agency. Memorandum for Deputy Director for Intelligence, Deputy Director for Science and Technology, and CIA SIGINT Officer. 4 November 1968. Subject: Intelligence Contingency Planning for the Vietnam Theater. CIA FOIA Reading Room, CIA-RDP71R00510A000300080001-4; Robb Hoover. Interview about RC-135M operations in Vietnam conducted by author, 18 April 2012.
62. 4252nd Strategic Wing. History, 1-30 November 1969, Volume I – Narrative and Appendices. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461433, Maxwell AFB, AL.
63. 4252nd Strategic Wing. History Narrative and Supporting Documents, September 1968. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461406, Maxwell AFB, AL.
64. Rivet Brass entry, Intelligence Resource Program, Federation of American Scientists. Available at [https://fas.org/irp/program/collect/rivet\\_brass.htm](https://fas.org/irp/program/collect/rivet_brass.htm), accessed 6 Oct 2018; 4252nd Strategic Wing. History, October 1969, Volume 1 – Narrative and Appendices. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461430, Maxwell AFB, AL; 4252nd Strategic Wing. Supporting Documents, Vol II, December 1968. N.d. Air Force Historical Research Agency, IRIS 461413, Maxwell AFB, AL.
65. 4252nd Strategic Wing. History, 1 January – 31 March 1970, Volume I – Narrative and Appendices. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461440, Maxwell AFB, AL.
66. 4252nd Strategic Wing. History, 1-31 December 1969, Volume I – Narrative and Appendices; History, 1 January – 31 March 1970, Volume I – Narrative and Appendices. N.d. Air Force Historical Research Agency, K-WG-4252-HI, IRIS 461436 & 461440, Maxwell AFB, AL.
67. Hanyok, Robert. Spartans in Darkness: American SIGINT and the Indochina War, 1945-1975. National Security Agency, 2002, pp. 265-266. Declassified/redacted version downloaded from NSA FOIA webpage.
68. 376th Strategic Wing. History, 1 October – 31 December 1970, Volume II – Supporting Documents. N.d. Air Force Historical Research Agency, IRIS 456846, Maxwell AFB, AL.
69. Strategic Air Command. History of SAC Reconnaissance Operations, FY 72; Historical Study No. 125, Vol I. 18 April 1974. Call # K416.01-125 V. 1. Air Force Historical Research Agency, Maxwell AFB, AL.
70. Strategic Air Command. History of SAC Reconnaissance Operations, FY 72; Historical Study No. 125, Vol I. 18 April 1974. Call # K416.01-125 V. 1. Air Force Historical Research Agency, Maxwell AFB, AL; History Division, Headquarters Strategic Air Command. History of SAC Reconnaissance Operations, FY 73. Historical Study No. 127. 15 November 1974. FOIA to ACC/HO by Robert Hopkins
71. History Division, Headquarters Strategic Air Command. History of SAC Reconnaissance Operations, FY 73. Historical Study No. 127. 15 November 1974. FOIA to ACC/HO by Robert Hopkins
72. History Division, Headquarters Strategic Air Command. History of SAC Reconnaissance Operations, FY 73. Historical Study No. 127. 15 November 1974. FOIA to ACC/HO by Robert Hopkins
73. Hanyok, Robert. Spartans in Darkness: American SIGINT and the Indochina War, 1945-1975. National Security Agency, 2002, pp. 273-275. Declassified/redacted version downloaded from NSA FOIA webpage.
74. Strategic Air Command. Project CORONA HARVEST V, 1 July 1972 – 15 August 1973. Volume I, Appendix A, LINE-BACKER II – SAC Operations. Call # K416.041-13, IRIS 1103578. Air Force Historical Research Agency, Maxwell AFB, AL.
75. History Division, Headquarters Strategic Air Command. History of SAC Reconnaissance Operations, FY 73. Historical Study No. 127. 15 November 1974. FOIA to ACC/HO by Robert Hopkins
76. Agreement on Ending the War and Restoring Peace in Vietnam (Paris, 27 January 1973); hosted on CVCE.eu by l'Université du Luxembourg. Accessed 23 May 2018. Available at: [https://www.cvce.eu/content/publication/2001/10/12/656ccc0d-31ef-42a6-a3e9-ce5ee7d4fc80/publishable\\_en.pdf](https://www.cvce.eu/content/publication/2001/10/12/656ccc0d-31ef-42a6-a3e9-ce5ee7d4fc80/publishable_en.pdf)
77. Executive Secretary, Committee for Imagery Requirements and Exploitation (COMIREX). Meeting Minutes for COMIREX-M-203. 18 April 1974. CIA FOIA Reading Room, CIA-RDP79B01709A001300020001-5; History Division, Headquarters Strategic Air Command. History of SAC Reconnaissance Operations, FY 73. Historical Study No. 127. 15 November 1974. FOIA to ACC/HO by Robert Hopkins

# An Attempt to Bring Home F1t Off Bruce F. Jepson



Flight Officer Bruce F. Jepson of the 529th Fighter Squadron.

Jon A. Reynolds

The U.S. Embassy Beijing in the spring of 1984 was focused on the pending arrival of President and Mrs. Ronald Reagan and party on April 22d. I too was a first time visitor to China that spring, arriving in Beijing with my family three weeks before the President. As one who was a relative newcomer to an Embassy, the Department of State, and the world of the diplomat, I was tangentially aware of the internal turmoil which had transpired during the first two years of the Reagan administration concerning China. The main problem confronting President Reagan during his first term was American arms sales to Taiwan, which the People's Republic of China (PRC) bitterly opposed. Vice-President George H. W. Bush and then Secretary of State Alexander Haig and other major figures within the administration had argued along Nixon/Kissinger lines in support of the PRC and limiting arms sales to Taiwan. They had ultimately negotiated a communique with China to that effect. Reagan was opposed to the policy and the Communique. Later, he unilaterally and secretly wrote his personal interpretation of the policy in which he stated that if China in fact upgraded its military capabilities, the U.S. would help Taiwan match those improvements. He was determined to maintain a balance of forces and power in the Taiwan Strait, and his memorandum on the issue was kept under lock and key.

The People's Republic of China was the first communist country Reagan visited. While the visit was long on symbolism and short on substance, he surprisingly used his brief stay to seek cooperation from the PRC in thwarting Soviet adventurism. No solid agreement was obtained, but a foundation for limited military cooperation was discussed and as is so often the case in China, such a program slowly evolved and took on a life of its own. The arms to Taiwan issue did not go away, but was put on a back burner by both nations so they might move ahead on other issues, not the least of which were commercial and technological in nature. It was an exciting period which infected the entire embassy at all levels. Mao was dead, Deng Xiao Ping was a new face determined to lead China into a new era. One needed only to look at the solemn and unsmiling faces of senior Chinese military figures, many seeing Americans for the first time since the Korean War, to know there would be problems. But optimism reigned. The prospect of participating in developing a new U.S./PRC military relationship was attractive. As a member of the Embassy, I would have a ringside seat. Who knew what the future held?

In late 1984, China's Ministry of Foreign Affairs (MFA) invited me to visit their offices to discuss "an act of humanity of great importance." This was a highly unusual summons from the Chinese side. The normal channel of communication between the active duty military officers in U.S. Embassy Beijing and the Chinese government in the 1980's was through the Foreign Affairs Bureau of the Ministry of Defense. Members of FAB, as it was known, were Chinese military officers who spoke varying degrees of English and whose prime responsibilities at that time included the collection of intelligence



Flight Officer Bruce F. Jepson of the 529th Fighter Squadron.

and the authority as the single point of contact between the U.S. and PRC military. With few exceptions, they were difficult to deal with, whether the business at hand involved a simple dinner invitation for one or more Chinese guests, or obtaining permission to travel within China. For all invitations, they expected to be included, for all travel, whether domestic or international, they expected to be advised. This changed in time, but in 1984, FAB was one level of bureaucracy designed to control and limit U.S. military and Chinese contacts. Hence, in that the MFA had either cleared my visit with FAB or had simply ignored it, I wasn't sure, but I was eager to see what the MFA had in mind. My personal guideline, developed during many years in the Far East was firmly embedded in my consciousness—be very wary of unexpected gifts.

Ambassador Ni Yaoli and his assistant Mr. Liu Xiaoming greeted me in an informal meeting room within the corridors of the MFA. Ambassador Ni was a long-term senior

*Brigadier General Jon A. Reynolds retired as assistant deputy director for attaches for the Defense Intelligence Agency. After receiving a bachelor's degree in engineering from Trinity College in 1959, he was commissioned through the ROTC program, and entered active duty that year. He received pilot training in F-100s and later F-105s, which he was flying when shot down in 1965 over North Vietnam. He spent eight years as a POW, returning in February 1973. After a variety of staff positions, General Reynolds was air attache and then defense/air attache to the People's Republic of China from April 1984 to January 1988. He later became the military assistant to the secretary of the Air Force, prior to his last assignment. His unique background provided an interesting perspective on the events in this narrative.*

diplomat of China who was preparing for a new post, the details of which he did not share. Mr. Liu was a new Foreign Service Officer, recently married and a 1983 graduate of the Fletcher School of Law and Foreign Affairs at Tufts University. I had met him the preceding spring, and he impressed me as intelligent, polished, suave, debonair, and capable. Tall and handsome, speaking fluent English, he should have an exceptional career ahead of him. I was curious as to why I had been invited to MFA—the domain of the professional diplomats.

My Chinese hosts told me a remote village in Shanxi Province, nearly 300 miles southwest of Beijing, had the remains of an American World War II pilot who had crashed near their village. In a gesture of friendship to the United States during this new period in U.S.-China relations, they would like to return his remains to America. Was I interested? The Ambassador asked the question with an absolutely straight face. I weighed the possibilities. Was it a trick, a plant, was he really an American? No matter, why not jump in.

"Yes," I replied. "I am interested." They offered no additional details concerning the downed pilot except that he crashed in Shanxi Province in the spring of 1945, and that MFA would proceed to make necessary arrangements for the transfer of the pilot's remains. Ambassador Ni continued, "We consider this a very special and important gesture on behalf of the Chinese people, and especially on the part of the villagers. We the Foreign Affairs Ministry will help as much as we can to make the villagers request a success, and we will tell you when to make the necessary travel plans. The small and very poor village is in a remote area still closed to foreigners, but we will work with the local political cadres and regional magistrate and give you additional information later."

The meeting ended, I thanked them once again for their willingness to participate in this act of kindness and again stressed the importance of such a humanitarian action to the U.S. Government. They confirmed again that they did not know the name of the pilot or have any additional information. As I returned to the Embassy I concluded that their promises were unlikely to be fulfilled, and that I probably would not have the opportunity to return the remains of the fallen airman to his home and family. Would they give me a coffin with the pilot's remains, suitable to be wrapped in an American flag? Not likely, the peasant villages in the closed areas were below the poverty level. It was too much of a long shot, and I disciplined myself not to get excited about it. Ambassador Hummel had once told me, "Take Chinese words with caution, more often than not they will disappoint you." Still, there was the notion, in China one can never be sure. In my own experience during my first nine months in China, U.S. Air Force Headquarters in the Pentagon had arranged a flight for a Chinese test pilot in the back seat of a T-38 jet trainer as part of a technology transfer program. This was no big deal for the U.S. side, but as a senior Chinese officer told me, the flight was of enormous significance to the Chinese—a compelling signal that the U.S. was serious about a US-China military relationship. He reinforced his comments, telling



Flight Officer Bruce F. Jepson of the 529th Fighter Squadron.

me “News of this flight will go not only to the Chinese Air Force, but also to the Central Military Committee.” The flight had been such a major event to the Chinese Air Force, I asked them to give me a similar ride in a two-seat MiG-17 fighter. There was no immediate response, only the inscrutable smile, but three months later General Wang Hai, then Vice-Commander of the PLA Air Force told me that my request had been approved, and I could have the flight at a time of my own choosing. Better sooner than later, and my flight took place shortly thereafter as promised at Shi Jiazhuang, a Chinese Air Force Training Base. I reminded myself of this, perhaps the return of the American pilot’s remains might come to pass. I decided to treat it as a done deal. Full of suspicion, I wanted to avoid a propaganda extravaganza on the part of the Chinese. No doubt they would milk it for all it was worth. However, to me, it was worth a lot.

The U.S. Army’s Central Identification Laboratory in Hawaii (CILHI) was responsible for recovery and identification of Vietnam era KIA/MIA remains as well as remains from Korea and WW II. I sent the office a message detailing my MFA meeting and requested information they might have on downed pilots in Shanxi Province in the spring of 1945. They responded almost immediately, adding that there had been over a hundred aircraft lost in China during the spring of 1945, but most likely the downed pilot was one Bruce F. Jepson. They promised not only to forward all the available data on this case, but also to partic-

ipate in the recovery operation. In fact, they insisted on it. The Central ID Laboratory also advised me that very strict laws controlled the search and recovery of human remains in the international arena, and I needed to inform the Chinese of such. They were anxious to move ahead with the recovery effort, but they would be unable to do so unless the Chinese agreed to follow the strict international procedures. As an example of their interest and enthusiasm in the recovery mission, they included the names of their proposed three man team: Major Joe Harvey, Commander of the Joint Casualty Resolution Center (JCRC), Barbers Point, Hawaii; John E. Webb, USA CILHI, Fort Shafter, HI; and Mr Tadao Furue, also of USA CILHI, a noted civilian anthropologist. I forwarded this information to MFA in my request for visas for the Central Lab team, and the entire operation came to a full stop. The problem was the presence of Mr. Tadao Furue. The MFA did not understand the requirement for an anthropologist, especially one of Japanese ancestry. Chinese animosity toward Japan and the Japanese had not warmed, and Mr. Liu Xiaoming told me the presence of the Japanese member was sufficient to cancel the invitation. “Is it really necessary,” he asked. “Surely there is a qualified American who can satisfy the requirement.” I told him it was necessary, international controls were in place, and he agreed to do what he could.

As promised, the Hawaii team provided additional information concerning the suspected downed pilot. Flight Officer Bruce Jepson of the 529th Fighter Squadron, based near Xian City, had apparently been shot down by Japanese ground fire during a raid on the morning of April 25, 1945. The flight of four P-51 Mustangs of which he was a part had attacked a large rail bridge crossing the Hsi-Nan River. As reported by his flight members, Jepson had been hit while strafing Japanese troops at low level, lost his coolant and then his overheated engine had caught fire, and he crashed near the small village of Dong Guo Cun in the vicinity of the medieval walled city of Ping Yao deep in Shanxi province. The flight had received his distress call and flown back to the crash site but could do little more than circle the burning aircraft. Villagers and Japanese troops in the immediate vicinity had also watched his crippled aircraft crash, burn and explode.

The pilots reported details of their mission and Jepson’s loss upon their return to Xian. Lieutenants Klem, Youngblood and Austin, had watched his aircraft crash and since they had seen no parachute, they concluded he had perished in the crash. The local villagers and Japanese soldiers from their garrison in Ping Yao had gathered at the crash site and watched the burning Mustang and knew the young pilot had been unable to escape the fire. When the flames and exploding ammunition subsided, they were able to get to the blackened cockpit. The dead pilot was badly burned and his flesh had peeled completely away from one hand and foot. The soldiers took everything of value off the corpse, even cutting off his fingers and wrist to take his ring and wristwatch. One soldier, perhaps for a souvenir, ripped off his dog tags. The Japanese ordered the villagers to bury the body in the hole created by the crash, and the next day they brought trucks and carts to remove

the wreckage. On the third day, the villagers noted that dogs had dug at the pilot's grave, which they then exhumed, took his clothing and boots, wrapped his body in cornstalks, and buried him again near the crash site. The presence of Jepson's grave however bothered the villagers and about a month later they exhumed him once again and reburied his body in the village cemetery. This time however, in an extraordinary gesture representative of Chinese villagers aid to American airmen during World War II, the villagers placed him in a crudely built wooden coffin. While Americans knew where Bruce Jepson crashed, they did not know details of his burial, and all his mother Mrs. Edwina Jepson knew for sure was her son was killed in action and his remains were in China.

Jepson was missing, but he and another estimated 3,000 downed pilots and crew members lost across the wide expanse of China during WW II were not forgotten, and the United States set about recovering the remains of American combatants and establishing the status of those missing in action.

On the last day of December 1945, Miss Eva Wang of Tai Yuan City, responded to an ad she had seen in the December 14th issue of the Peiping Chronicle newspaper concerning missing American pilots. She wrote directly to the U.S. search and recovery team based in Peiping that she knew about Jepson, that he had been killed in a forced landing near Ping Yao and that he was buried nearby. To establish her credibility, she told the recovery team she had the "medal" he wore around his neck, and she was eager to return it. On February 11th, Flight Officer Griffin of the recovery team traveled to Tai Yuan to receive the medal and make plans to recover Jepson's remains. They learned the details of his crash and burial from the villagers of Dong Guo Cun, but were unable to recover the remains because of the on-going warfare between Chinese Nationalist and Communist forces in the immediate area. After considerable debate, the recovery team decided to return to Peiping, wait until the political situation had stabilized and then recover his remains. The team returned to Peiping on February 18, 1946. It would be almost forty years to the day until another U.S. team would make another effort to recover Jepson's remains. Several of the villagers of Dong Guo Cun were still in place.

### **The Second Effort to Recover Flight Officer Bruce Jepson's Remains Beijing: 1985**

Within a few weeks of my initial visit, the Ministry of Foreign Affairs sent me the official approvals for the visit of myself and the three man CILHI team to the closed cities of Tai Yuan and Ping Yao. The trip to the long-closed central region of Shanxi Province was already scheduled. We would leave Beijing Central Station on the evening of February 26, and arrive the following morning in Tai Yuan, at which point the official visit would begin. Mr Liu then told me, "You will be accompanied by a State Official, but you will see him only if there is a problem. He will have your official travel approvals, and you will be met by government officials in Tai Yuan." His real message was, follow



The city walls of Ping Yao.

the rules, don't talk to the locals, and there will be no problems. Once again I remembered, in China, controlling the travel of foreigners (especially diplomats) and their contact with local Chinese had always been an issue. Even now, it was still only 1985, and the country in general, and certainly Shanxi province in particular, had been in the dark since 1949. Memories of the Cultural Revolution excesses between 1966 and 1976 were still vivid. In the mid-1980's, Chinese citizens would cross the street to avoid an approaching foreigner, especially an American.

Mr Liu Xiaomin, as he provided details of the pending visit, reminded me once again of the great importance MFA attached to this visit. "Upon your arrival in Tai Yuan you will have a banquet lunch with city officials. After lunch you will drive directly to the gravesite, which is near a small village on the way to the county guest house where you will be staying. At the gravesite you will meet an 'old friend' and visit the tomb of the American pilot. They will arrange for laborers to open the tomb. After you see the remains and the open tomb you will return to the guest house. At 6:00 pm the County Magistrate will host you and your group for dinner. The following morning you can identify and officially accept the remains, which will then be packed for your return trip. You will then return to the guest house for lunch. That afternoon we have arranged a tour for you of the historic city of Ping Yao. It is one of the six famous walled cities of China, and you will be some of the first foreigners to see it since the Revolution. We would also like to take you to the Shuanglin Temple if time permits. That evening the leader of the Foreign Affairs Bureau will host you for an official banquet. The following day we will take you for a tour of Taiyuan, famous for the Jinci Temple, a monastery and several other sites. That evening, we will put you on train no. 288 leaving Tai Yuan at 7:35 pm, scheduled to arrive in Beijing at 6:00 am the following morning."

I had no questions, but thought to myself. Something must have been lost in the translation. Grave site? Tomb?



The city walls of Ping Yao.

Old friend? Pack the remains for the return trip? What were they talking about? But it was occasions such as this which made time in China such a great adventure. Imagine, a trip to an area which had been closed to the outside world for thirty-five years, a village informed only by what they were told on a daily basis by the Central Government. Who was the “old friend” he mentioned, and were they really going to give me a box of bones to carry back to Beijing? Surely not, but with a qualified and responsible anthropologist as part of the American team it seemed unlikely they would fill a coffin with phony remains. I detected ample TV opportunities for the local politicians before and during the scheduled banquets. Banquets were a Chinese specialty, and Chinese politicians and city/state leaders were masters at toasting their guests with the local spirits. The best way to survive these sessions was to follow Chinese protocol and let the host make his welcome greeting, follow him immediately with a return toast, and then drink along with the Chinese side who could be counted upon to turn their attention to the guests visiting China for the first time. Grave site? Tomb? I could hardly wait to see what was planned. I had been in China long enough to be fully prepared for the unexpected, but the events that played out in the days ahead staggered the imagination.

The report Central Identification Lab Hawaii sent me concerning Jepson’s shoot down and the earlier effort to recover his remains I considered proprietary and had no intention of sharing it with the Chinese except on a select basis if necessary. I had enough information to know whether or not the hosts of this promised “act of humanity” were legitimate. The Chinese names of the villagers who had buried Jepson were written in Chinese characters (vice the romanized pinyin) in various documents within the CILHI report, and I saw no reason to illuminate names of Chinese who may have supported Americans during WW II after the excesses of China’s Communist Revolution. My strategy was to take the report with me to the recovery site, and I would share details only if necessary.

The Central Laboratory team arrived in Beijing as planned. Steam powered locomotives were still the rule in China in the mid-1980’s, and most Americans on their first visit enjoyed boarding the train and checking into the assigned double-bunk “soft-seat” compartment. Chinese men smoked, and I could scarcely decide if there was more smoke in the sleeping compartment or near the engine. The hissing locomotive was steaming from every crevice and rivet, but somehow didn’t smell as bad as our passenger compartment, which reeked of years of nicotine. While the chaos at Beijing’s central station was equal to that of any major city which depended on rail as the main form of long distance transportation, precisely at the appointed minute, the brakes released, a huffing and puffing could be heard at the far end of the station, the cars clanked in sequence, and the train moved slowly and gracefully forward. The cars were stuffy, but it was still quite cold in Beijing, and we kept the compartment windows shut. As the train accelerated into the night, I took the CILHI team to the dining car for a late beer. If someone was keeping an eye on us, I didn’t notice. The one benefit of surveillance was the additional security it provided for personal goods, and we left our compartment unlocked. Pilfering was never a problem in China during that era of Communist rule. They would rummage through your apartment during your absence, but they never took anything.

We arrived in Tai Yuan City on schedule, the expected welcoming party greeted us, and after a working lunch with no toasting and not much talk, our hosts took us directly to the village of Dong Guo Cun, near which the “American pilot” had crashed. As we entered the village, the first Americans to have visited the area in over thirty-five years, I noted with interest the assembled inhabitants scarcely acknowledged our presence. Only the children stopped dead in their tracks to gape at us-foreign devils with big noses. They didn’t return smiles, just stared, perhaps the first Caucasians they had ever seen. Dong Guo Cun was a working village, conversation of the unsmiling middle aged women sitting on stools in what was probably a place where the villagers would meet if such was necessary, almost ceased. Surely our visit received advanced notice, but I didn’t see it as a set-up. I really didn’t know what to expect in what was actually the first authentic village I had visited during my first year in China. Barn fowl, pigs, donkeys, goats let their presence be known. The weather was cool, and the smell was actually quite pleasant. Dried corn was hanging from the roofs. One of our handlers gave us a brief introduction, told us how old the village was and wanted to make sure we were aware of the main event which had happened in Dong Guo Cun in the last ten years—the flood of 1977. The village was on a slight knoll, but still one could easily see an unmistakable high water mark about four to five feet above the ground along the sides of all the buildings. I wondered, was someone going to present us with the remains of the American pilot? According to the published schedule, we were to visit the tomb of the American pilot and “laborers” would open it for us.

Almost on cue, Mr. Wang (a fictitious name for the dour head politico of our visit) told us with a flourish, “We will



Villagers at Dong Guo Cun along with the recovery team.

now visit the cemetery where the American pilot is buried.” The graveyard was on the same knoll as the village and only a short walk distant along a sandy path. The path and cemetery were memorable in that every time I dragged my shoe in the loose soil, a bone popped out. There were no real tombstones, some weathered wooden markers, but other than that, it was simply a village grave yard on a sandy knoll probably established several hundred years ago in which the vast majority of the Dong Guo Cun inhabitants had been buried two to three feet below ground level without coffin or marker. People living on the edge who had survived multiple floods and famines and a history of hardships meted out by a severe government were unlikely to go to great lengths in landscaping or tending their village cemetery. I reminded myself at the same time however of the annual Chinese Grave Cleaning Celebration at harvest time with the traditional “moon cakes.” I also remembered how the villagers had buried and reburied Jepson three times.

As we approached the edge of the graveyard, a middle aged man stepped forward. His name was Liu Shenggan. He stretched his hand out in front of his face and pointed to the far side at the edge of the trees and said, “We buried him over there.” I followed his gaze, as did the members of the Hawaii Laboratory team. There were no discernible clues or markings as to a specific site. Almost immediately, a different Mr. Liu exclaimed, “No, he was buried over on this side, pointing ninety degrees further to the south.” Mr. Wang, the local politico, was ready for the imminent fire drill and hastily addressed the assembled villagers. After a few clipped comments, he turned to us and said, “The villagers will meet this evening and decide where the American is buried, and we will proceed with our scheduled plan tomorrow. In the meantime we will give you a tour of sites of interest here in the local area.” I spoke to the CILHI team who were mildly puzzled and had come all the way from Hawaii with the idea they were going to receive the

boxed remains of the downed pilot, and explained what I believed was going on. This was their second visit to China. They were polite and also accustomed to recovering remains of American combatants throughout Asia, to include Burma, Thailand, Japan, Korea, and elsewhere. To these pros, minor hiccups in the process were not a problem.

The morning of February 28 was cool and gray. Perfect, I thought for a visit to a graveyard. Ping Yao City, undergoing considerable restoration at the time, was of enormous historical interest because of its banking and commercial role during the Ming Dynasty. Shanxi is often considered the cradle of the Chinese financing industry, and the early Ping Yao streets were once centers for exchanging money. We walked along the massive ancient wall which surrounded the entire city and as we prepared to go to the next site, a minor temple of little significance, I told Mr. Wang that while we were greatly interested in this famous historical area of China which would soon open to the public, we would like to proceed and recover the remains of the pilot. He told me the villagers were still searching for the grave site. I then asked if one of the villagers had seen the plane crash and might be able to take us to the actual site. With this, he turned to Mr. Liu Shenggan, who again stepped forward and said he had seen the plane crash and could indeed take us to the actual site. I suddenly remembered that this was the man who as a youth was mentioned in the report submitted by Flight Officer Griffin and his China Theater Search Detachment Team No. 1. He had actually helped bury Jepson the first and second times, and his name was prominent in the report that the Central Identification Laboratory had sent to me.

After a short drive, and as we stepped out of the van at the edge of the village, Mr. Liu needed no prompting. He pointed at a small hummock and said “At the time of the crash a small bridge crossed this ditch which is now gone. This is where the plane hit, and this, almost at our feet, is where he was buried the first time.” As a credibility test of sorts, I asked him to tell us details of the whole thing. Confident that he had not read any of the official records concerning the earlier search and recovery efforts, I asked him to start at the beginning. He said he had been a young boy at the time. They frequently saw American planes in the area along the railroad, but he took special notice of this aircraft because its engine was making a different noise, not running smoothly, and trailing black smoke. He repeated the story almost verbatim as to what was in the official report. He continued, pointing with his hands. “The plane was headed in a southerly direction and was coming down slowly. Then the pilot’s ‘window’ flew off, he stood up in the cockpit and the parachute came out and reached to the tail just before he hit the ground.” He described the explosion and the fire and the bullets exploding. The Japanese came and after the fire had cooled they saw the pilot was badly burned. His seat belt was open, and they took his leather flying boots. The next day the Japanese came and the villagers loaded the plane into carts which the Japanese took. To me there was no question as to his authenticity.



The casket begins to emerge from the dirt.

As we stood at the site of the crash, a young boy ran up and whispered something to one of the villagers which was then relayed to Mr. Wang. His entire demeanor changed. I looked at my watch and noted it was approximately 11:00am as he announced “The villagers have found the remains of the pilot, we are now going directly to the graveyard”. My thoughts were to the effect “That’s the cue, right on time, standby for a giant charade.”

I was pleasantly surprised. As we approached the graveyard I could see a sizeable group of villagers was gathering. They were all ages, from young children to the wizened village elders. During the preceding night, by lanterns, a team of villagers had literally dug up the entire hillside upon which the cemetery was sited. The slit trenches, less than two feet deep, crisscrossed the entire length of the graveyard, spaced four or five feet apart, from one end to the other until one of the trenches ended abruptly. I was told that Mr. Liu Shenggan and his friend, another Mr. Liu, had actually discovered the casket earlier that morning. The villagers had simply dug trenches in the sandy loam until one ran into what appeared to be a casket. The earth around it was untouched, and he had stopped digging as soon as the weathered piece of pine became visible. I could scarcely believe this was Jepson’s casket, could it be? At the same time, I wondered what the villagers, superstitious beyond imagination, thought about digging up their ancestors graveyard. I wondered, how many bones had been pushed aside or come to the surface during the night? Many more visitors, from Dong Guo Cun and beyond were quietly collecting around the graveyard. Not much happens in the remote villages of China, where obtaining food and sustenance is a major preoccupation on almost a year-round basis. But this was a major event, and the people were gathering, ones and twos and more, hungrily down to watch. The graveyard however was almost totally silent, the usual banter amongst the peasants and

children playing was not happening. They were all watching, silently, waiting to see what the strange-looking foreigners would do next.

The team from Hawaii knew precisely where to begin and what to do. With Tadao Furue in the lead, they crouched around the site and carefully isolated the four sides of the casket. They then opened their kits, laid out the necessary equipment for exhuming remains and started to do so. They first slowly and carefully removed the sod from above the casket, uncovering the remains of a dog and a six year old child in the process. The wooden top of the casket was missing, apparently rotted away. Furue said this was not unusual except in the driest of terrains. Moisture would seep through the earth, the top would slowly decay, and the casket would fill with dirt. The sides of the casket were still in relatively good shape considering their time underground. Tadao Furue carefully spooned out the dirt. Soon a bone was dislodged, then another, and another, then a button. I looked at the button carefully, thinking it might be an Army Air Forces uniform or flight suit type, but such was not the case. Soon a pelvis emerged, then the bowl of a small broken clay stem pipe—common in China. Finally, after an hour or so of methodically digging out dirt, they found the skull. Now that they had found the skull and the pelvis, the CILHI team with their experienced anthropologist had a brief discussion and asked that I join them. They told me the skeleton which they were exhuming was not a Caucasian, but was that of an Oriental. The bones were those of a male, estimated age late twenties/early thirties, five foot six or so in height, but definitely not a Caucasian. They looked at the gathered villagers, set down their tools and instruments, and continued, “Because of the international restrictions governing our work, and the guidelines under which we operate, we cannot and will not proceed any further.” Their disappointment was obvious, as was their resolution.



The exhumed casket, prior to opening.

The Chinese villagers, now hunkered in a 360 degree circle around the casket, were without expression, absolutely silent. Since the visiting Americans had stopped work and were talking to me and one another, Mr. Wang slowly approached to find out what was going on. I explained to him, "The remains of the person we are exhuming are not those of a Caucasian, not an American, but are those of an Oriental." He paused. I noted the expression of a man who would not let the unexpected change his plan, or that of his superiors. He was processing the information, the Americans, the villagers. Suddenly, he had, to himself, a plausible explanation, "Incredible, the American pilot was Chinese!" This was a response I didn't expect, and I too paused for a moment and looked primarily at the Chinese. The elders surely remembered the burial of the American pilot in their cemetery. But the Hawaii team was adamant, there was no question in their mind that this was neither Bruce Jepson's skull nor that of any other Caucasian. I faced Wang and told him "No, the pilot was not Chinese, he was an American pilot and not Chinese." Wang's expression became sterner, all traces of a smile and the former friendly demeanor disappeared as he said, much more firmly, "It was a Chinese pilot, he was Chinese."

I could see the situation deteriorating. The laboratory team was packing up their equipment, preparing to leave the opened casket with bones spread on a khaki colored cloth. My impression was the team wanted to leave immediately. Best I could, I explained to Wang, "We know who the dead pilot is, his name was Jepson, he crashed in 1945, and I have a report here concerning him, the village of Dong Guo Cun, and some of the people present. It is in English, but here, you can look at it." I had opened the book to the report by Flight Officer Griffin dated March 6, 1946. Wang took the book, showed it to his translator, but he himself could read the names of the Chinese who had participated in the recovery effort of 1946 and whose names were written by hand

in Chinese characters on the typed pages. He mentioned the name Liu Shenggan, who at the moment happened to be standing by his side. I thought to myself, this must be "the friend" the diplomats had mentioned some months earlier. Wang and Liu discussed the issue between themselves for a couple of minutes out of my earshot. Wang walked back, his entire demeanor once again changed, and said, "You are right. I'm very sorry. We have unfortunately put you and your people to a lot of trouble, especially those who have come so far. We will return to the guesthouse and pick up your luggage. We can have dinner, and then we will take you to the train station. There will be no banquet. But, we will look into this matter and find out about the American pilot."

As we left the opened casket, I looked at the villagers surrounding the site. It seemed they had not moved. In front of them was the village graveyard and the buried remains of their ancestors of untold generations. One coffin had been opened, the bones were scattered on a cloth. Were any of the others in coffins? I didn't know, but I thought not. Much would have depended on how prosperous the village had been, and I had seen nothing that indicated Dong Guo Cun was anything more than a traditional Chinese peasant farming village. I wondered who the current village chief was, he had not come forward. Mr Wang from the City Council seemed to be the senior Chinese present. The Provincial political hack in charge would be hosting the dinner, the Chinese were not yet ready to let the villagers of Dong Guo Cun socialize with foreigners. Mr Liu Shenggan, who was walking nearby, told me he was now a deputy village chief. He said he would not be joining us at the dinner, it would just be the four Americans and Mr Wang. I spoke to him in Chinese and thanked him for all his efforts. I told him again, "We know the story of the American pilot you buried. All the Americans here today know you were involved, and we appreciate your efforts very much. Perhaps some day we will know what happened to the re-

mains of the young pilot.” He just shook his head. The village of Dong Guo Cun, supported by the powerful Ministry of Foreign Affairs, had lost face. I didn’t look at it that way, but the Chinese did. The scheduled “banquet” was a somber affair. Toasting was perfunctory and the media did not participate. We boarded the train as scheduled and returned to Beijing.

Nearly two months later on April 18, 1985, summoned by the MFA, I again visited Mr. Liu Xiaorning and met Ambassador Ni Yaoli’s new replacement. Liu told me the Ministry and Provincial dignitaries were very embarrassed by the whole episode concerning the remains of the downed pilot. There was no mention of an “act of great humanity,” and I waited to hear what the new senior diplomat present had to say. “We have made a very thorough investigation of the American pilot and recent events at the village of Dong Guo Cun. There are three possible explanations as to what happened to the deceased American. First, the Japanese soldiers dug up his remains for biological research. Secondly, you saw signs of the great flood of 1977 which left high-water marks on all the buildings in the village. It would not be unreasonable to expect that his casket was washed away during the flood. Finally, in the history of Dong Guo Cun, which is a very poor village, there were ever only two people buried in coffins. One was the American pilot.” I waited, not knowing what to expect. He continued, “The second casket contained the remains of a Chinese hero, a martyr of the Chinese Revolution. His name was Fan, Martyr Fan. Some years ago, his coffin and remains were moved to a place nearer to his home, far away in western China, a cemetery dedicated to martyrs of the Chinese Revolution.” He paused and looked at me silently. I said nothing. Finally he asked, “What do you think?” I paused and then answered, “I think you moved the wrong casket.” He said nothing, but nodded his head slowly. I continued, “The United States is still interested in recovering the remains of this pilot, we would be willing to go to wherever the martyr cemetery is.” I knew there was little hope for this, but thought I would try. The thought would give the Chinese pause as to the efforts Americans will go to obtain the remains of its fallen soldiers and airmen. Mr. Liu answered, “No, the cemetery is too far away, and we would have to obtain the approval of the family.”

A week later Ambassador Ni Yaoli called me at home, expressed his regrets, told me he was headed to Canada as the new Ambassador, and said MFA had told the local officials to forward to me any information they might obtain as to the remains of the American pilot. I thanked him, wished him success in his new assignment, and made a mental note to myself, “End of story.”

My service as Defense and Air Attache in Beijing ended in January 1988. No further information concerning Bruce Jepson or any other American pilot ever came to my attention prior to my departure. While visiting San Francisco in June of 1989, I related the story of Flight Officer Jepson to Mrs Nancy Stilwell Easterbrook, daughter of the heroic yet controversial General Joseph W. “Vinegar Joe” Stilwell, at her home in Carmel, California. She listened attentively. When I finished, she looked at me, shook her

head and smiled. “What a wonderful story, an American pilot, resting in a Chinese cemetery for martyrs.”

In 1995, and again in 1998, while living in Beijing as the employee of an American defense contractor, I hosted Mr Liu Xiaoming for a quiet dinner. He was then a Minister Counselor in the Chinese Embassy in Washington, and would soon be the Deputy Chief of Mission. Later he was appointed China’s Ambassador to Egypt followed by his current position as China’s Ambassador to the UK. I brought up the subject of Flight Officer Jepson and asked if he had ever heard any additional information. He offered nothing other than “the cemetery is far away in western China.” And while he never said it, he too agreed with me, they had indeed moved the wrong casket.

In the spring of 2007, via the internet, I learned about a reunion in 2006 of the 529th Fighter Squadron, of which Flight Officer Bruce F. Jepson had been a member. Four members of the squadron had traveled to China that year as guests of the Chinese Government. One of them was a retired U.S. Air Force Colonel Robert A. Austin who was a member of the fateful flight on April 25, 1945 when “Jep” crashed near the village of Dong Guo Cun. He had retired after a long and successful career in the U.S. Air Force, always flying fighters, and I am most grateful to him for information concerning Jepson and combat operations in China and also for leading me to other members of the squadron. Mr. Paul Crawford of Atlanta, who roomed with Jepson in China, agreed to meet with me in June of 2007 at the Dulles Hilton Hotel, where veterans of the 529th Squadron were meeting once again in preparation for another reunion scheduled for China in 2008. He also provided me with much information, copies of squadron orders and monthly reports, and pictures of the squadron and several pictures of Flight Officer Jepson in China, for which I am also very grateful. Mr. John E. Webb, Commander of Central Identification Laboratory Hawaii from 1982-1993, who visited Beijing and Dong Guo Cun in 1985 and is currently Deputy Commander of Support and External Relations of JPAC, provided several documents concerning the extensive U.S. search and recovery efforts which took place in China and Southeast Asia after World War II. His search and recovery efforts still continue and have now expanded to include U.S. airmen lost in Russia.

Meeting with the former members of the 529th Fighter Squadron at their reunion was a special moment. While the fighter pilots of yesterday had lost some of the vinegar and spice of years gone by, their spirits were high and the depth of friendships established more than sixty years ago were apparent. They mentioned the names of some who had attended the previous reunion, but for reasons of health or more serious disabilities, were not present. They were veterans, men who had been through something together—a war. They had fought side-by-side, and were remembering fallen comrades in general, and one in particular. They told me, first hand, about their squadron mate Bruce Jepson, what a talented artist and pilot he was. They listened in silence as I told my story as to what had happened to him since he radioed his distress call in April of 1945 and crashed in a remote area of China. ■

**Stalag Luft I: An Official Account of the PoW Camp for Air Force Personnel 1940-1945.** By UK Air Ministry Personnel. Havertown PA: Casemate, 2018. Photographs. Map. Abbreviations. Index. Pp. 256. \$44.95. ISBN 978-152670879-3

This book is comprised of several reports prepared by the United Kingdom's Air Ministry immediately following World War II. The reports appear to have two objectives. First, to recognize the actions of RAF, Commonwealth, and Royal Navy airmen who were confined in Stalag Luft I; and second, to capture "lessons learned" to prepare airmen should they become prisoners in future conflicts. The text reads like a military document—highly structured, sterile, and devoid of the emotion and humanity that brings books to life.

*Stalag Luft I* is, however, filled with interesting details of POW experiences at the hands of Luftwaffe captors. Covering the entire war—from the first airman captured in 1939 until liberation in 1945—it is possible to view Stalag Luft I as it evolved over the course of the war. From 1939 until late 1943, one is struck by the "civility" of the Stalag experience on the part of the captors and prisoners. Prisoners were allowed to go to nearby towns for recreation and medical treatment. Those who were placed on punishment rations of "bread and water" were given hot meals every third day. The most frequent escape method was to walk through the front gate wearing homemade civilian clothes or uniforms. Numerous escapees made their way to ports and walked aboard Swedish-flagged vessels which sailed to neutral destinations. If discovered, the escapee was returned to the Stalag, where he received a stern talking to. Prisoners received parcels from home as well as the Red Cross to supplement their rations and smuggle in items useful in escape attempts.

But, as the war turned in favor of the Allies and allied airman were associated with bombings of cities with massive civilian casualties, the civility disappeared; and the UK POW experience deteriorated quickly. Rations were reduced and supplemental packages disappeared. Punishment that had been the responsibility of the *Abwehr* was shared with the Gestapo. The introduction of the Oflag IV-C camp at Colditz to hold incorrigible POWs and the use of capital punishment for escapees preceded the use of forced marches of POWs during the brutal winter of 1944-45 to delay liberation by advancing Russian forces.

This book is not a great literary achievement. The complete lack of narrative convention makes it a tough recreational read. It makes no substantive mention of other allied POWs held at the camp. There are numerous fiction and non-fiction works that bring the PoW experience to life for the reader in ways that *Stalag Luft I* does not. But it does serve a purpose. If one is researching a member of his or her family tree who was incar-

cerated in Stalag Luft I and found his name listed as a member of the NCO Escape Committee or Code Writer Group, this book would perform an admirable service.

*Gary Connor, Docent, Smithsonian National Air and Space Museum. His great uncle was a B-17 tail gunner shot down over Rostock during Big Week and held in Stalag Luft I for several months.*



**RAF on the Offensive: The Rebirth of Tactical Air Power 1940-1941.** By Greg Baughen. Philadelphia: Frontline Books, 2018. Maps. Tables. Photographs. Notes. Appendices. Bibliography. Index. Pp. viii, 304. \$34.95 ISBN: 978-1-52673-515-7

The subtitle sums up both the book's thesis and its substance. Baughen's premise is that in the wake of the RAF's failed efforts in its early strategic bombing efforts and independent operations in the defeat of France, some elements of the RAF rediscovered its true *raison d'être*: support of, and cooperation with, the other services in their efforts to win the war. Baughen's goal is to refute the belief that airpower alone can be the decisive force in war. This argument has raged since Hugh Trenchard's, Guilio Douhet's, and Billy Mitchell's time and continues unabated today. Baughen chose to use an RAF reeling from multiple defeats in 1939-40 as his test case to show how, in some instances, it did return and, in others, ought to have returned to a subordinate role in fighting the war.

Baughen revisits the industrial web vs. interdiction vs. close air support arguments of airpower and definitely comes down in favor of close air support as its most effective use. He goes so far as to say the RAF, and air forces in general, should return to the concept of an aerial umbrella over ground troops. This tactic was completely discredited by 1942, and no Air Force espouses it today. This doesn't mean his basic premise concerning close air support is necessarily wrong.

Unfortunately, his argument lacks balance. He fails to make use of much evidence supporting it or address examples which seem to contradict it. He focuses his attention on three areas: the minutia of aircraft procurement, the imminent threat of a German invasion and its impact on British thinking, and the folly of Air Ministry leaders set on what he sees as a flawed doctrine of strategic bombing. In discussing aircraft procurement, he goes into detail about fighters and why every bomber was in some measure a failure. This is not, in itself, a problem except that he fails to even mention the one significantly successful large British bomber, the Lancaster. He overplays the threat and possibility of invasion well into the planning for 1942, when it was obvious to virtually everyone that the Germans could not mount such

an attack. The argument against Britain's bombing campaign is valid when considering the demand that four-engine bomber construction made on Britain's limited resources. These could only be built in the numbers requested by the Air Ministry at the expense of virtually all other aspects of the British war machine. Failing to mention the one plane that was a major success, though, throws all the rest of this discussion into question.

Baughen focuses his attention on events in England, virtually ignoring, and then basically dismissing as irrelevant, the RAF and British Army's successful cooperative efforts in the desert campaign. His discussion of this pivotal effort is cursory and ignores the fact that Coningham and Montgomery developed a very effective process that became the template for cooperation between services followed by all Western Air Forces for remainder of the war. This cooperation did not call for subordination but, rather, cooperation as equals.

The bottom line is Baughen chooses to ignore evidence contrary to his theory rather than accounting for these facts and making cogent arguments explaining why he is right. The ironic thing is the best potential evidence for his argument existed on the other side of the continent in the form of the Russian Air Force. It never developed strategic bombing but focused its efforts on exactly what Baughen feels an Air Force should do—supporting troops on the ground. Of course, the Russians reaped the benefits of the Western Allies' strategic bombing efforts (whatever you decide them to be), so even that example isn't perfect. But it still makes a stronger than the one he chooses.

The book has merit in a few very limited areas. The discussion of fighter development: interceptor vs. air superiority, cannon vs. machine gun, and British vs. US designs is very good. Baughen also does a good job (to a point) of showing the divisions within the Air Ministry and RAF both at home and abroad and their impacts, but he ultimately fails to show how this makes his case concerning close air support. His main sources are official message traffic, but there are no citations in the bibliography. The premise that close air support constitutes the main purpose for an air force is a matter for discussion, but Baughen's choice to cherry pick his evidence to strengthen his argument fatally weakened his case. I do not recommend this book.

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



**Democracy in Exile: Hans Speier and the Rise of the Defense Intellectual.** By Daniel Bessner. Ithaca NY: Cornell University Press, 2018. Notes, Bibliography. Photographs. Index. Pg. xv, 294. \$35.00 ISBN:978-0-8014-5303-8

*Democracy in Exile* examines the rise of the defense intellectual in the US national security arena through the lens of Hans Speier, a highly regarded social scientist who was a leading proponent of the think-tank concept. Speier led the Social Science Division of RAND, the Cold War's most prominent think-tank, and was in the vanguard of a dramatic change in strategic thinking—and in the supporting role of propaganda—brought on by World War II and the ascendancy of the United States as a global power. The growing sophistication of weapons technology, especially nuclear weapons, and the rise of the US as a global leader placed intellectual demands on the nation's civil and military leadership. Consequently, think-tanks became indispensable tools to address complex issues. In today's very complicated global environment, think-tanks have become ubiquitous, playing a critical role in national-security decision making and in the shaping of military strategy. The importance of the defense intellectual can be traced to Speier who emphasized, in understated support for his professional role, that "the primary task of the social scientist...[is] to give advice to the statesman."

First and foremost, the book is about Speier, a key figure in this evolution of the defense intellectual's role, and about the social, environmental, and intellectual milieu that conceptually shaped his world view. Bessner reveals insights into Speier's motivations for the intellectual's role—as he envisioned it—in the endless crises of the Cold War era. Speier's outlook was shaped by earlier experiences in Weimar Germany, where Hitler came to power with the support of ordinary people. He was convinced that the people, ironically, could not be trusted in a democracy to make correct political decisions. Therefore, democracy works only where there is rule *for* the people as opposed to rule *by* the people. The intellectuals' role is to act in the interest of democracy by playing a key part as nonpartisan advisors to decisionmakers in sorting through complicated issues and giving sound advice. In other words, in a post-industrial democracy, expertise, otherwise lacking in the general public, has become an essential component of intelligent policymaking. He saw this, in intellectual terms, as the necessary relationship between knowledge and power. He believed that intellectuals were well suited to be key players because they were superior to any other social group. Speier pointed out that defense intellectuals have made substantive contributions to the most important US foreign and national-security policies from nuclear strategy to counterinsurgency doctrine.

How did Speier and other defense intellectuals remain practically unknown to the general public? Because they provided much of their research and policy recommendations in a classified format; they escaped public scrutiny and congressional oversight, thus avoiding controversy.

Bessner begins by examining Speier's earlier years

in Germany, his experience as an exile in America, his contributions during the Second World War, and ultimately his conclusion that democracy is a fragile political form. Notions of democracy had to be placed in “exile” in order to save the institution from itself until Cold War crises were resolved.

I thought Bessner might have referenced the classic Cold War film, *Doctor Strangelove*, because it drew attention to the “invisible,” yet highly influential, defense intellectual. The film’s caricature of a defense intellectual, known to almost none of the film’s characters, does not emerge until the final scenes when the superpowers are on the cusp of global annihilation. It is at that moment when we learn that Dr. Strangelove, who, like Speier, was an intellectual in exile from Germany, had provided the justification for a mutually destructive doomsday strategy.

Although the book centers on earlier phases of the Cold War, I thought its conclusions might have looked at how the inputs of defense intellectuals influenced the decisions made in this country during two disastrous wars of choice. Considering the impact RAND and other early think-tanks had on national security strategy, Bessner makes only the slightest reference to the defense-intellectual’s contributions during the Vietnam War. Likewise, he makes only a passing reference to the catastrophic decision to go to war in Iraq, despite the war’s upending of US national-security interests in the Middle East. In the case of the Vietnam War, Speier, as an exile, apparently showed misguided gratitude to the US by remaining uncritical.

This aside, the book is a well-researched, intelligently written, and very interesting read. Speier’s assessments of democracy’s shortcomings in Weimar Germany and their consequences give pause for thought, in light of current political turmoil in America and Europe.

*John Cirafici, Milford, Delaware*



**Shattered Dreams: The Lost and Canceled Space Missions.** By Colin Burgess. Lincoln: University of Nebraska Press, 2019. Photographs. Tables. Appendix. Sources. Index. Pp. xx, 268. \$36.95 Hardcover ISBN: 978-1496206756

*Come Fly with Us*, the 16th volume in the University of Nebraska Press Outward Odyssey: A People’s History of Spaceflight series, conveyed the personal stories of astronauts who flew as payload specialists on space shuttle missions. *Shattered Dreams*, the series’17th volume, focuses on the stories of talented individuals whose spaceflight dreams went unfulfilled. This volume extends chronologically from NASA’s Apollo program

through the Space Transportation System (STS) era and from Russia’s early Vostok/Voskhod spacecraft through their Soyuz successors. It spans the globe geographically, with stories about aspiring candidates—women and men—born in the United States, Russia, the United Kingdom, Australia, Indonesia, and Argentina.

Burgess, who also serves as series editor, has chosen to sketch, in almost eulogistic fashion, the lives of more than a dozen individuals—and identifies many others—who underwent extensive preparation for spaceflight but ultimately failed to fly. As one might expect, the reasons varied from circumstances beyond the individual’s control (e.g., funding cuts or launch disasters causing lengthy postponement or cancellation of scheduled launches) to personal crises (e.g., unanticipated health problems or familial issues). Tragic accidents, whether on a highway or in the air, killed some aspiring astronauts and sidelined others.

Readers of *Air Power History* might be interested especially in the stories about former Air Force officers. Charles Edward Jones, for example, entered the USAF Manned Spaceflight Engineer (MSE) program in 1982, but the *Challenger* disaster in January 1986 led to cancellation of Jones’ December 1986 space shuttle mission; Jones died on 11 September 2001 as a passenger on American Flight 11 when it crashed into the North Tower of the World Trade Center. Joe Henry Engle had been assigned to the Apollo 17 crew but lost his opportunity to walk on the Moon, because a political decision replaced him with geologist Harrison Schmitt. In August 1965, Air Force flight surgeon Duane Edgar Graveline, a member of NASA’s fourth astronaut group, would “go down in spaceflight history as the shortest-serving NASA astronaut” after his wife filed for *divorce*, a word that “had no place in the squeaky-clean aura NASA was trying to maintain around its astronauts.” Robert E. Stevenson, who had flown as a B-17 navigator with the 368th Bombardment Squadron (Heavy) over Peenemunde in 1944, became known as the “Father of Space Oceanography” but voluntarily abandoned his assignment on STS-41G in 1984 to be at his terminally ill wife’s bedside.

Burgess has drawn from an impressive variety of sources to tell the stories of these individuals and the others highlighted in *Shattered Dreams*. In addition to using books, periodicals, online articles, NASA and academic archives, and even websites such as YouTube and Find a Grave, Burgess conducted numerous interviews and personal communications via letter or e-mail. Although he admittedly borrowed some of the stories from previously published spaceflight magazines—the British Interplanetary Society’s *Spaceflight* or *Quest: The History of Spaceflight Quarterly*—or from books published elsewhere, such as *The First Soviet Cosmonaut Team* that he and Rex Hall co-authored, Burgess insists, “These stories have been rewritten and expanded with

---

a host of fresh information, while others were researched and compiled with the assistance of many people, chiefly with the families of each person whose story is related in this book.”

While some fans of the *Outward Odyssey* series might find *Shattered Dreams* less appealing—either because of subject matter or some other reason—than previous volumes, this title definitely belongs with its companions on any serious space historian’s bookshelves. It delivers a both sobering and inspiring message, one that Burgess summarizes in his epilogue by quoting Ralph Waldo Emerson, who wrote, “Dare to live the life you have dreamed for yourself. Go forward and make your dreams come true.” Without daring to dream, no woman or man ever would have “slipped the surly bonds of earth” to visit outer space.

*Dr. Rick W. Sturdevant, Deputy Director of History, HQ Air Force Space Command*



**Sir Alan Cobham: The Flying Legend Who Brought Aviation to the Masses.** By Colin Cruddas. Pen & Sword Books, Ltd.: Barnsley, United Kingdom (2018). Illustrations. Photographs. Appendix. Index. £25. Pp. xv, 206. ISBN: 978-1-52673-840-0

Colin Cruddas retired from Flight Refueling, Ltd. in 1982 and became the company’s historian. In the intervening years, he has penned ten books on British aviation history. Aside from four regional histories, he has focused on themes related to Cobham’s career—lengthy survey flights; air circuses in the 1930s; and, naturally, inflight refueling. Intimately familiar with Cobham’s story, Cruddas brings a detailed perspective to the subject.

While never achieving the stature in the United States of Charles Lindbergh or Ernst Udet, Cobham emerged as the poster boy for British aviation between World War I and World War II. Serving as an instructor, he learned to fly late in the Great War. Unlike so many other military pilots out of a job after November 1918, Cobham signed on with Berkshire Aviation, a touring outfit offering what was for many their first ride in an airplane. Leaving that firm, he flew photographers conducting aerial surveys for the Airco Aerial Photography Department. When Airco was acquired by another firm, engineer Geoffrey de Havilland departed to start his own company. Cobham left with him. De Havilland’s company offered a taxi service, enhancing Cobham’s experience. By winning the King’s Cup Air Race in 1924, Cobham vaulted to national prominence.

From there, he pursued his dream of promoting commercial aviation by flying from the U.K. to Melbourne, Australia; to Cape Town, South Africa; and circumnavi-

gating Africa by air. In the 1930s, he organized and operated national tours throughout England and, on a more limited basis, in South Africa. Meanwhile, Cobham had become fascinated with the potential of inflight refueling that might allow him to fly non-stop to Australia. While the technical limitations of the time made such a trip extremely difficult, he pursued the technology hoping either the Royal Air Force or commercial aviation—or both—would embrace it.

When Imperial Airways officials showed interest in a concept that might improve range to allow regular trans-Atlantic service, Cobham focused on developing the most effective coupling technique. In the late 1930s, after many tests, he settled on a system that literally shot the tanker’s hose at the receiver. Using a cable, the receiver was able to capture the hose. The demands of World War II cut short further development; but, immediately after the war, the U.S. Air Force took a serious interest in Cobham’s work. Ultimately, it would effectively purchase what would become known as the probe-and-drogue system from Cobham. On a global basis, this system remains the most widely used. The Air Force and Boeing developed the flying-boom method because of a much faster transfer rate better suited for bombers such as the Boeing B-52 Stratofortress.

Cobham’s company, Flight Refueling, Ltd., diversified well beyond aerial refueling over the years, before Cobham retired in 1969. The firm changed its name in 1994 to Cobham plc.

Despite Cruddas’ proximity to the subject, he portrays his subject in a reasonably even-handed manner. Besides extolling Cobham’s exploits, Cruddas notes that the man could be very short-tempered; impatient; and, in general, difficult to work with. Yet Cobham retained many of his most talented associates in spite of his personality. This book is recommended for anyone interested in aviation’s Golden Age or in the serious development of inflight refueling.

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



**MacArthur’s Coalition: US and Australian Operations in the Southwest Pacific Area, 1942-1945.** By Peter J. Dean. Lawrence KS: University Press of Kansas, 2018. Tables. Maps. Illustrations. Drawings. Pp. 476. \$39.95 ISBN: 978-0-7006-2604-5

*MacArthur’s Coalition* examines the World War II military connection between the US and Australia. Dean is a prolific historian at the University of Western Australia whose previous works include a three-volume history of Australia’s World War II military campaigns and is, thus, well versed on the subject. His book scrutinizes

assumptions never quite addressed by previous histories. If Australia was part of the British Commonwealth, why was the US its principal ally in the Pacific War instead of Great Britain? Why did Australia so willingly accept MacArthur's dominance of military strategy and tactics? Why do citations in most histories of Australian forces in combat in the Pacific fall off after late 1943?

Dean explores these questions through the lens of early twentieth-century Australian history. During the 1920s and 1930s, Australia cut its military budget and depended on Britain's Royal Navy for protection. The British never entirely endorsed this strategy, however; and, as war with Japan grew closer in 1941, the realization slowly dawned in Australia that Britain could spare little for its defense. Australia turned to the US for military assistance a few months before Pearl Harbor. The US, for its part, recognized Australia's strategic value for defense of the Philippines only in mid-1941. The two countries were in the early stages of a military partnership when Pearl Harbor occurred.

The title reveals Douglas MacArthur as the dominant military leader in the South West Pacific war. Unlike the primarily American perspective of most biographies, Dean details the Australian political, economic, and military factors that enabled MacArthur to assume his preeminent role. After Roosevelt ordered MacArthur out of Corregidor, Australians—at that point expecting the enemy to follow soon thereafter—welcomed him as a guarantee of American defense of their country. Dean details MacArthur's crucial relationship with Australian Prime Minister John Curtin, finding that his influence spilled over into domestic economic and political decisions. British pursuit of seemingly anti-Australian policies only drove Australia further into the American orbit. Churchill's failed attempt to send Australian troops to Burma in February 1942, where the enemy shortly would have captured them, seemed to Australians a violation of their sovereignty. Similarly, as the British contended that they spoke for the Commonwealth, no Australian representative sat on the Combined Chiefs of Staff. Despite occasions when MacArthur's influence seemed heavy-handed, Dean asserts that Australians saw it as the only realistic choice to save their country.

Dean meticulously dissects each campaign to vividly reveal the development, evolution, and eventual waning of the combat linkage of the two countries. Essentially, the cooperation started with the short-lived ABDA command in early 1942, grew through the defense of Port Moresby and the capture of Buna, and peaked with the prolonged fight for New Guinea. He plumbs the successes, failures, strengths, and weaknesses. Numerous difficulties challenged the leadership, particularly at the top, where MacArthur and Australian generals at times labored to understand one another. Such trials were much less manifest at the field level, where tactical com-

manders cooperated quite well. Significantly, Dean emphasizes General Kenney's ability to work with his Australian counterparts as an important factor in building a pivotal role for air power. Two examples are the Battle of the Bismarck Sea and the secret air base at Marilinan, both described as jointly planned and executed US-Australian operations.

Dean attributes the gradual withering of the military connection between the two countries as the fighting neared the Philippines to the distinction between an alliance and a coalition. An alliance is a true partnership, with members integrating strategies, tactics, leadership, logistics, and training. Although Americans and Australians actually took a few steps toward such integration, Dean characterizes the overall effect of their efforts as more of a coalition, with members coordinating strategies and tactics only as needed. When the need was gone, the cooperation faded. When the enemy was near Australia, the two militaries planned and fought together. As they pushed the enemy away from Australia, MacArthur increasingly found it easier to work with just American forces. Had the US and Australia achieved a true alliance would the added force of Australian units—air, sea and land—have contributed to an earlier end to the war? Would US losses have been smaller?

The bibliography contains most of the recent major published works on the Southwest Pacific war. Dean consulted monographs, articles, compendia, and official histories and records in both Australia and America. He examined such original evidence as Australian and American government and military records, the papers of such noted generals as Sir Frank Horton Berryman, and the MacArthur Memorial archives.

As numerous other works more than adequately picture MacArthur and the war in the Southwest Pacific, this book contains no photographs. Many accurate and detailed maps, figures, and tables of organization buttress Dean's points throughout. This valuable reassessment of the war in the South West Pacific should be on every airpower scholar's shelf.

*Steven Agoratus, Hamilton New Jersey*



**Messerschmitt Bf 109.** By Robert L. Jackson. Barnsley UK: Pen and Sword Aviation, 2018. Maps. Tables. Illustrations. Photographs. 80 Pp. \$20 paperback. ISBN: 9-78152671053-6

When Jackson's book came across my desk, I was anxious to begin exploring its contents. I have always admired the Bf 109; its iconic canopy design gave it a suitably menacing profile. The 109's amazingly long service life—its first aerial victory came in 1937—provided

many opportunities to modify the basic design to keep pace with its evolving mission requirements. But then I had a thought. After eighty-five years of photographs, stories, articles and entire books, how much “new” material could Jackson offer? Out of curiosity, I inserted “Bf109” into an internet search engine and within 0.5 seconds found 10,500,000 hits. A few more key strokes disclosed that the A6M Zero (80,600,000), Spitfire (76,700,000) and P-51 (50,600,000) all provided significantly more hits than the Bf 109. So, just maybe, there was room for Jackson’s book to offer something new.

A large-format paperback, Jackson’s book is divided into two distinct segments. It opens with a narrative description of the aircraft’s early life and moves smoothly into a discussion of the numerous sub-variants that appeared in the skies between 1935 and 1945. The first segment contains a wealth of information on the aircraft and demonstrates that the only differences between most sub-variants were in the armament configuration. Unfortunately, there is little explanation for why such a myriad of different weapons combinations was necessary or effective. Some collation between operational experience and weapon suites would have improved the book.

A brief discussion of the Bf 109 service history followed. This segment flows much smoother than the first and contains some useful analysis of the aircraft strengths and limitations. The narrative segments are supported by a wealth of photographs, many showing the aircraft, its pilots and its support personnel. The Luftwaffe clearly based its aircraft as close to the front as possible to minimize response time and the inherent limitations posed by the Bf109’s limited range. I found myself hoping Jackson would offer more information on how the Luftwaffe managed the logistics for these forward-deployed units and multiple sub variants. With limited spares and ground support equipment, how did the Luftwaffe maintain a meaningful operational readiness rate?

The last portion of the book is focused on serving the modelling community. It is comprised of color profiles and practical suggestions on modelling techniques and procedures for the large variety of Bf 109 kits on the market.

Jackson’s work is a quality product. The large format and high-quality paper show the photographs and drawings to full advantage. The initial segments of the book offer a concise introduction to the Bf 109 but would likely be perceived as overly simplistic to anyone who has researched the Luftwaffe in general and German fighters in particular. Jackson moves the bar marking knowledge of this iconic aircraft but doesn’t move it very far.

Gary Connor, Docent, National Air and Space Museum



**America’s Round-Engine Airliners: Airframes & Powerplants in the Golden Age of Aviation.** By Craig Kodera and William Pearce. Forest Lake MN: Specialty Press, 2019. Maps. Tables. Diagrams. Illustrations. Photographs. Bibliography. Index. Pp. 216. \$46.95 ISBN: 978-1-58007-257-1

For those wondering why a book about airliners is being reviewed in *Air Power History*, the answer is simple. While the aircraft discussed served in airlines from nearly the beginning of commercial service until after the jet age began, many (most) were also in service as military transports. And the vast majority of the production output of engines covered in the book served in the US (and many foreign) military forces in all types of aircraft. The technology of these aircraft and engines is the technology employed by airpower from the 1920s through much of the Cold War.

Kodera is the airplane and airline expert, while Pearce covers the powerplants. Each chapter in the chronologically organized book starts off with a Kodera section in which he examines the aircraft of the time and the state of commercial aviation. From the real start of airlines after World War I (whose primary job was to haul the airmail in their Ford Trimotors, Stinsons, and Vultees), through the transition airliners (Boeing 247, Douglas DC-2/3) to the days of the great airliners of the late 1940s and 1950s that carried passengers in relative luxury across the US and the oceans (DC-4/6/7; Lockheed Constellation, and Boeing 377), Kodera covers it all, both land planes and the great seaplanes (Boeing 314, Sikorsky S-42, Martin 130) of the 1930s. One cannot understand the development of the aircraft unless the underlying business is also presented. So the formation and growth of Eastern, Pan American, TWA, United, and many other airlines (most gone today) are superbly covered as well.

But a discussion of the development of larger and faster commercial aircraft is nothing if the development of the engines that powered them isn’t covered concurrently. That’s Pearce’s job, and he does it very well. And one can’t cover the engines unless one also presents the stories of the two primary manufacturers of the era, Pratt & Whitney and Curtiss-Wright. Pearce covers both companies’ tribulations and triumphs very well as he lays out the needs for ever higher-power and higher-reliability powerplants, the uses for these engines, and—from my perspective, one of book’s best features—the technologies used. Cylinder development, the use of single-piece or assembled crankshafts, single-piece vs. split master piston rods, cooling baffles and cowlings, and many other aspects of the design of these phenomenal engines are all discussed. Some readers may want to gloss over these details, but I think they are at the heart of the story of the development of not only commercial aviation, but that of military aviation as well.

The excellent text is backed up with a superb collection of photos (both contemporary and from museums), diagrams (engine interiors and parts, cut-away views of the interior of the airliners), route maps, advertising brochures from the manufacturers and airlines, and the like. For every one of the engine types, there is an accompanying table showing all uses of the engine and its various models—both commercial and military. There are even a few vignettes scattered throughout looking at various aspects of the commercial flying experience from the perspective of pilots and stewardesses. And all of these are presented in hi-resolution on glossy paper, so their quality is excellent.

My only complaint lies in the book's layout. With the hundreds of pictures, tables, and diagrams, the breakup of the text often drove me nuts! You are right in the middle of a major story (and right in the middle of a paragraph), turn the page and find of photos and the like before the text picks up in the middle of the second column perhaps three or four pages later! But, if you can live with that, what lies between the covers is an absolute goldmine. These two authors have done an admirable job of covering a major piece of aerospace history. The book is worth every cent of its cost.

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



**An Anxious Peace: A Cold War Memoir.** By Hans Mark. College Station TX: Texas A & M Press, 2019. Photographs. Pp. 676. \$47.00 ISBN: 978-162349727-9

Hans Mark has quite a story to tell in his journey from childhood refugee from Nazi Germany to Secretary of the Air Force and, eventually, to chancellor of the University of Texas, with a spectrum of accomplishments in between and after. His professional careers over six decades have included director of the NASA-Ames Research Center, deputy administrator of NASA, author, and director of the National Reconnaissance Office (NRO).

In what is both a memoir and an account of America's decades-long effort to stay ahead of the Soviets, Mark returns the reader to the Cold War and his personal involvement in the struggle of the United States to maintain superiority over the Russians in nuclear weapons, strategic reconnaissance, aviation, and space exploration.

Mark was often in a key position playing an important role in the space race, the refinement of nuclear weapons, the design of highly advanced aircraft and satellites, and the promotion of ideas. He has been a scientist, nuclear engineer, division chief at the Lawrence Livermore National Laboratory, an academician and department chair, and senior public servant. In this book

he discusses a large selection of subjects ranging from the science behind the research and development of nuclear weapons to the advances in technology leading to very sophisticated aircraft and reconnaissance satellites. He also adds new dimensions with his own up-close observations of prominent personalities, to include presidents of the United States, with whom he interacted in the course of his many senior positions.

Reading a ponderous book of nearly seven hundred pages would have been tedious had it not been so well written and interesting. Hans Mark's memoir is carefully paralleled by a backdrop of Cold War developments and the changing political atmosphere in Washington such that the reader can see the larger picture at the same time as Mark discusses his involvement in national security projects and the space race. Even the discussions of the science behind nuclear weapons were fascinating, although I will admit it was occasionally necessary to do some side reading to properly grasp the science.

As a minor side note, I was pleased that, as with few books published today, there is almost an absence in errors of any kind in the narrative. For a book containing so many facts, I noticed only two mistakes. One was a date that was certainly a typo and not a result of the writer being uninformed. The other was a misstatement in a discussion of air base vulnerability where he maintains, in error, that North Vietnam did not attack any air bases in Thailand during the Vietnam War. Actually, they conducted three sapper attacks against Ubon Air Base on three separate occasions. The very few errors are, in any case, minor and pale in contrast to the insights and richly informative narrative provided by Doctor Mark.

While this book will require some investment of personal time, it is well worth reading.

*Col (Ret) John Cirafici, Milford, Delaware*



**A History of the Mediterranean Air War, 1940-1945, Volume Four: Sicily and Italy to the Fall of Rome, 14 May, 1943—5 June 1944.** By Christopher Shores and Giovanni Massimello, *et al.* London, UK: Grub Street, 2018. Diagram. Maps. Photographs. Pp. 696. \$79.95. ISBN: 13-9781911621102

This is the fourth in a projected six-volume series to cover the much neglected Mediterranean air war. It is the product of a team of six authors. They cover the tactical air war, reserving strategic operations after October 1943 for an anticipated sixth volume. From the outset, a perspective reader should be cautioned that this is clearly a huge, lavishly illustrated reference book, certainly not a narrative or analytical study. It covers the title's timeframe chronologically with a brief prose summary of events for nearly every day, and then lists the

claims and casualties of the warring air forces on that day. In addition, these entries include the unit, aircraft types involved, sometimes serial numbers or buzz codes, location, time, and aircrew names and fates. Clearly, this is a wealth of great detail.

Apparently based on Allied and Axis primary documents, it confirms many of the pilots' victory claims, while demonstrating the gross over-claiming by all of the combatants. It also makes clear that "friendly fire" was a problem for both sides (including the worst incident when, during the invasion of Sicily, at least eight of 144 C-47s conducting a paratroop drop were shot down by Allied ships). This study concentrates on the air war but traces interconnections with the ground war as well. While these summaries of the air conflict are very similar, the authors occasionally include long, direct quotes from participants. They also include a number of curious incidents of interest such as the withdrawal of a 16-year-old B-26 gunner (who had enlisted at 14); the downing of a B-17 by an Italian pilot flying a captured P-38; and the surrender of 33 Italian soldiers to their American flyer captive. The many photographs are in sharp detail on the book's slick paper, and some are rare. While the book focuses on American, British, and German air forces, the activities of the Italian and Free French air forces are notably not neglected.

For all of its strengths of detail and research, this book has its faults. There are neither citations nor a bibliography. While the text indicates considerable research in multiple sources, there is no indication as to which archives and materials were used or not used. There is no summary/conclusion—no cumulative accounting. One of the most perplexing aspects of the book is the indexing, a critical item for a research tool. There are eleven indices. Each of the five combating air forces has an index for personnel; four air forces have separate indices for their units; and there is one index for ships and another for places. As to content, certain important events are only casually mentioned. For example, for all of the detail, there is essentially no mention of the Allied failure to prevent the Axis evacuation from Sicily over the Straits of Messina during which some 100,000 troops and 10,000 vehicles escaped—a serious failure in an otherwise successful campaign. Finally, while this is an invaluable reference on this subject, the price will limit its circulation to all but the most dedicated or affluent.

In summary, students of the air war during World War II should be aware of this series of books. They are important for their richness of detail, scope, and especially for viewing the conflict from the varied perspectives of the different air forces. No future publication on the Mediterranean air war will be credible without use of this series.

*Kenneth P. Werrell, Culpeper, Virginia*



**The Polish Few: Polish Airman in the Battle of Britain.** By Peter Sikora. Philadelphia: Pen and Sword Military, 2018. Tables. Photographs. Notes. Appendices. Index. Pp. xvii, 574. \$49.95. ISBN: 978-1-52671-485-5

The general story of refugee pilots from many European countries who joined the RAF in the fight against Hitler is well known (the highest scoring RAF ace during the battle was actually Czech). Sikora claims this book corrects historical inaccuracies and finally ensures that the Poles get the recognition they deserve. He is one of a small group of Polish historians and writers who have made it their mission to ensure the World War II contributions of their countrymen don't go unrecognized. His agenda is apparent in his treatment of his primary subjects, the Poles, and the supporting cast, basically everybody else. This bias doesn't completely skew the book, but it does require a critical eye. Someone without a solid grounding in the history of the events described could easily come out with a warped perspective.

These aviators certainly made a material contribution to the defense of Europe as a whole and Britain in particular. They watched the German war machine roll over their country. Staying in Poland meant they couldn't use their skills as pilots to continue the fight. Seeing France and Britain as their only hope to continue the fight they chose either the French or British air forces as their next home. After the fall of France, those who could made their way to Britain in hopes of joining the RAF. This exodus is actually one of the more interesting parts of the book. What is missing, unfortunately, is the story of the training and transition to qualified RAF pilots once they reached England. Some went straight to combat units with seemingly little training, while others never made it into combat despite arriving earlier than their counterparts. The lack of explanations leaves a huge whole in the story. The discussion of their role in battle follows a pattern filled with details but misses the emotion and excitement of the people and events.

The book overall is very formulaic. Sikora repeats himself detailing the same aspects of the each flyer's story instead of focusing on one or a group with representative experiences and then sharing the unique aspects of each. His excessive details bog down the text—assignments and transfers, specific tail numbers flown on each mission, and so on—and should have been moved to an appendix. What is supposed to be the heart of the work ends up being a plodding narrative. When he does include unique tidbits, there is no detail explaining its relevance. Two examples suffice. The first is a photo caption referring to the three Polish pilots shown as the Three Musketeers. This seems like an interesting story but never shows up in the text. The second is a comment about a poor decision one of the British squadron leaders made with no further explanation.

Sikora never explains what happened or the negative result it caused.

This last is symptomatic of Sikora's bias against all things not Polish. He is biased against everyone, whether enemies (Germany and Russia) or allies (Britain and France). With a few individual exceptions, everyone is obstructing, interfering with, or impeding the patriotic Polish in their efforts to strike the enemy. Sikora also makes some dubious claims. He says the Polish invented the fluid finger-four tactical fighter formation before anyone else (generally credited to the German Werner Molders), when his sources clearly show the Polish consistently fought using the tactics of their sponsoring countries. He offers no evidence that the Polish either created or ever used this tactic. Another is that Herman Goering was a disciple of Guilio Douhet, the early airpower advocate; and this affected the organization, tactics, and leadership of the Luftwaffe. This stunning revelation is accompanied by absolutely no proof. Even if true, it is irrelevant to the story he tells. There are other weaknesses as well. There are no explanations for discrepancies between victory claims on one side and losses on the other. There are too many misspellings to count. More maps would also have been helpful.

One unique feature I liked was the individual biographies of all Polish pilots who fought in the RAF in the Battle of Britain. It takes up nearly half the book and adds no narrative value but is a tremendous resource. At the end of the day, this is not the book to read for *the* story of Polish aviators in the Battle of Britain. As a resource, on the other hand, it is well worth a look.

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



**The British Overseas Airway Corporation: A History.** By Graham Simons. Haverstown PA: Casemate, 2019. Photographs. Drawings. Illustrations. Appendices. Pp 280. \$49.95. ISBN: 978-147388357-1

"Flew in from Miami Beach BOAC  
Didn't get to bed last night  
On the way the paper bag was on my knee  
Man, I had a dreadful flight"

Songwriters: John Lennon/Paul McCartney  
Back in the U.S.S.R. lyrics © Sony/ATV Music  
Publishing LLC

This book follows Simons' earlier works on *Olympic Airways*, *London's Airport*, and other titles that describe the commercial side of aviation. And, just as in his earlier works, this title is a meticulously researched and lavishly illustrated book. The role that the British Overseas Airway Corporation (BOAC) played in the social, political,

economic, and technical history of the United Kingdom cannot be understated. Simons does a workmanlike, if uninspired, job of telling a complex and entertaining story.

That said, I am always concerned when an author begins his work with an apology. Simons tells us that "The story was not easy to write . . ." And the final product was "akin to squeezing a quart into a pint pot." The author and editors accomplished this feat by using a myriad of acronyms, miniaturizing the illustrations, and printing the text in an eye-blurring eight-point font. The text became almost unreadable after a few minutes. I eventually reverted to using a magnifying device to improve readability. Simons would have done better putting his quart-sized work in a quart pot; the result would be to the reader's advantage.

As described by Simons, "BOAC began with World War Two and ended as cheap aviation fuel vanished. In between lay a firestorm of political, technical, and commercial change." BOAC's story is also a cautionary tale on the involvement of governments in commercial affairs. British government ministers were described as using the airline as a guaranteed market for the heavily subsidized British aviation industry—an industry which frequently proved unable to provide adequate and competitive airframes in a timely fashion. Perhaps the most critical misstep was the British government's failure to secure overflight rights for the Concorde. This led to the commercial failure of this superb technical demonstrator.

The book is not without its strong points. The descriptions of the major aircraft used by BOAC are all quite good. Simons offers technical details as well as wonderful, if small, supporting imagery. The production details on the Concorde are excellent. I believe the discussion of the ill-fated Comet and its importance to BOAC is the best part of the book. Clearly, acquiring the "right" aircraft for the right price and delivered at the right time was always a challenge for BOAC until they made the leap to the Boeing 707 and 747 families. But by that time the corporate fiscal situation had become so dire and the airline so politicized that another major restructuring was the only option.

The BOAC story is the story of commercial air travel during the post-World War II period. Technological transitions were arriving at breakneck speed. Societal and economic changes were coming just as fast with the collapse of the British Empire. The need for partnerships came at the expense of profitability. Just as the Beatles commemorated their "dreadful" BOAC experience and arrived in America in 1964 aboard a Pan American jet, many of the coat-and-tie-travel set also chose other carriers.

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



**Reaching for the Moon: A Short History of the Space Race.** By Roger D. Launius. New Haven: Yale University Press, 2019. Illustrations. Bibliography. Index. Pp. viii, 248. \$30.00 Hardcover ISBN: 978-0-300-23046-8

More than three dozen new books about the Apollo 11 lunar mission appeared in the twelve months preceding the fiftieth anniversary of Neil Armstrong and Buzz Aldrin landing on the Moon. An even larger number of new books about the overall Apollo program appeared during the same period. Former NASA chief historian and National Air and Space Museum associate director Roger Launius personally added two titles to the total count: *Reaching for the Moon*, and *Apollo's Legacy: The Space Race in Perspective*.

For those wanting a relatively succinct introduction to the competitive human spaceflight activities of the US and the USSR during the 1960s, *Reaching for the Moon* fits the bill. Launius describes the Soviet Union's early lead and how the US managed to catch up, ultimately winning the race to send humans to the Moon. He critiques how President Kennedy's decision to put an American on the Moon and return him safely to Earth before the decade ended "fundamentally altered the space program then under way at NASA." He interprets the Apollo decision as a model of public policy formulation. Launius then juxtaposes the organizational and technological approaches, along with program leadership (including General Samuel Phillips, USAF) of the two superpowers to shed light on why America ultimately triumphed over Russia. Finally, he ponders the significance of the space race, generally, and America's spectacular lunar missions, specifically, as both "a watershed in world history" and as "an anomaly in human history."

The absence of annotations gave me the impression of a well-written, thoroughly explicated response to a doctoral exam question. The volume amounts to a scholarly A+ synthesis of the who, what, when, how, and why of the space race. Although some readers might criticize the limited attention accorded Apollos 12 through 17, Launius compensates with a brilliant chapter titled "Revelations," where he expounds on "a series of important outcomes," such as "a new environmentalism," "a triumph of engineering and technological virtuosity," significant "scientific return," and bolstered American "pride and prestige" that amounted to "soft power." He also addresses the outcome of the space race as "a fulfillment of the dominant narrative of Soviet/Russian and

American triumph, exceptionalism, and success" that exemplified "a grand visionary concept for human exploration and progress."

Perhaps the most interesting section of this final chapter is Launius's discussion of the Apollo program, decades later, as representing "a powerful incarnation of nostalgia." Film, literature, music, theater, and advertising all manifest Apollo nostalgia. In all those different media, he observes three great themes that evoke Apollo's past: first, a spiritual quest, a purification of humanity, and a search for absolution and immortality; second, the next step in human evolution, with Darwinian overtones of the survival of the fittest; third, "and perhaps most important," harkening back to an era in which order ruled and all seemed in its place. "At a sublime level," Launius speculates, "Apollo nostalgia may serve as a trope for a larger lack of interest in the future expressed by Americans in the first part of the twenty-first century."

While delivering little new historical information, *Reaching for the Moon* offers an abundance of refreshing historical analysis that seems capable of generating meaningful public discussion. If for no other reason, this volume ranks high on my list of recently published books about Apollo and the race to the Moon.

*Dr. Rick W. Sturdevant, Deputy Director of History, HQ Air Force Space Command*



#### 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.)  
3704 Brices Ford Ct.  
Fairfax, VA 22033  
Tel. (703) 620-4139  
e-mail: [scottlin.willey@gmail.com](mailto:scottlin.willey@gmail.com)

# Coming Up



Compiled by  
George W. Cully

#### January 3-6, 2020

The **American Historical Association** will hold its 14th annual meeting at the New York Hilton Hotel in New York City, New York. For registration and program details, see the Association's website at <https://www.historians.org/annual-meeting>.

#### March 13-14, 2020

The **Society for History in the Federal Government** will hold its annual meeting at the Robert C. Byrd Center for Congressional History and Education at Shepard University in Sheperdstown, West Virginia. The theme of this year's gathering is "Stories from the Heart of Government: Politics and History." For more information, see the Society's website at <http://shfg.wildapricot.org/>.

#### March 17-19, 2020

The **American Astronautical Society** will host its annual Robert H. Goddard Memorial Symposium at the Tommy Douglas Conference Center in Silver Spring Maryland. This year's theme is "Innovation and Sustainable Exploration." For more information, see the Society's website at <https://astronautical.org/events/goddard/>.

#### March 18-21, 2020

The **National Council on Public History** will hold its annual meeting at the Westin Peachtree Plaza Hotel in Atlanta, Georgia. The theme for this year's assembly will be "Threads of Change." For registration and schedule details, see the Council's website at [ncph.org/conference/2020-annual-meeting/](http://ncph.org/conference/2020-annual-meeting/).

#### March 30-April 2, 2020

The **Space Foundation** will host its 36th annual Space Symposium at the Broadmoor Hotel in Colorado Springs, Colorado. For registration and other details, visit their website at [www.spacefoundation.org](http://www.spacefoundation.org).

#### April 2-5, 2020

The **Organization of American Historians** will hold its annual meeting and conference at the Marriott Wardman Park Hotel in Washington, D.C. The theme for this year's gathering will be "(In)Equality." For registration and other details, see their website at [www.oah.org/meetings-events/oah20/](http://www.oah.org/meetings-events/oah20/).

#### April 9-11, 2020

The **Vietnam Center and Sam Johnson Vietnam Archive** and the **Institute for Peace & Conflict at Texas Tech University** will jointly host "1970: Nixon and Discord during the Vietnam War". The conference will be held at the MCM Elegante Hotel in Lubbock, Texas. For registration and other information, see the Center's website at [https://www.vietnam.ttu.edu/events/2020\\_Conference/](https://www.vietnam.ttu.edu/events/2020_Conference/).

#### April 16-17, 2020

The **American Airlines CR Smith Museum** and the **University of Texas at Arlington** will co-host the 55th Annual Webb Lecture Series, "Flight Culture and the Human Experience." The Series will feature new and emerging research into the transformation brought by the advent and extension of aviation technologies. For more information as it develops, check the UTA History Department's website at <http://www.uta.edu/history/research/webb-lecture-series/index.php>.

#### April 22-24, 2020

The **Army Aviation Association of America** will host its annual Mission Solutions Summit at the Gaylord Opryland Hotel and Convention Center in Nashville, Tennessee. For more details see the Association's website at [www.quad-a.org/](http://www.quad-a.org/).

#### April 30-May 3, 2020

The **Society for Military History** will hold its 87th annual meeting at the Crystal Gateway Marriott Hotel in Arlington, Virginia. The theme of this year's meeting is "Policy By Other Means." For registration and other information, see the Society's website at [www.smh-hq.org/index.html](http://www.smh-hq.org/index.html).

#### May 4-7, 2020

The **Association for Unmanned Vehicle Systems International** will present Xponential 2020, its premier annual convention and exhibition at the McCormick Place Exhibition Center in Chicago, Illinois. For registration and other details, see their website at [www.auvsi.org/events](http://www.auvsi.org/events).

#### May 6-10, 2020

The **Council on America's Military Past** will host its 54th annual Military History Conference in Baltimore, Maryland. For more details as they become available, see

the Council's website at <http://campjamp.org/upcoming-2020-conference>.

#### May 19-21, 2020

The **Vertical Flight Society** will present Forum 76, its annual forum and technology display at the Palais des congrès de Montréal in Québec, Canada. Forum 76 is the longest-running and most established vertical flight event in the world. For more information, including paper topic presentations, see the Society's website at <https://vtol.org/annual-forum/forum-76>.

#### 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](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/>.

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](mailto:warty@knology.net)

# History Mystery Answer



The F-100 Super Sabre was the first of the Air Force's Century Series of jet fighters (F-100, F-101, F-102, F-104, F-105). While officially named the Super Sabre, the F-100 was affectionately known as the "Hun" (Short for 100). Having first flown in 1953, the North American Aviation F-100's flying career included a series of firsts including being the first USAF jet capable of supersonic speeds in level flight and the first jet to fly over the North Pole. The F-100 was part of the first USAF jet fighters to arrive in Vietnam in 1964. During the war, the "Hun" performed a variety of missions including fighter-escort, close air support, the surface to air missile suppression ("Iron Hand") and as a high-speed forward air control aircraft (FAC), known as ("Misty FAC"). Ultimately, the F-100 flew over 360,000 combat missions. While serving in Vietnam, both future CSAF's Gen Merrill McPeak and Gen Ronald Fogleman flew "Hun" along with Medal of Honor Recipient Bud Day. After 25 years of flying service, the final F-100 retired in 1979. After being retired from active flying,

two hundred plus F-100s continued to serve the Air Force as drones for air-to-air missile testing.

**To read more about the Air War in Vietnam:**

*A War Too Long: The USAF in Southeast Asia, 1961-1975* by John Schlight <https://media.defense.gov/2010/May/25/2001330271/-1/-1/0/AFD-100525-077.pdf>

*The War in South Vietnam The Years of the Offensive 1965-1968* by John Schlight <https://media.defense.gov/2010/Oct/13/2001329762/-1/-1/0/AFD-101013-038.pdf>

*The F-100 in Southeast Asia:* <https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/858858/f-100-super-sabre-in-southeast-asia/>

*The F-100F:* <https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/196002/north-american-f-100f-super-sabre/>



This issue's quiz:

This Cold War Jet fighter served in many countries' Air Forces. The jet was the first in a series of six jets that served as the backbone of the Air Force's fighter force during the 1950's and 1960s. Stationed around the Globe, this fighter also served two stints with the USAF Thunderbirds (1956–1964 and 1964–1968). Finally, this aircraft was one of the first jet fighters to arrive in South Vietnam, where it ultimately served in a variety of roles. Two future Chiefs of Staff of the Air Force and a Medal of Honor recipient flew this aircraft. What was this jet?



Air Force *Historical* Foundation  
P.O. Box 790  
Clinton, MD 20735-0790



To: Air Force *Historical* Foundation  
P.O. Box 790  
Clinton, MD 20735-0790

Visit Us Online at:  
[www.afhistory.org](http://www.afhistory.org)



Know the Past,  
Shape  
the Future

A I R F O R C E H I S T O R I C A L F O U N D A T I O N M E M B E R S H I P F O R M

NAME \_\_\_\_\_ PHONE \_\_\_\_\_ E-MAIL \_\_\_\_\_

STREET ADDRESS \_\_\_\_\_ CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

- Associate Membership (\$25/year) (on-line magazine access)** (Visit our Web site at [www.afhistory.org](http://www.afhistory.org))
  - Sustaining Membership (\$45/year)** GIFT FOR (NAME) \_\_\_\_\_
  - Gift Membership (\$45/year)** ADDRESS \_\_\_\_\_
  - Life Membership (Inquiries to the Foundation)** CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_
- Become a Patron or Contributor (Please ask)**

\* Non-US recipients please add \$8.00 for postage (See Web site for additional membership options)

- Check enclosed, payable in US Funds to Air Force *Historical* Foundation**
- Please charge my credit card (VISA/MasterCard/Discover)**

CARD NUMBER: \_\_\_\_\_ EXPIRATION DATE: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_

Send form, along with your remittance to:  
**Air Force *Historical* Foundation**  
**P.O. Box 790**  
**Clinton, MD 20735-0790**

