WINGS

SUMMER 2024
VOLUME 76 NO.4

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MANAGING EDITOR'S MESSAGE

IN OUR FINAL EDITION OF 2024, I wish to acknowledge the *Wings* team for their commitment and passion in producing the magazine throughout the year. I would also like to thank the AFA, the RAAFA Publications Board and all our advertisers and contributors who provide ongoing support. Most of all, I wish to thank you, our readers.

In this edition, we continue our series on the F-35 JSF aircraft (part 2 of 3) and conclude our interview with the Chief of Guided Missile and Explosive Ordnance, Air Marshal Leon Phillips. We take a look at the developments in innovation and invention during the Battle of Britain along with more recent developments in additive manufacturing (3D printing). There is also a wonderful account of the history of the Australian International Air Show, which will be held in March 2025.

Our series on the RAAF in Vietnam continues with a story on flying Broncos, the Australian War Memorial contribution focuses on the C-130 and we pay tribute to the RAAF service of the P-3C aircraft. The Women in Aerospace article on LACW Jenny Phan, who works on EA-18G Growlers, highlights the career opportunities available in the ADF.

Visit wingsmagazine.org to arrange a personal or Christmas gift *Wings* subscription, or become an AFA member and receive a free subscription.

Enjoy the festive season and all the very best for the New Year.

Rob Amos, Wings managing editor

EDITORIAL DEADLINES

Please send submissions and letters to **managing.editor@wingsmagazine.org**, including your name and details. Submissions maybe edited for length and clarity. We cannot guarantee all material will be published.

EDITION	DEADLINE
Autumn 2025 (March)	13 January
Winter 2025 (July)	21 April

AIR FORCE ASSOCIATION

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A MESSAGE FROM

COMMANDER COMBAT SUPPORT GROUP

AS WE APPROACH THE END OF 2024, the focus of Air Force, indeed the entire Defence enterprise, continues to be on the priorities articulated 18 months ago by the Defence Strategic Review, further guided by the approach to the defence of Australia articulated earlier this year in the National Defence Strategy.

This focus has been consistent, and is multi-faceted. While additional resources and capabilities will be delivered in the years ahead, Air Force must be ready to fight tonight if called on. While concurrently working with the strategic centre to contribute to the shaping and developing of the future force, Air Command in particular has been focused on getting the best from the capabilities and resources we have at our disposal today. In Combat Support Group, this has involved some interesting and difficult challenges.

The nature of conflict continues to evolve as the cyber and space domains become ubiquitous, with almost all players in the modern battlespace having access, to some extent, to both. How we operate today and into the future will not be the same as we have in recent operations and conflicts. As we continue to reinvigorate and build on our force protection, security and agile operations skill sets, the lessons of the conflicts in Europe and the Middle East are being closely observed. There are new lessons being learnt, and some old ones being relearnt. As we refresh our tactics and procedures, we must remain cognisant of the temptation to 'train for the last war', but we ignore the lessons of history at our peril.

It is vital that, alongside the contemporary and cutting edge, we maintain core skills that are still as valuable and necessary in the contemporary combat environment as they were when the RAAF was formed. Consider the not insignificant distances associated with operating across the north of Australia; we might be a better connected force that can almost instantaneously pass significant quantities of data over great distances, but the challenges of moving fuel, food and ordnance over those same distances remain remarkably similar to what they were during World War II. Similarly, modern medicine greatly enhances the chances of recovering from catastrophic injury, but the immediate response to a blast injury or a severed limb today is still the same as it was in the 1940s – it's the person next to you. And, as it has always been, our greatest strength today is our people. It is the contemporary aviator who is coming up with novel ways to get after these challenges, blending modern capabilities with aspects of some time-honoured and tested tactics that are technology agnostic. Some might even say we're seeing a resurgence of some good old-fashioned Australian know-how.

Air Force continues to be a credible and capable force for the defence of Australia. Our cutting edge capabilities, combined with the ingenuity and resilience of our aviators, remain a force to be reckoned with. Whether it is tonight or in the years ahead, Air Force will deliver when called upon.

Air Commodore Robert "Dubbo" Graham

ON THE COVER
A restored RAF Supermarine Spitfire Mark 1a, part of the Imperial War Memorial collection. Photo: Airwolfhound/ World History Encyclopedia.

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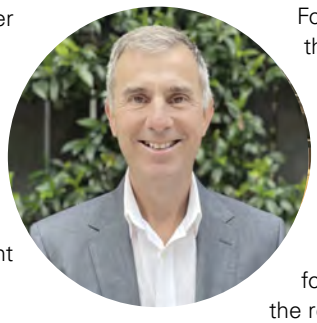

WELCOME TO THE summer edition of *Wings*. As with most changes of seasons, it's a time for us to reflect on where we've been, where we're at, and where we're going with the Air Force Association.

Perhaps the most significant event since my last message was the release of the Royal Commission into Defence and Veteran Suicide's *Final Report* on 9 September 2024. The report is the result of three years of extensive interviews and inquiries by the commissioners. It does not make for comfortable reading, but is a necessary step for truth and transparency into the impacts of service on the individual and their families. I thank all those who have had the courage to contribute during the process. I also acknowledge the courage and drive of Julie-Ann Finney to advocate and lobby for the establishment of the Royal Commission.

The government is yet to formalise its response to the report and the associated 122 recommendations. I know many of the ex-service organisations are still analysing the practical initiatives they can progress to address the issues identified. It has been helpful for me and the National Executive to remain engaged with the State Divisions to garner their views on the approach we, as the AFA, can undertake.

For those who have not read the full report, I recommend you take the time to go through Volume 1 which includes the executive summary, recommendations and an outline on the fundamentals. I have found it helpful to frame the recommendations around the five priority areas identified by the commissioners:

- Prevent harm
- Intervene early
- Improve communication, coordination and collaboration
- Build capability and capacity
- Strengthen oversight and accountability.

I appreciate that we all have numerous things on our plates. Equally, as we lead up to Christmas, I know this can be both a joyous and stressful time for many. Please be kind to each other, and yourselves, too. When we connect with others, we can often find that our burdens are lessened. Reach out to those who you may not have spoken with in a while to check in. It will make a world of difference.

Thank you for your ongoing support and enjoy this edition of *Wings*.

Joe Iervasi
National President,
Chair of the AFA Ltd Board of Directors

CORRECTION

The spring edition of *Wings* included two incorrect QR codes (pages 14 & 15). To see Paul Murray's Fighter World simulator experience, scan the code below. To see the Wings Australia YouTube channel, scan the QR code on page 65. We apologise for the error and any resulting frustration.

LETTER TO EDITOR

Your article entitled 'The Supreme Sacrifice' in the spring edition caught my attention because of a similar event which took place on Bougainville during WWII.

In April 1943, Catalina A24-43 from RAAF No 11 Squadron was assigned to drop supplies to some coast watchers on Bougainville. My father, CPL Stan Warren (pictured) was scheduled to fly out on that mission as an air gunner, but was hospitalised due to acute stomach problems. His friend, CPL Jack Fenwick took his place but never returned.

The plane crashed, possibly due to enemy fire, near Aita on Bougainville Island. Some of the crew were killed instantly, namely F/LT Clark, F/O Potts and SGT Ward. With the aid of the coast watchers, who quickly located the wreckage, the surviving crew members were helped to an AIF commando encampment to await rescue on a US submarine.

CPL Jack Fenwick lay injured with a badly broken leg when Japanese troops located the group and opened fire. One of the commandos, Lt Bedkober, heroically stayed to defend the wounded airmen. Bedkober and Fenwick were taken captive. Fenwick was sent to Tunnel Hill POW Camp on the island of New Britain and subsequently to Talili Bay where he was reportedly executed in March 1944. He is interred in the Bita Paka War Cemetery in Rabaul.

Although I was not born until 1951, I hold the memory of Jack Fenwick in high regard. For in a strange way, and sadly for Jack, I would not be here to put pen to paper had events unfolded differently.

(Note: I have extracted information from Catalina Chronical *by David Vincent, and from pacificwrecks.com.)*

Rob Warren, Mona Vale, Sydney

EDITED BY Bob Treloar

USAF B-2 Spirit

BOMBERS RETURN

THREE US AIR FORCE (USAF) B-2 SPIRIT BOMBERS participated in a Bomber Task Force mission while deployed at RAAF Base Amberley, Qld in August and September, flying some 295 hours on 34 sorties. The bombers from the 509th Bomb Wing and 131st Bomb Wing, Whiteman Air Force Base, Missouri were supported by two KC-135R tankers from the Illinois National Guard and operated with USAF F-22 and RAAF F-35A aircraft.

Bomber Task Forces typically last two to three weeks, with training events to practice interoperability and deployments with Allies to gain experience operating from airfields unaccustomed to supporting bomber operations.

Source: Air and Spaces Forces Magazine

LEFT A RAAF E-7A Wedgetail, two EA-18G Growler jets and two F-35A Lightning II aircraft in formation with two USAF B-2 Bombers and two F-22 Raptor fighter jets. Photo: FSGT Christopher Dickson.

B-21 PROGRAM PROGRESSES

THE B-21 RAIDER PROGRAM, begun in 2011 as the classified Long Range Strike Bomber project, emerged from the shadows in 2015 when the Defense Department announced it would award a contract to Northrop Grumman. The first test aircraft was formally introduced at Air Force Plant 42 in Palmdale, California, in December 2022.

The Raider is the USAF's first bomber in three decades and is being built using agile software development and digital engineering tools. It is a strike stealth bomber capable of delivering both conventional and nuclear munitions.

Part of the ongoing nuclear triad modernisation, it will be one member of a larger family of systems for conventional long-range strike, including intelligence, surveillance and reconnaissance, electronic attack and communication capabilities. It is also designed to accommodate manned or unmanned operations. The program is expected to deliver 100 aircraft.

Source: National Defense Magazine

AUKUS KILLER DRONE TRIALS

IN AUGUST, the AUKUS partners, Australia, the UK and the US, conducted trials using AI-enabled uncrewed aerial vehicles (UAVs) designed to enhance military operations by allowing human operators to locate, disable and destroy ground targets. The trial marked the first real-time military exercise where autonomy and AI were integrated into UAV operations to demonstrate the use of AI and autonomous systems to reduce the time required to identify enemy targets, while operating at lower risk levels.

The trial included drones from each AUKUS nation, operating together in the same airspace, supported by an AI team that adjusted and deployed AI capabilities on the platforms.

Source: UK Defence Journal

ABOVE British Blue Bear drones.

USAF orders rapid prototyping of E-7A Wedgetail

THE USAF HAS ORDERED the rapid prototyping of two E-7A Wedgetails. Boeing, as the prime contractor and the original equipment manufacturer of the Wedgetail, will produce the prototypes under a contract modification valued at more than US$2.5 billion at Tukwila, Washington, expected to be completed in August 2029.

The US has already begun to prepare its forces for the incorporation of the Wedgetail and has worked closely with partner nations to achieve that readiness. In November 2023, NATO ordered six aircraft, with an anticipated introduction into service in 2031. The E-7A is currently operated by Australia, South Korea, Turkey and the UK.

Source: Air Force Technology

ABOVE A USAF Aircraft Technician marshals an E-7A Wedgetail from No 2 Squadron for a flight at RAAF Base Darwin during Exercise Pitch Black 24. Photo: DVIDS.

GHOST BAT MILESTONE

BOEING'S MQ-28A GHOST BAT PROGRAM achieved another milestone in August when the first RAAF operator took to the controls of the aircraft. Wing Commander Phil Parsons was the first non-Boeing pilot to complete training as remote systems pilot on the Ghost Bat. He has been a remote systems pilot for the past decade.

MQ-28A is designed to team with piloted aircraft through an 'operator-in-the-loop' approach. Boeing's MQ-28A co-development program with the RAAF is accelerating, with the focus shifting from testing the aircraft's flying and handling qualities to capability advancement including progressing teaming behaviours, mission systems, sensors and payload testing.

Source: Defence Connect

RAAF to train
LUFTWAFFE PILOTS

GERMANY WILL TRAIN its military pilots in Australia, with a declaration of intent signed between the two air force chiefs in August that will see the first Luftwaffe pilots arrive in Australia in 2025.

NATO standards require that each pilot log 180 flight hours per year (40 on simulators), but low aircraft availability in the Luftwaffe has reduced training throughput. The Luftwaffe trainees will undergo lead-in fighter and tactics training on the Introductory Fighter Course (IFC) on Hawk Mk 127 aircraft and on simulators at RAAF Pearce. IFC training is also provided at RAAF Williamtown.

Relations between the RAAF and the Luftwaffe deepened in 2022, when the German Air Force participated in Exercise Pitch Black for the first time.

Source: Janes

ABOVE A mock-up of an F-35A in Luftwaffe markings. It's first F-35 is expected in 2026.

BLACK HAWK FLEET EXPANDS

TWO UH-60M BLACK HAWK helicopters delivered by a USAF C17 Globemaster to RAAF Base Richmond in July bring the Army Black Hawk fleet to eight. A total of 12 new Lockheed Martin-built helicopters are scheduled to be delivered by the end of the year, with a total of 40 aircraft scheduled for delivery by 2029. The fleet will be based at Oakey, Qld and Holsworthy, NSW.

Each UH-60M utility helicopter has a useful load of 3,100kgs or 12 fully equipped, seated troops. Mission capability includes combat assault, medical evacuation, aerial firefighting, search and rescue, special operations, and VIP transport.

Source: Australian Aviation

ABOVE Two Australian Army UH-60M Black Hawk helicopters on the tarmac at RAAF Base Richmond. Photo: CPL Emma Schwenke.

BELOW Retired Caribou aviators and 35 Squadron Association members with a restored de Havilland DHC-4 Caribou at the RAAF Amberley Aviation Heritage Centre. Photo: Sergeant Peter Borys.

Wallaby Airlines remembered

IN AUGUST, No 35 Squadron Association members gathered at RAAF Base Amberley to commemorate the 60th anniversary of the deployment of RAAF Caribou aircraft to Vietnam.

A twin-engine short take-off and landing tactical transport of rugged construction and an ability to lift useful payloads out of short, rough airstrips, the Caribou was ideal for its primary role of supporting troops in the field.

During their Vietnam service, Caribous carried more than 700,000 passengers and 41,300 tonnes of freight while logging 79,739 sorties and 47,000 flying hours.

Based out of Vung Tau and known as 'Wallaby Airlines', No 35 Squadron was the first RAAF unit to serve in Vietnam and the last to withdraw, leaving the country in 1972.

Source: DoD

APACHE SUSTAINMENT PACKAGE

IN AUGUST, the US Defense Security Cooperation Agency approved the sale of support and sustainment services for Australia's AH-64E Apache fleet. Worth AU$443 million, the approval includes personnel training, technical documentation, contractor support and the cost of US Government employees working on the AH-64E program. Four personnel from the US Government and prime contractors Lockheed Martin and Boeing will be based in Australia for up to five years.

Source: Australian Defence Magazine

Farewell F-15C EAGLES

A FOUR-SHIP OF F-15C EAGLES departed USAF Kadena Air Base, Japan in August, headed for disposal or to be used at other Air Force units. They are being replaced with the F-15EX Eagle IIs.

Combat capable since September of 1975, F-15C aircraft have an impressive record with over 100 wins and zero losses in aerial combat. The final flight of the remaining F-15C Eagles out of Kadena is yet to be determined.

Source: U.S. Indo-Pacific Command

ABOVE An F-15C Eagle taxis down the flightline at Kadena Air Base, Japan. Photo: Senior Airman Jessi Roth, 18th Wing Public Affairs.

Block II IRST Pods FOR SUPER HORNETS

THE RAAF WILL RECEIVE 12 ASG-34A(V)1 Block II Infrared Search and Track (IRST) pods for its fleet of 24 F/A-18F Super Hornets in 2024 and 2025 in a $74 million Foreign Military Sales case with the US Navy.

Block II IRST Pods are modified FPU-12/A centreline fuel tanks with the nose changed to accommodate a Lockheed Martin IRST21 sensor. The modified tanks, known as FPU-13/A carry 490 fewer litres of fuel compared with the standard FPU-12/A and will not require upgrade of the F/A-18F aircraft to the Block III standard.

Block II pods, which first flew in late 2019, are yet to enter operational service. They have better performance than the Block I system and are also lighter and smaller, which allows more fuel to be carried in the tank portion of the unit.

Source: ADM

A US Navy F/A-18F equipped with a Block I IRST pod flying in the Middle East. Photo: US Navy.

Red Flag strengthens COMBAT CAPABILITIES

US MILITARY FORCES and the RAAF participated in air and ground operations during Red Flag-Alaska 24-3 at Eielson Air Force Base, Alaska in August. A Pacific Air Forces directed exercise, it provided field training for US and international forces flown under simulated air combat conditions at Joint Pacific Alaska Range Complex.

Red Flag integrated US Army, Air Force, Navy and Marines from 33 different units and Allied forces in all aspects of air and ground operations. It was the first Red Flag without a dedicated aggressor squadron and US military forces and RAAF provided both blue and red air forces. Blue air is the team being trained, while red air plays the role of the adversary to challenge and improve the skills of blue air. The US Navy integrated the Tomahawk Land Attack Missile activities within the exercise.

Source: DVIDS

A 3 Squadron F-35A Lightning II. Photo: Senior Airman Julia Lebens.

TYPHOON CRASH AT PITCH BLACK

AN ITALIAN AIR FORCE EFA 2000 Typhoon aircraft encountered an unknown issue during a training flight that resulted in the pilot ejecting and the aircraft crashing during Pitch Black in July. The pilot was uninjured and was transported to Darwin hospital.

The crash site, outside of the Darwin and Katherine flying areas, is the subject of a crash investigation. The cause of the accident is yet to be determined.

Around 140 aircraft, 4,500 personnel and 20 nations participated in the exercise.

Source: DoD

Second Triton enters testing

FOLLOWING A 3,770KM FLIGHT from Northrop Grumman's Palmdale, California facility, the RAAF's second MQ-4C Triton, A57-002, arrived at Naval Air Station Patuxent River on 29 August where it will be tested by US Navy Air Test and Evaluation Squadron 20 (VX-20) to provide certification.

The RAAF's first MQ-4C Triton, A57-001, was formally handed over to the Air Force in late July at RAAF Tindal. Initial Operational Capability for the Triton is not expected until at least mid-2025.

Source: ADM

Growlers' Indian DEPLOYMENT

THE RAAF DEPLOYED three EA-18G Growler aircraft from No 6 Squadron along with 120 personnel to India in August to participate in Exercise Tarang Shakti. It is the first time India has conducted the exercise, held at Air Force Station Jodhpur, with 11 participating nations and 18 observer nations attending.

Australia and India have enjoyed increased air defence cooperation in recent years, including hosting Indian Air Force Flankers at Exercise Pitch Black in 2018, 2022 and 2024.

Air Force also conducts several training and engagement activities with Indian Navy P-8I Neptune surveillance aircraft.

Source: DoD

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Companionship FOR VETERANS

AS ONE ELEMENT of the Air Force Association (AFA) commitment to provide support for the broad veteran community, AFA NSW recently initiated a program to provide companionship dogs to selected veterans who face challenges such as PTSD and social anxiety. Working through Defence Community Dogs (DCG) (dcdogs.com.au), the first of our squad was identified and inducted onto the requisite training program.

Following two years of maturity and training by the inmates of the Bathurst Correctional Centre, Twix (callsign Mr Majestic) graduated on 26 August 2024 and has been paired with Ian, a RAAF veteran suffering PTSD and social anxiety who has been reluctant to venture beyond the house. Ian is delighted with his new companion and looks forward to going on outings to the movies with Twix. AFA NSW is thrilled to be able to enhance life's quality for one deserving member of our family.

ABOVE DCG Managing Director Leanne Kyle and AFA NSW President Ron Glew with Twix.

Maryborough MEMORIAL WALL

THE MARYBOROUGH MILITARY AVIATION MUSEUM ASSOCIATION is looking for relatives of 569 men who trained at the No 3 Wireless Air Gunner School (3WAGS) at RAAF Station Maryborough and died in service during World War II.

Under the Empire Air Training Scheme set up in December 1939, Maryborough was chosen as a facility for a military air base serving the RAAF for 3WAGS and other units. Between October 1941 and December 1944, 29 courses were provided by 3WAGS.

Each month a new intake of trainees (ranging from 70 to more than 100) joined a course and after 24 weeks they graduated and moved to Bombing and Gunnery School at either Evans Head, NSW, Port Pirie, SA or Sale, Vic to complete the gunnery component of the course. As wireless operators or air gunners, they became crewmembers for various RAF and RAAF squadrons and served in all theatres of the war. Those who perished died in air battles, aircraft accidents or as prisoners of war.

Volunteers undertook hundreds of hours of research to identify the 569 men, including staff, killed in active service.

With funding from the Department of Veterans' Affairs Saluting Their Service grant program, the association has designed a memorial wall with the 569 names cut into 24 steel composite panels. The panels have been installed along the southern boundary of the museum complex site at the Maryborough airport – the area where 3WAGS operated during WWII.

The museum is in contact with a few local men who were there during the war and some local families related to men who trained at 3WAGS. It is now trying to contact as many relatives as possible around Australia. If you can help, email mmamsecretary@gmail.com or contact David Geck, 0434 104 601, or Jenny Elliott, 0447 846 317, or visit the 'Maryborough Military Aviation Museum' Facebook page.

Sir Valston Hancock House opens its doors

RAAFA WESTERN AUSTRALIA'S first targeted accommodation program for local veterans, Sir Valston Hancock House, was officially opened on 25 September.

AFA National Vice President, Deanna Nott, RAAF WA President, Clive Robartson and RAAF WA CEO Michelle Fyfe APM attended the opening event alongside other dignitaries, including the Governor of Western Australia, His Excellency the Honourable Christopher John Dawson AC, APM and his wife, Darrilyn Dawson, federal Minister for Veterans' Affairs and Defence Personnel, Matt Keogh, and WA Minister for Defence Industry and Veterans Issues, Paul Papalia CSC, MLA. The purpose-built facility was delivered by RAAF WA with support from RSL WA and Hancock Prospecting, which purchased and refurbished the South Perth property in December 2023. Over the next 12 months, RAAFA WA plans to welcome at least 15 veterans as part of its commitment to addressing homelessness within the veteran community. Veterans in need of help can email veteranhousing@raafawa.org.au

Battle of Britain COMMEMORATION

THE NATIONAL BATTLE OF BRITAIN commemorative service was held in Hobart from 13-15 September. It was the 35th year the commemoration has been hosted in Hobart by AFA (Tasmania).

This year marks 84 years since the WWII campaign, 10 July – 31 October 1940. More than 30 Australians flew combat operations during the Battle of Britain and 10 were killed in action.

Key commemoration events included a memorial service at St David's Cathedral and a formal dining-in night where Air Commodore James Badgery proposed a toast to The Few. The formalities concluded with a wreath-laying ceremony at the Hobart Cenotaph where dignitaries representing former allies and foes joined RAAF personnel to lay wreaths and pay respect to those who fought.

The commemorations were led by Wing Commander Jenny Robertson, AFA Tasmania State President, alongside National AFA Board member Air Commodore Doug Chipman (ret'd). Special guests included Her Excellency the Hon. Barbara Baker AC, Governor of Tasmania and Air Marshal Stephen Chappell, Chief of Air Force, who delivered a heartfelt address at the wreath laying ceremony. "Whether in the cockpit, in the hangar, or at the plotting tables, everyone involved fought the battle with tenacity, courage and devotion to their duty," he said. "While 84 years later we have very different aircraft and technology, at the heart of each aviator remains the same determination to serve and defend our nation."

During the ceremony, an aerial display by the Air Force Roulettes, and flypasts by two Hawk 127s and a P-8A Poseidon, showcased Air Force's modern capabilities.

Ceremonial support was provided by No 29 (City of Hobart) Squadron, the Air Force Band and Australian Air Force Cadets.

AFA National Board members Air Commodore James Badgery AM, Greg Hood AO, Brigadier Jim Campbell AM and several military attaches also attended.

The event also welcomed 104-year-old FLTLT Brian Winspear AM, a distinguished WWII veteran.

The Battle of Britain is regarded as the first military campaign fought entirely by air forces, a significant milestone in the evolution of military aviation combat operations. For more, see page 48.

BELOW From left, representatives of the Netherlands Armed Forces, the German Armed Forces, the RAF and the USA at the wreath-laying ceremony. Photo: CPL Brett Sherriff.

76SQN standard CONSECRATION

ON 30 AUGUST, AVM Glen Braz AM, CSC, DSM, Air Commander Australia, reviewed the 76 Squadron Standard Consecration Ceremony on behalf of the Governor General. GPCAPT Neville O'Donnell, OC 78WG, hosted the parade as WGCDR Leon Cossins, CO 76SQN, commanded the parade.

The squadron standard is awarded by order of the Sovereign for 25 years of service in the Australian Flying Corp or the RAAF. It is the second 76SQN standard.

76SQN was formed on 14 March 1942 in Archerfield, Qld, flying P40E Kittyhawk aircraft, and was immediately deployed to Milne Bay to confront the advancing Japanese. Since then, the squadron has served in New Guinea, Borneo, Japan, Malta and at RAAF Base Williamtown, where it currently provides training for fast jet pilot and air combat officer trainees, along with ADF support activities.

ABOVE The RAAF Parade Colour Party during the 76SQN Colour Consecration parade at RAAF Base Williamtown. Photo: ACW Laura Flower.

Veteran recognised FOR SCULPTURE

AFA-SA VICE PRESIDENT, Dr Robert Black (GPCAPT ret'd) attended a special presentation at RAAF Base Edinburgh in October where the family of the late Colin Dudley DFC received the Henry Hering Medal, an international sculptor award.

Colin Dudley, a RAF WWII Bomber Command veteran, completed 39 missions with 578SQN as a navigator flying Halifax bombers – all with the same crew. He was awarded the Distinguished Flying Cross (DFC) in January 1945 for his actions with the squadron.

After the war, Dudley worked as an art teacher. He moved to Australia in 1983 and completed a PhD in the geometry design of gothic medieval cathedrals. He was commissioned to paint the Prince of Wales receiving the Freedom of the City of Canterbury, Kent, England (now part of the British National art collection) and designed the gates for St Augustine's Abbey in Canterbury.

A talented sculptor and active member of the 578SQN veteran community, Dudley was asked to design a bronze wreath for a new Bomber Command Memorial in London. He devoted several years to the creation, which he presented to the RAAF at the AFA (SA), Torrens Parade Ground in 2012. It was transported to the Middle East and handed over to the RAF for transport to London, to become part of the Bomber Command Memorial.

In 2023, the New York-based National Sculpture Society recognised the memorial by awarding the Henry Hering Medal to five people instrumental in its design and construction, including Colin Dudley. Sadly, Dudley had died in 2014 and his family could not be contacted, so the award was presented to a RAAF officer.

Early this year, the RAAF and AFA (SA) located Dudley's family and the medal was presented to his daughter, Celia Murray, by GPCAPT Greg Weller, Deputy Senior Air Force Representative (SA) at a special ceremony at RAAF Base Edinburgh.

The service concluded with Dr Black reciting the Ode prior to the sounding of Last Post and Rouse performed by Joss Willmott, Colin Dudley's grandson.

LEFT The Henry Hering Medal..

ABOVE Robert Black, Celia Murray, John Horsburgh (Vice President Bomber Command Association Australia) and GPCAPT Greg Weller at the ceremony.

AFA EXPANDS DIGITAL PRESENCE

THE AFA IS EMBRACING new digital platforms and a refreshed image to connect with veterans from all branches of service. Recent enhancements include redesigned marketing materials and the launch of national Facebook and LinkedIn pages, creating an inclusive space for veterans and their families to stay informed and engaged.

AFA President and Chair, Air Vice-Marshal Joe Iervasi AM, CSC, who joined the RAAF in 1985 and retired from full-time service in 2022, said the Association had always been committed to advocating for veterans.

"With our updated digital presence, we're building a space where veterans, whether newly transitioned or long-serving, can feel a sense of belonging and support," he said. "We are committed to staying relevant and accessible to all veterans. Our new digital platforms will not only inform but also foster connection among our members nationwide, creating a unified community. Together, the AFA continues to advocate, commemorate and support the veteran community as it grows and evolves."

The AFA remains dedicated to advocating for all veterans, including those from the Navy and Army, and is a strong voice within the Department of Veterans' Affairs Ex-Service Organisations Round Table. The national board includes distinguished members such as former Chief of Air Force, Air Marshal Mel Hupfeld AO, DSC (ret'd), Greg Hood AO, Brigadier James Campbell AM (ret'd), Air Commodore James Badgery AM and Honorary Secretary/Treasurer Peter Colliver OAM.

AFA Vice President, Wing Commander Deanna Nott, an active Reservist and seasoned communications professional, said the new digital presence would assist the AFA with its veterans' homelessness initiative.

"For over 100 years, the Air Force Association has been there for Australian veterans," she said. "We're continuing that proud legacy by raising funds for vital accommodation and services for veterans facing homelessness.

"Our housing-first approach, delivered through dedicated partners, ensures veterans and their families can rebuild their lives with the support they deserve."

The Association invites veterans and supporters to follow its Facebook and LinkedIn pages to keep up with news, events and updates.

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Your legacy isn't just etched in the skies – it continues with you.

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SCAN ME

TRANSITION FINANCIAL SUPPORT

THERE IS A LOT to consider when you transition from the ADF, particularly in relation to financial options and support.

The Defence website has a section dedicated to transition (defence.gov.au/transition), which includes pages outlining the financial support options available to help you prepare for transition – in the next year or further down the track. The Civilian Literacy on the Cost of Living factsheet gives you an idea of some of the hidden civilian expenses you might not think of as you might currently receive these as part of your conditions of service.

Air Commodore Kaarin Kooij, Director General Joint Transition Authority says that with the current cost-of-living concerns, it is imperative ADF personnel and their families fully consider all the financial aspects of leaving ADF service. "Use all the tools available to you to compare your current financial circumstances to the employment, housing and lifestyle circumstances you are contemplating on transition," he says.

"You may also be eligible to access a $1,000 contribution towards professional advice, but remember that this will not fully cover what you may need."

The Defence website provides links to other agencies that can support transition, including the Commonwealth Superannuation Corporation (CSC).

Engaging your family in the process is important, including in financial education. Information about the ADF Financial Services Customer Centre (also known as ADF Consumer) can be found on the Family Financial Advice page of the Defence website. ADF Consumer provides a wealth of impartial financial education to ADF personnel and their families, including the Employment Package Estimator, to allow you to understand the true value of your current ADF remuneration.

To help breakdown financial information, helpful fact sheets include Wellbeing and Compensation Advocacy, Transition and your Super, and Medical Transition and your Super, all endorsed by the CSC and DVA.

In addition to the advice provided at ADF Member and Family Transition Seminars, CSC holds group education seminars and one-on-one consultations on bases throughout the year.

Caroline Falconer, Joint Transition Authority

C Transition Coaching and Support, May Thian at the 2024 Welcome to Cerberus community event in Hastings, Victoria. Photo: LSIS Sittichai Sakonpoonpol.

Remembering The Few, SA

ON 14 SEPTEMBER, AFA-SA and RAAF Edinburgh hosted the 2024 Battle of Britain commemorative service at the Air Force Memorial, Torrens Parade Ground, Adelaide.

More than 100 attendees, including dignitaries, Air Force serving and ex-serving veterans and AFA-SA friends and stakeholders came together to commemorate The Few – the Commonwealth aircrew, supported by ground crews, who fought in the incredible air campaign that resulted in the first military defeat of Germany in WWII. In particular, they acknowledged the eight South Australians who flew in the Battle of Britain.

His Excellency, Dr Richard Harris SC, OAM, Deputy Governor of South Australia attended as a special guest, sharing the day with WWII veteran Ray Merrill DFC and the families of several Battle of Britain aviators. The service was supported by Australian Air Force Cadets and aviators from No 1 Remote Sensor Unit based at RAAF Base Edinburgh.

ABOVE A RAAF Edinburgh aviator places rosemary on the Battle of Britain Wreath at Adelaide's Battle of Britain Commemorative Service.

Upcoming Seminars 2025

- **Feb 10** SLG Seminar, Vibe Hotel, Canberra
- **Feb 19** ADF Transition Seminar, Royal International Convention Centre, Brisbane
- **Feb 20** JTA Stakeholder Forum, Royal International Convention Centre, Brisbane
- **Feb 26** Virtual Live Day, online
- **Mar 12** ADF Transition Seminar, Melbourne Convention Centre
- **Mar 13** JTA Stakeholder Forum, Melbourne Convention Centre
- **Mar 18** ADF Transition Seminar, Optus Stadium, Perth
- **Mar 19** JTA Stakeholder Forum, Optus Stadium, Perth
- **Mar 26** Virtual Live Day, online

Please note: bookings will be available once the above dates are confirmed. defence.gov.au/transition

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EDITED BY John Kindler

Hypersonix DART, a 3.5m hydrogen fuelled Mach 7 aircraft powered by a single air-breathing SPARTAN scramjet engine.

Hypersonix SIGNS WITH UK MOD

AUSTRALIAN HYPERSONIX LAUNCH SYSTEMS, which specialises in hydrogen scramjet propulsion technology and hypersonic aircraft design and manufacture, has signed a framework contract with the United Kingdom Ministry of Defence (MoD) to advance the UK's hypersonic capabilities.

The MoD will spend approximately $1.9 billion over seven years to deliver its Hypersonic Technologies and Capability Development Framework (HTCDF) initiative, sourcing services, technologies and testing capabilities from more than 90 accredited framework suppliers, including Hypersonix.

The UK HTCDF contract comes 12 months after Hypersonix was awarded the HyCAT program by the United States Defense Innovation Unit to build and fly Hypersonix's DART hypersonic test bed.

Source: Defence Connect

EOS' $9 million Defence contract

CANBERRA-BASED ELECTRO OPTIC SYSTEMS (EOS) has secured a $9 million contract with the ADF Joint Capabilities Division to further develop space capabilities. That is on top of a $5 million contract announced by EOS' Space Technologies business in April. The project is expected to be delivered in late 2024 and 2025.

Source: Defence Connect

Next-generation combat aircraft

THE THREE GLOBAL COMBAT AIR PROGRAMME (GCAP) NATIONS, UK, Italy and Japan, unveiled a new concept model of their next-generation combat aircraft at Farnborough International Airshow. Exhibiting at the show together for the first time, the GCAP partners and their lead industry partners, BAE Systems (UK), Leonardo (Italy) and Mitsubishi Heavy Industries (Japan), showcased the strides they are making to deliver a truly next-generation combat aircraft.

The concept model features a more evolved design than previous concepts with a larger wingspan to improve aerodynamics. Engineers from the three lead industry partners are working together under a collaboration agreement on the design and development of the aircraft using a range of innovative digital tools and techniques, including computer-based modelling and virtual reality to evolve the aircraft's design during its conception phase.

The combat aircraft, set to be in service in 2035, will be one of the world's most advanced, interoperable, adaptable and connected fighter jets in service, boasting an intelligent weapons system, a software-driven interactive cockpit, integrated sensors and a powerful next-generation radar capable of providing 10,000 times more data than current systems, giving it a battle-winning advantage.

Source: Defence Connect

ABOVE Computer generated image of the concept model of a next-generation combat aircraft.

Trailblazer missile DEFENCE PARTNERSHIP

A NEW ILAUNCH Trailblazer project aims to strengthen defence research in Australia by maturing a full stack missile detection capability. Northrop Grumman Australia and Spiral Blue are working together on the project.

"We are bringing together Australian knowhow to build an advanced space surveillance system for missile defence tailored for deployment on small satellites," said iLAuNCH Trailblazer Executive Director, Darin Lovett.

The mission aspires to cultivate a new sovereign capability for hypersonic missile detection through the fusion of cutting-edge infrared detection technology and industry-leading space-based artificial intelligence (AI) and machine learning (ML) data processing techniques.

Anticipated outcomes encompass hypersonic vehicle radiance and trajectory modelling, comprehensive design and rigorous analysis of an infrared electro-optical system, by leveraging state-of-the-art infrared detectors and space edge AI/ML hardware and algorithms for on-board event detection.

Source: ADM

Australian-first loitering munition

THE COMMONWEALTH GOVERNMENT will support the third phase of development of Innovaero's OWL B precision loitering munition with the manufacture, test and evaluation of the capability to refine its performance, reliability and interoperability with existing ADF assets.

The contract award follows a series of live fire tests overseen by the Perth-based company, Commonwealth agencies and the Australian Army in 2023 and 2024 where the system completed successful flight tests and payload integration.

Innovaero designs, develops, manufactures and certifies sovereign aeronautical products in Australia. The OWL B system, designed to provide a tactical advantage in various operational scenarios, represents a significant advancement in the precision loitering munition technology.

Source: Defence Connect

HYPERSONIC FLIGHT TEST SERVICE

AUSTRALIAN LAUNCH SERVICES company Gilmour Space Technologies is launching a new suborbital flight test service in Australia aimed at commercial and Defence customers that require hypersonic speeds above Mach 5 (more than five times the speed of sound).

The company identified a growing bottleneck in high-speed flight test capabilities as designs progress from concept to prototyping and testing.

Director of Launch Vehicles and Satellites at Gilmour Space, David Doyle said that while wind tunnel tests (which offer hypersonic flow for 200 to 300 milliseconds) are excellent for early stage testing of materials and geometries with scaled-down models, a significant challenge remains in scaling the technologies to full-size applications.

"Our new hypersonic flight test service will help to bridge that gap by providing a real-life environment for researchers and companies to test, demonstrate, and advance their innovations to higher technology readiness levels in Australia," Doyle said.

The Hyper Flight service, set to launch in 2025 from a few potential sites, leverages Gilmour Space's orbital launch vehicle technology.

Meanwhile, Hypersonix and Southern Launch have signed a memorandum of understanding to collaborate on providing a hypersonic test bed service. They will work on a concept of operations for a hypersonic testbed launch and return service using Hypersonix's vehicles and Southern Launch's facilities. Southern Launch says the joint mission could launch in late 2025.

Source: ADM

Australian SATELLITES LAUNCHED

THREE AUSTRALIAN SATELLITES blasted off from SpaceX's Transporter 11 mission in August. CUAVA-2, Kanyini and Waratah Seed lifted off from Vandenberg Space Force Base in California.

The Waratah Seed Space Qualification Mission is a NSW government-funded space-flight qualification initiative delivered by the University of Sydney. It is carrying tech from five competition-winning NSW space start-ups as well as technology from commercial clients.

Kanyini is SA's bushfire-detecting satellite, a collaboration between the state government, SmartSat CRC, satellite manufacturer Inovor Technologies and global IoT provider Myriota. Its payload includes a hyperspectral imager which will be used to detect information beyond the visible eye, including analysing vegetation and soil to a granular degree and detecting bushfire smoke.

CUAVA-2 is the second iteration of the CUAVA organisation's CubeSat program. CUAVA is the Australian Research Council's training centre for CubeSats, uncrewed aerial vehicles and their applications. It will carry a hyperspectral imager developed by the Space Photonics Group at Sydney University as well as a GPS reflectometry payload developed by the Australian Centre for Space Engineering Research at the UNSW.

Transporter-11 was the 12th flight for the first-stage booster supporting this mission, which previously launched SDA-0A, SARah-2, and nine Starlink missions. Onboard the latest were 116 payloads, including CubeSats, MicroSats, and an orbital transfer vehicle carrying eight of those payloads, five of which will be deployed at a later time.

Source: Space Connect

737 deep maintenance facility

CONSTRUCTION HAS BEGUN on a deep maintenance and modification facility for the RAAF fleet of 737 variant aircraft. The $200 million facility is being built adjacent to RAAF Base Edinburgh on land owned by the South Australian Government. It will accommodate up to four 737 aircraft at a time and include offices, workshops, stores and plant rooms.

The facility, expected to be complete in mid-2026, will replace a modified hanger on base at RAAF Edinburgh. It will support the RAAF's fleet of 14 P-8A Poseidon and six E-7A Wedgetail aircraft as they undergo regular maintenance and upgrades.

Laser wins $1 million Sandbox

MELBOURNE STARTUP AIM Defence has taken out first place at the international Counter Drone Sandbox in Canada, netting a $1 million dollar prize with its Fractl:1 Tactical Directed Energy Laser.

The Sandbox is part of the Canadian Armed Forces' Innovation for Defence Excellence and Security program which has run biannually for the past six years and is internationally regarded as an independent assessment of counter drone capabilities for both NATO and Five Eyes allies.

The win cements AIM's position at the forefront of low-cost and compact Tactical Counter-Drone Systems and follows an Australian Government decision to spend $5.4m to purchase a Fractl counter drone system for internal test and evaluation.

The Fractl system uses in-house developed state-of-the-art AI tracking and ultra-compact laser technology and has integrated with US Space Force to safely engage above the horizon.

During the Sandbox event, Fractl was able to track and neutralise drones up to 1.5km away, and successfully shot down more than 30 targets.

Source: Defence Connect

MODEL 437 COMBAT DRONE

THE FIRST KNOWN PROTOTYPE of the Model 437 from Northrop Grumman subsidiary Scaled Composites has flown. The design has been in development as an advanced loyal wingman air combat drone since at least 2021, but this initial example has a cockpit.

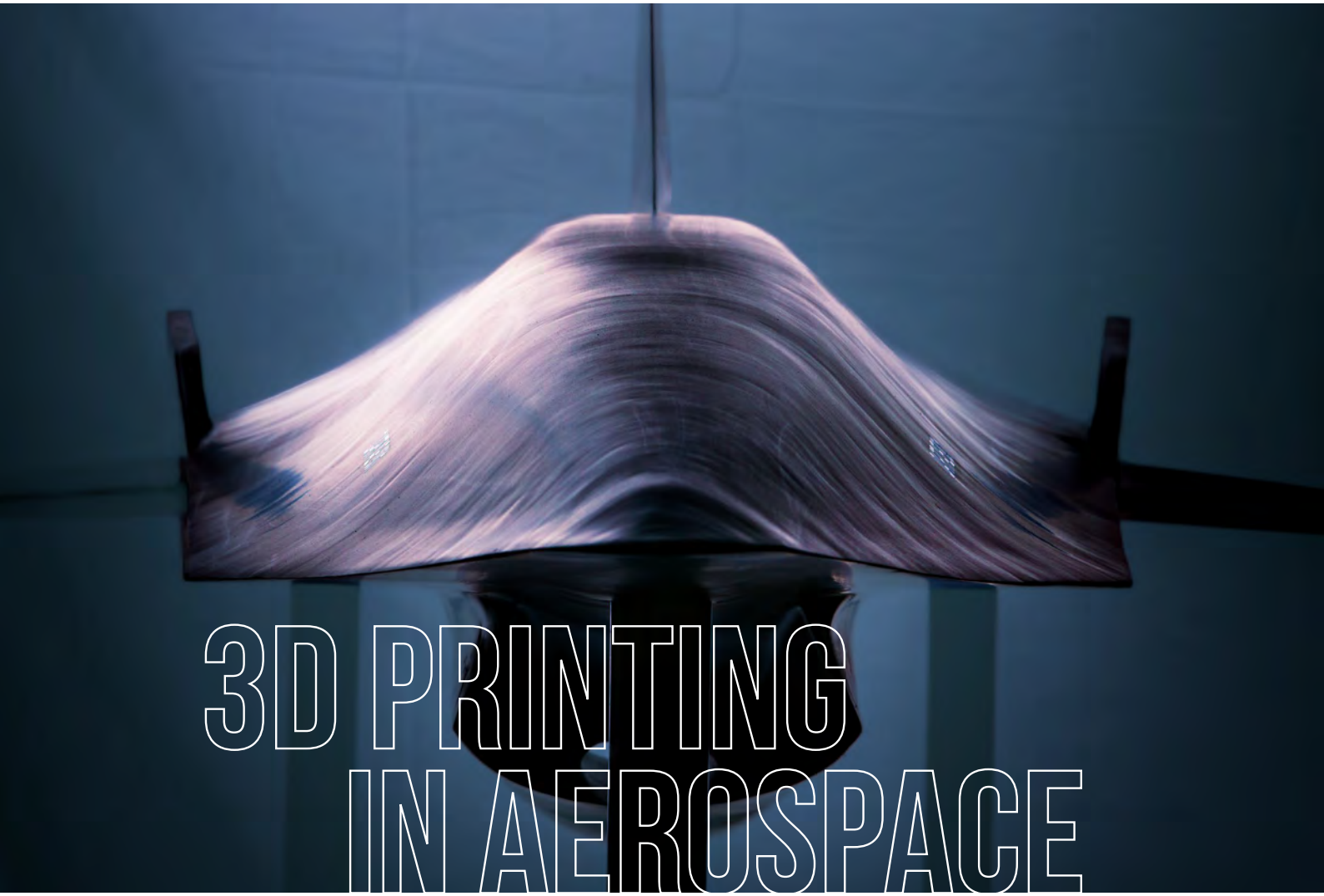
Details about the Model 437 and its development are scarce, but it was designed to fulfill some of the US military's advanced unmanned combat aircraft needs, most likely including the Collaborative Air Combat (CAC) mission set. Exports are also a growing possibility for at least some of the USAF's CAC aircraft.

This design clearly evolved from Scaled Composites' Model 401 demonstrators, which themselves evolved, at least inspirationally, from the company's ARES demonstrator. The Model 401 is also now touted as having the potential to be offered alongside the Model 437 in an unmanned production configuration.

The drone has an internal centreline payload bay that is designed to carry up to 1,000 pounds of stores or other systems. The outlet said that a pair of AIM-120 Advanced Medium-Range Air-to-Air Missiles or a side-looking radar imaging sensor were two possible loadouts.

The Model 437 Vanguard is powered by a single Pratt & Whitney 535 engine with approximately 3,400 pounds of thrust. The aircraft has a wingspan of 41 feet and is 41 feet long with a gross takeoff weight of 10,000 pounds, according to Scaled Composites.

Source: The Warzone



3D PRINTING IN AEROSPACE

WHILE ADDITIVE MANUFACTURING IS BEING USED TO MAKE NON-CRITICAL COMPONENTS AND GROUND EQUIPMENT IN THE AEROSPACE INDUSTRY, 3D PRINTING OF FLIGHT-CRITICAL COMPONENTS IS ANOTHER STORY.

ADDITIVE MANUFACTURING, OR 3D PRINTING, of aerospace components in a range of metals, as well as plastics and composites, has become a reality. Air forces and aircraft operators are grappling with the cost, logistics and certification implications as 3D printing moves inexorably out of the laboratory and into our everyday world.

Manufacturing flight-critical components using 3D printing techniques is still quite rare. The vast majority of additive manufacturing (AM) techniques in the aerospace sector are applied to non-critical components and ground equipment.

There are three principal issues driving (or slowing) the adoption of 3D-printed components. The first is qualification and certification. Nothing flight-critical goes onto an aircraft, missile or engine unless the component itself, including the materials it's made from and its method of construction, is certified and qualified.

The second is manufacturing. If you're going to 3D print certain components (and subject to qualification and certification), you may end up with a cheaper, lighter platform with higher performance, but it might also be more expensive. Users may need to decide whether strength, lightness, complexity or cost is most important to them.

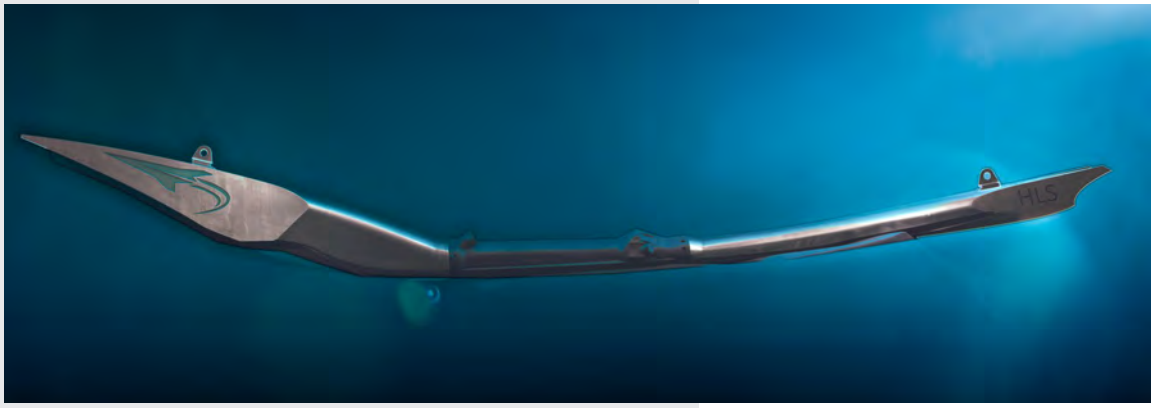
The Australian Manufacturing Technology Institute is leading a proposal to establish an additive manufacturing cooperative research centre to canvas some of those issues and build a world-class AM industry in Australia to help local businesses to innovate and grow commercially. The outcome of the proposal should be known around the end of 2024.

The third issue is sustainment. You can't simply replace an existing component with a 3D-printed part and it probably won't be cost-effective to do so anyway. But if it is possible to 3D print a component

LEFT Hypersonix DART Mach 7 multi-mission aircraft. Image: Hypersonix.

BELOW Spee3D Expeditionary Manufacturing Unit. Photo: Spee3D.

BOTTOM Hypersonix's 3D-printed and hydrogen-fuelled SPARTAN scramjet engine that will power the DART. Image: Hypersonix.



replacement locally, rather than sending back to the USA or Europe for the part, it could save you weeks or months. That might matter a lot.

Most reputable AM practitioners have evolved the following rough rules.

- Never employ AM unless there is no other choice.
- If you're building for strength, use metal and not plastic.
- Every AM part will need post-processing: machining, heat/surface treatment or polishing. Anybody who tells you otherwise is lying. The same engineering and risk-management processes still apply when you're doing AM.
- If an original equipment manufacturer-designed replacement is easily available, then it may not be cost-effective to replace it using an AM-made part.
- However, if you're trying to make something out of Titanium or Inconel, then the sheer difficulty of machining the metals might make AM attractive.
- If you want to make a complex part, such as a heat exchanger or some sort of deliberately porous structure or an aerospike rocket nozzle with lots of cooling channels, you can only do it affordably using AM.

Melbourne and Darwin-based Spee3D uses cold-spray AM to make what it calls 'parts of consequence'. It doesn't make gun barrels or flight-critical components, but its Expeditionary Manufacturing Unit (EMU) 3D prints parts for guns, vehicles and other equipment in the field.

You can't take spares of every component into the field with you and the lack of a spare may stop you doing whatever it is you're trying to do. Getting a replacement might take a week, or a month, or 18 months, so if you can 3D print it on the spot and have a replacement ready within 24 hours, that's a huge benefit.

The EMU consists of two 10-foot ISO containers housing the 3D printer (with a build rate of 6kg an hour, which is incredibly quick), a metrology lab, a heat-treatment facility, a machining facility and hand-finishing facilities.

At the opposite end of the scale, Brisbane-based Hypersonix Launch Systems uses Melbourne-based Amiga Engineering to AM its 3m-long DART hypersonic platform, made from incredibly hard Inconel 718 which has a very high melting point. The difficulty of machining such a material means AM is the only cost-effective way to manufacture it. Amiga Engineering uses laser powder bed fusion, also known as selective laser melting, in which very small spherical metal particles are melted into position by the laser. It's a relatively slow process, but it results in something very near net shape.

However, after printing, the components of the DART still need to go through heat treatment at 1,000ºC to relieve their internal stresses. And they need machining to produce flat-mating surfaces and polishing for thermal management.

In the middle is Rosebank Engineering which has used cold-spray AM for repairs and coatings on a variety of ADF fixed- and rotary-wing aircraft over the past decade. One of its specialities is building up corroded and worn components such as transmission casings, landing wheels and brake housings and undercarriage components.

It machines away any corrosion, uses cold spray to build up the affected part and then machines it back to its net shape. Rosebank Engineering is now the designated F-35 wheel and brake repair depot for the entire Asia-Pacific region

and is working closely with the original equipment manufacturers and sustainment prime contractors, including Honeywell, Collins and Lockheed Martin, to establish broader sustainment capability in the region.

It advocates using cold spray as a prophylactic treatment: putting something like tungsten carbide on, say, an undercarriage component can prevent wear and corrosion and thus reduce costs over the life of the item. The company also says the treatment can be quicker, cheaper and easier than, for example, chrome plating.

Equally important, Rosebank Engineering says, is the ability to conduct relatively cheap repairs in-country within a couple of weeks, rather than waiting up to 18 months for the Foreign Military Sales supply chain to come up with a repair or replacement. AM can impact hugely on readiness, supply chains and spares holding costs.

For that reason, the company is looking to expand into submarine components for the Collins-class, Virginia-class and, eventually, the SSN-AUKUS boats. Using AM, it may be able to replace certain forgings and cast items with components of at least the same strength and characteristics and shorten the supply chain. It might take 18-24 months to get some components from the USA, but if these can be made in-country within a few weeks, the effect on readiness and preparedness is significant. For that reason, says the company, the US Navy has shown considerable interest in Rosebank Engineering's AM capabilities to augment its own industry base.

In Adelaide, wire additive manufacturing company AML3D is also manufacturing submarine components for the US Navy. It specialises in direct energy deposition (DED) and also works for Defence Science and Technology Group (DSTG), Boeing and BAE Systems on projects it is unable to discuss. The US Navy is interested, again, because AML3D can manufacture large, complex parts in eight weeks where the US supply chain has a two-year queue for some cast components. DED is essentially a sophisticated MIG (metal inert gas) welder connected to a robotic system and AML3D has developed and refined both the software controlling the system and the operating system itself.

The CSIRO's Lab22 began life focusing purely on titanium (22 is its atomic number), but the laboratory now works in AM with many different alloys. It has just won a contract to install a Nikon SLM-80 (selective laser melting) system to support the iLAuNCH Trailblazer. It is the first of its kind in the Southern Hemisphere and enables complex product geometries as well as high-strength multi-material alloys such as copper with steel or nickel for use in things like rocket motor nozzles.

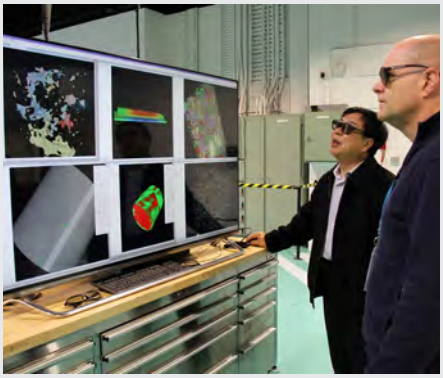
Lab22 director, Dr Daniel East says AM is the best solution where performance is controlled by the geometry or chemistry of the components: it excels in producing complex things like heat exchangers, hydraulic mixers and aerospike rocket nozzles as well as combinations of alloys and materials.

He believes cost is also an important consideration: even if you could make tooling for a lengthy run of AM parts, the theoretical cost of each part would still be roughly the same because the process won't change. Conversely, making tooling for a traditional component would see unit costs drop substantially over a long production run. So where cost matters, AM may only be a superior solution in a short production run.

With hypersonic flight, AM addresses the challenges of handling extremely high temperatures caused by atmospheric friction. Royal Melbourne Institute of Technology's (RMIT's) Centre for Advanced Materials and Industrial Chemistry has experimented with fuel-cooled airframes using complex 3D-printed heat exchangers coated with catalysts, synthetic minerals known as zeolites, to maximise performance. The results have been excellent.

An RMIT alumnus and veteran of RMIT's Centre for Additive Manufacturing, Dr Stephen Sun, who now works for DSTG, is also working to qualify and certify flight-critical AM-made components. His focus is on development of non-destructive inspection techniques for AM-made aerospace components. He has been experimenting with a high-power X-ray computer tomography system to penetrate layer by layer and identify potential internal defects that could cause fatigue problems later.

Additive manufacture is a reality for the aerospace community. But the sensible conservatism of the community's engineers is unlikely to result in the widespread adoption of flight-critical AM components until the qualification and validation issues are sorted out definitively. Meanwhile, there's plenty of potential in the non-critical space.



ABOVE The CSIRO's Lab22 facilities can 3D print out of sand, titanium and other metals.

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PLANES, PEOPLE, PASSION &

PROFESSIO

Inaugural Australian International Airshow, Avalon Airport, 1992.

NALISM

THE BIRTH OF THE AVALON AIRSHOW

What follows is an edited version of a presentation delivered at the 2015 Safeskies Conference by Ian Honnery, the long-serving CEO of the organisation that became the Air, Maritime and Defence Australia Foundation (AMDA). Planes, people, passion and professionalism is the title used by Ian for his address. In his words, it's "the story of how a small group of aviation enthusiasts grew a Sunday afternoon air pageant at Schofields aerodrome in outer suburban Sydney into a major international aviation, aerospace and defence exhibition and air show at Avalon – a world-class event which is now well established on the international aerospace industry calendar… a tale about people as much as it is about planes, about passion as much as it is about professionalism, about tenacity as much as it is about technology".

IN EARLY 1976, a bunch of blokes were gathered around an esky at Schofields Aerodrome in north-western Sydney late on a Sunday afternoon, profoundly contemplating how Schofields Flying Club could raise enough money to buy an aircraft. In an Archimedean moment of inspiration (fuelled by the content of several cans from the esky) one of them (fatefully) suggested the flying club should hold an air show.

So began a series of seven air shows which were held at Schofields Aerodrome between 1976 and 1985, rapidly growing into one of the largest general aviation events regularly held in Australia. They were to become the genesis of the Australian Bicentennial Airshow at Richmond in 1988 and, later, the Australian International Airshow that was first held at Avalon in 1992 (and every two years since then).

That first air show, on a wet Sunday afternoon in September nearly 40 years ago at Schofields Aerodrome (which, at the time, hardly anyone in Sydney even knew existed) cost $10,000 to put on – a fortune in 1976, especially when your flying club didn't have the money in the first place and, together with your fellow club committee members, you had to jointly guarantee your club's line of credit from the bank

(without telling your wife, of course!). The flying display lasted only two and a half hours and, despite the drizzly weather, the pageant attracted 10,000 people.

The seeds were being sown – the future was beginning to reveal itself…

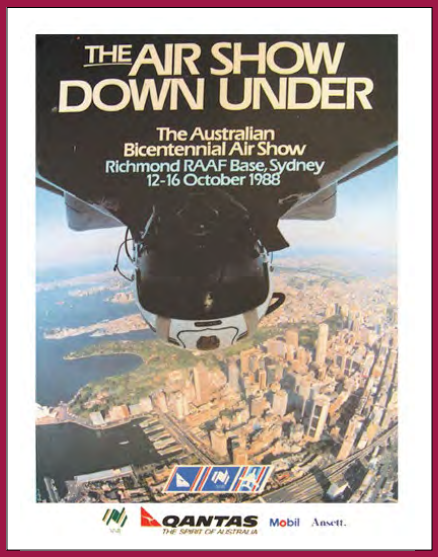
THE PRECEDENT

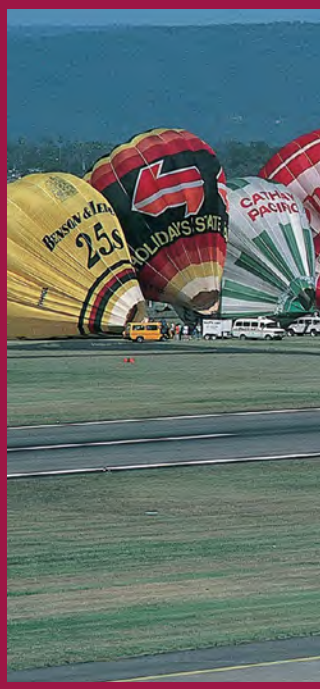
In the early 1980s, the government established the Australian Bicentennial Authority. Its purpose was to encourage and coordinate a series of events around Australia to celebrate 200 years of national achievement since the arrival of the first fleet into Sydney Harbour in 1788. The authority decided there should be a "Bicentennial Air Tattoo" (as the aviation centrepiece of its bicentenary celebration program) which would parallel the "Bicentennial Fleet Review" (to be run by Navy) and a "Bicentennial Military Tattoo" (to be run by Army).

Some of you would have been to the Australian Bicentennial Air Show at RAAF Base Richmond, NSW in October 1988… Few of you, however, would be aware that it was actually organised by the Schofields Flying Club (albeit with substantial support from the RAAF), and on a totally voluntary basis. Apart from a handful of salaried staff, all the senior executives in the Australian Bicentennial Air Show Organisation (including the executive chairman) were volunteers. As typified by the examples set by our early aviation pioneers, it is people who drive progress in every kind of human endeavour (especially aviation) – through their passion, their purpose and their professionalism. Without people propelled by those qualities, a major aviation event of that scale would never have been achievable.

Taking five years to plan and prepare for, the show's mission was to present the Australian public with an event that would be the aviation centrepiece of the bicentennial program. The aim was to combine the very best features of the world's greatest air shows (Farnborough, Paris, Oshkosh and the Royal International Air Tattoo), so Australia's proud aviation history could be displayed, the nation's technological and industrial capabilities in aviation and aerospace showcased and the full spectrum of aviation featured (from military aviation, business aviation and airlines through to amateur-built aircraft, air-sport and recreational flying).

The Bicentennial Air Show enjoyed many international accolades. It attracted nearly 230,000 visitors, a comprehensive array of modern and historic aircraft and military participation from around the world, and it hosted a substantial aerospace industry exhibition. Because of the unremunerated effort of its senior executive management team and an army of about 2,000 volunteers, the Richmond show was, perhaps, the only major event in the entire bicentennial program to make a profit. With six days of good weather





and a bucket-load of good luck, the show achieved its underlying objective – which was that, after the bicentennial party was over, a lasting legacy would be left for the promotion of the development of Australian aviation… Schofields was the genesis, but Richmond was the precedent.

AVALON

With the spectacular success of the Bicentennial Air Show being a hard act to follow, Schofields Flying Club could have kept the money and cut and run. But it didn't. Instead, it established a not-for-profit foundation (later to become the Aerospace Maritime and Defence Foundation of Australia) and it endowed the lion's share of the show's profit on the new foundation to enable it to pursue its AirShows DownUnder program and thereby continue to promote Australian aviation and aerospace through a permanent and regular event at Avalon which would become firmly established on the international air show calendar.

The inaugural Australian International Airshow and Aerospace Exposition was held at Avalon Airport near Geelong, Vic in October 1992. In the tradition initiated by the bicentennial show at Richmond three years earlier, the Avalon event combined significant industry, military and government participation, through the Aerospace Expo, conferences and media briefings, with a lengthy and varied flying display featuring everything from light aircraft to aerobatics, novelty acts, warbirds, airliners and supersonic jets.

LEFT & BELOW The Australian Bicentennial Air Show, RAAF Base Richmond, 1988.

Over 200,000 people turned out to see the first Avalon show… Importantly the international aerospace industry also supported it. But it is worth noting that the inaugural Australian International Airshow in October 1992 very nearly didn't happen – thanks to the best efforts of Mother Nature.

The wettest spring in Victoria's history had turned Avalon into a swamp, with car parks and aircraft static display areas looking like paddy fields. The decision to go ahead, or not, was left to the last moment and, happily, the weather relented just in time. The damage done to the site by the rain was substantial and, as was noted at the time, just one more day of rain on the eve of the show (or during it) would have killed it completely. Every truck load of pine-bark that could be acquired in Victoria, and even from as far afield as South Australia and southern NSW, was urgently procured and spread thinly over the precarious areas of the site to render the ground at least passably usable.

The fact it went ahead at all is a tribute to the passion and commitment of the show's professional team and its army of enthusiastic volunteers. In fact, there were many among the authorities who urged that it be cancelled and, financially, that would have been tempting, because a uniquely worded cancellation insurance policy would have allowed the not-for-profit foundation to "pull the plug" and walk away, after expenses, with a "windfall" surplus of a cool $1 million. With that sort of dough in the offering, and the relief, in many ways both operationally and logistically, that cancellation would permit, you would naturally have to stop and think… And, yes, it was thought about, but only for a nanosecond, because there was much more at stake.

You see, if the inaugural event had been cancelled, that would in all likelihood have been the end-of-the line. The Airshows DownUnder program, of which the biennial Avalon show has become the centrepiece, would not have endured. Australia would not have ended up with its own world-class international showcase for the nation's aviation, aerospace and defence capabilities.

The level of trade participation in the Australian International Air Show has, of

2013 Australian International Airshow and Aerospace & Defence Exposition.

RIGHT 1976 Schofields Air Show.

FAR RIGHT 1992 Australian International Airshow display and poster.

course, grown strongly since that first event in 1992. In that year, 226 exhibitors from 12 countries took the opportunity to participate. By the 12th Avalon show in March 2015, there were 578 participating exhibitor companies from 22 countries, 148 delegations from 28 countries, 39 associated conferences, seminars and symposia, 599 accredited media from 18 countries and 682 participating aircraft. Over the 23 years since it began, the Avalon show has become truly one of the world's great air shows.

As I said at the outset, this tale is about passion. It is also – dare I say it? – about unabashed, old-fashioned patriotism, hopefully of the best non-jingoistic kind, like that demonstrated by Australia's early aviation pioneers. But, above all, it is about a commitment to the ideal of the retention – and, hopefully, the advancement – in this country of a credible technological and industrial capability with respect to aviation, aerospace and defence. And this is where the serious purpose of the AMDA Foundation comes into focus.

AMDFA is a not-for-profit charitable institution set up to promote the development of aviation and Australian industrial, manufacturing and information/communications technology resources in the fields of aviation, aerospace, maritime and defence. As well as mentoring the biennial Australian International Airshow at Avalon, the foundation also initiated the biennial Pacific International Maritime Exposition (staged in conjunction with Navy) and the biennial Land Forces Exposition (conducted in conjunction with Army) to promote this mission.

Australian aviation today, with its enviable safety record and its unrivalled international reputation for proficiency and best practice, is in no small part the legacy of our aviation pioneers. Their passion and perseverance lives on in the altruistic commitment of individuals and organisations promoting aviation – like AMDFA and the many other not-for-profit groups of aviation enthusiasts and aeronautical professionals around Australia that continue to share the passion of our aviation pioneers.

Note from the Wings managing director

I thank Ian for permission to use his address and, more importantly, for applying his skills and drive to establish the Australian International Air Show. As a past president of the Schofields Aero Club and founder and (until recently) CEO of AMDFA (now trading as AMDA), Ian is a living example of the passion and professionalism he refers to in his address. In 2022, Ian was succeeded by the present AMDA Foundation CEO, Justin Giddings.

GROWING SUCCESS

Since this address was given in 2015, the Avalon Australian International Airshow has been scheduled biennially, growing in both industry and public participation with each event. Avalon 2023 attracted 794 exhibitor companies from 28 nations, with 396 aircraft from eight nations on flying or static display. The trade days attracted more than 48,000 attendances, while the overall event, including the weekend public airshow program, attracted nearly a quarter of a million.

In addition to the Avalon Australian International Airshow, the AMDA Foundation now delivers five biennial industry events and air shows, including the RotorTech Helicopter and Uncrewed Flight Exposition, the Indo Pacific International Maritime Exposition, Land Forces International Land Defence Exposition and Indian Ocean Defence & Security conference and exhibition.

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A TRI-SERVICE FORCE

An F-35C Lightning II comes in for a landing on USS *George Washington*. Photo: Todd R. McQueen/Lockheed Martin.

INTRODUCTION
BY Bob Treloar

This is the second of three articles that looks at the development, capability, production and introduction into service of the F-35 Lightning II. These articles have been drawn from F-35 The inside story of the Lightning II *(Skyhorse Publishing, New York).*

The four authors are: Tom Burbage, a Naval aviator in a previous life and Executive Vice-President and General Manager of the program for the first decade of the project; Betsy Clark and Adrian Pitman, Director of Acquisition Engineering Improvement in the Australian Defence Materiel Organisation, who both participated in nine separate reviews of the F-35 program; and David Poyer, a noted writer of American sea fiction. Together they have created an excellent insight into the unique and often troubled development of what is arguably the most sophisticated and effective fighter aircraft yet built.

BELOW F-117 Nighthawk. Photo: Lockheed Martin.

THE X-35B BECAME THE FIRST AIRCRAFT IN HISTORY TO ACHIEVE SUPERSONIC AND HOVERING FLIGHT IN A SINGLE SORTIE.

OVER THE YEARS, America's three air combat services had become stove piped, responding to what they perceived as different missions and thus different operational requirements. In the early 1990s, all three were on a path to replace their inventory with roughly similar but higher-performance planes. However, Secretary of Defense Bob Gates wanted a single family that could meet the economies of commonality, interoperability and scale that could accompany a creative new strategy. Gates cancelled the individual programs and launched the Joint Advanced Strike Technology Program to define the requirements for such an aircraft.

On 23 February 1993, the Department of Defense initiated a formal bottom-up review (BUR) of US military forces and modernisation plans. In September 1993, the results of the BUR were formally announced. The F-22 and F/A-18 E/F program would continue and a new Joint Advanced Strike Technologies, or JAST, program would be started. The objective was to introduce, for the first time, a true tri-service, multinational-coalition force. This would demand three variants, with significant structural differences, that would 'look' identical to the pilot and share many parts in common. Such standardisation would, for the first time, enable true interoperability.

STEALTH TECHNOLOGY

The earlier F-117 Nighthawk had some unique features. Its 'stealth switch' would retract all antennas below the skin to go covert. The Nighthawk drivers were essentially flying with no communications, alone, in the dark. Technology advances would later incorporate conformal antennas embedded in the skin. About 70 percent of the Nighthawk stealth was derived from its shape, and the rest was from a complex set of radar absorbing materials.

On 7 September 1997, the F-22 Raptor completed its first flight at the Lockheed Martin production facility in Marietta, Georgia. Stealth technology had continued to advance and, when coupled with the very high, very fast performance of the Raptor, could allow some relaxation of traditional stealth design to allow increased maneuverability.

The design freeze between the F-22 and the F-35 was over 10 years. That decade saw many technology evolutions, both in electronics and in materials that would change the design strategy for the Joint Strike Fighter. The evolution of digital design tools would now enable a truly integrated three-dimensional design.

The use of advanced composite manufacturing was also in its infancy, but evolving quickly during that 10-year gap. This meant major structural segments that still had to be metal in complex areas on the F-22 and earlier stealth airplanes could move to composite structures for F-35.

THREE VARIANTS

Three variants would be needed to meet the unique operating environments of the Air Force, Navy and Marine Corps. While there would be differences among the variants, such as a heavier undercarriage needed by the Navy for catapult launches and wire-arrested landings on carriers, it did seem possible to design variants using the same basic 'air-vehicle' design, vehicle management systems, engines and mission systems. This would enable a level of interoperability and force multiplication never before possible. This could also save on both production and maintenance costs and simplify the logistical and training tails

as well. It promised to dramatically reduce the cost of sustaining long-term combat air operations.

As mentioned earlier, in the early to mid 1990s, each of the US services was starting development programs to replace their ageing frontline fighters. The Marine Corps was farthest along. It was developing prototypes for an advanced short takeoff and vertical landing replacement for the venerable AV-8 Harrier and versatile AV-8B. The US Air Force was also in the early stages of developing the operational requirements for a multi-role fighter to replace several ageing fleets, including the F-16, A-10, and potentially the F-117. The US Navy had been through several attempts to replace their 1960s-vintage F-14/A-6/A-7 carrier-operated inventory, including the A-12. All had been abandoned in favor of a less-risky approach, upgrading and modernising the F-18 into the F/A-18 E/F Super Hornet.

From an engineering view, the initial design strategy was to do the simplest version first, the F-35A, then move the design team to the next-closest structural variant, the F-35B, then finally, to the most unique structural variant, the F-35C. This order also paralleled the needs of the services, with the exception that the Marines had the most pressing need for early replacement of their ageing Harrier fleet.

The experimental version of the F-35, the X-35A, would fly first and demonstrate basic aerodynamic qualities. Later it would be converted to an X-35B by installing the lift fan, produced by Rolls Royce, adding the ability to hover, transition to forward flight, transition back to STOVL [short take-off and vertical landing] flight and still perform at supersonic speeds.

The X-35B became the first aircraft in history to achieve both supersonic and hovering flight in a single sortie. In 2001, the lift-fan team was awarded the Collier Trophy by the National Aeronautic Association "for the greatest achievement in aeronautics or astronautics in America".

The Navy or C variant was designed from the beginning to be different from the A and B. The Navy's overarching requirement was suitability for operation off carriers. There's a direct correlation between lower landing speeds and a reduced accident rate in the unforgiving environment of carrier traps. In addition, the C needed a distinctly beefier structure, for the high stresses of catapult launches and arrested landings. The Navy also demanded high taxiing maneuverability for the tight spaces of the hangar and flight decks. This meant foldable wings and reducing the space required to do major maintenance like changing the engine. For good reason, Lockheed chose to make the carrier version the most unique.

ABOVE
F-135B engine.
Image: Rolls-Royce.

LEFT
F-135B engine.

BELOW LEFT
The experimental X-35.
Photo: Mark Jones Jr.

BELOW RIGHT
An F-35B takes off from USS *America*.

THE ENGINE

Previous American fighter programs had always considered the engine a subsystem … a part that could be swapped out more or less at will. This fostered competition among contractors, both to force innovation and drive down prices. But the daunting performance requirements of the JSF meant only one existing engine had the capability to power both challengers in this early competitive phase. That was the F119 engine. Both Boeing and Lockheed Martin would use it in their concept demonstrators.

Pratt & Whitney had developed the F119 for the F-22 Raptor program. This impressive engine combined low-observable technologies with high thrust-to-weight performance. Its two-dimensional pitch-vectoring exhaust nozzle provided extreme maneuverability when coupled through software with the flight control systems. While the F119 had the potential to adapt to short takeoffs, it was not adaptable for vertical takeoff and landing.

The Pratt & Whitney team had the responsibility for delivering all the engine combinations to both Boeing and, with their Rolls-Royce lift-fan partner, to the Lockheed Martin team. It was apparent that the STOVL version was critical to winning this program. The engine for the X planes was the Pratt & Whitney F119. However, Pratt & Whitney later developed a larger and even more powerful engine, the F135 for the F-35. The F135's single-engine thrust equals the combined thrust of most twin-engine fighters.

A hefty driveshaft emerged from the front of the F119 engine, connected to the rear turbine. The challenge was to translate the energy from a rotating shaft to a counterrotating lift fan operating in a different plane. In addition, the fan would only be engaged during STOVL operations.

Just behind the lift-fan door is the auxiliary inlet door. When opened, it provides more air for the main engine during STOVL operation, when there's no forward speed. The F-35B has two auxiliary inlet doors hinged on the outboard side of the opening, which greatly improved the inlet performance.

The airflow from the lift fan was now ejected from a simplified air ejection system through a variable area vane box nozzle. This was like a set of venetian blinds that can precisely direct the thrust. This gave the F-35B pilot much better control in the hovering mode and in maneuvering for precise landings, as well as increasing overall lift.

Along with power, the F135 engine had to be designed for mass production – unlike earlier high-performance power plants, which had been largely one-off, hand built 'racing engines'. From the government perspective, 'production strategy' had nothing to do with the actual design or manufacturing processes used to build the engine. It had to do with the best use of the American and allied industrial base to promote competitive pricing and future technology developments.

The eventual F-35 specifications took the two-engine requirement (the F135 engine fit for the F-35A and C, and the other F135 for the F-35B) a step further. The alternative engine program would require a level of 'interchangeability' never attempted before. Both F135 engines would use the same controls, have the same attachment points for installation, and use the same set of hand tools for the maintainer and the same engine trailer to move it, whether on land or on a ship at sea. The controlling software for both would be integrated into the same operational flight program installed in every F-35. The airplane would recognise which engine was installed and only activate the software associated with it.

GLOBAL PARTNERSHIPS

The grand vision was to form a true partnership with the US' closest allies. They would participate in funding the system development and demonstration phase. They would buy their planes in common production lots with the US Government, helping everyone achieve economies of scale. An additional incentive, and one of the most challenging aspects of the program, was the invitation from the US Government for all allies joining the program to help build the plane. Industrial participation would be based on a concept referred to as 'best value' rather than offset.

The rewards for participating would be great. A small participating partner, like Denmark, could buy a small quantity of F-35s but provide parts and components for thousands of F-35s if they could remain competitive and provide best value to the F-35 supply chain. No partner wants to pay more for their F-35. The risks, relative to traditional 'offset', were also huge. No longer would industrial benefits be considered a gift to an ally. Everyone would have to pull their weight, or the whole program would crash and burn.

The stakes were immense. As originally announced, the production runs envisioned were 3,000 for the US military, 250 for the United Kingdom, and probably many more thousands to allies throughout the world, if the sales record of the F-16 was any guide. It was billed as the "largest acquisition program in the history of the Department of Defense" and "the last manned fighter".

Lockheed Martin was the F-35 prime integrator and would concentrate on final assembly and checkout. Lockheed Martin would also be the main source to produce the wing and forward fuselage (the cockpit), Northrop Grumman would produce the center fuselage, and BAE Systems would produce the aft fuselage and tails. All three would be tasked to develop a second major subcontractor capable of manufacturing their major assemblies. It was clear that only a very few companies in the world could step up to that challenge.

The F-35 had been sold as an affordable fifth-generation fighter largely based on the use of common parts across the three variants. The designs diverged and relied on what were called 'cousin' parts, meaning they were no longer identical but they could be produced with the same manufacturing tooling. The cost savings were real, but critics of the F-35 focused on the disappearance of identical parts.

The development of 3D digital models for all parts significantly reduced form, fit, and function changes common to new programs and dramatically improved fabrication and assembly processes.

Today, all three F-35 variants are produced on a common production line. Digital virtual assembly of the major structural elements is conducted while they are still in their individual production factories before they are delivered to the final assembly operation in Fort Worth. The assembly facility in Fort Worth employs automation, robotics, and other advanced manufacturing technologies to a level not seen in other defense programs, dramatically reducing assembly time and cost while improving quality.

An F-35A. Photo: Lockheed Martin.

A CAREER **UNLIKE** ANY OTHER

WHEN JENNY PHAN VISITED AN ADF OPEN DAY, SHE DISCOVERED A PASSION FOR FAST JETS WHICH HAS LED TO A FASCINATING AIR FORCE CAREER.

ABOVE LACW Jenny Phan inspects the undercarriage of an EA-18G Growler. Photo: CPL Jesse Kane.

LEADING AIRCRAFTWOMAN JENNY PHAN'S job is unlike any other. As an aircraft technician in the Air Force working on fast jets, she strives to achieve the Defence mission every day while being in a career she loves.

"I love fast jets and everything about it really fascinates me," LACW Phan says. "I am always quite in awe of the technology that is in front of us. I work on the EA-18G Growlers and I do everything from the airframe, fuel systems, engine systems, to hydraulics and service the aircraft for flight."

Growing up in Melbourne, Phan had little exposure to the ADF and was unsure of where her passions would lie. However, after attending an open day at HMAS Cerberus, Mornington Peninsula, she knew exactly what she wanted to do.

"I watched a Classic Hornet fly over and I thought, that's what I want to do, I want to work on a fast jet," she says. "I started off with no mechanical skills, but the ADF gave me all the necessary skills to get to where I am today."

LACW Phan conducted all her hand-skills training and theory study at the RAAF School of Technical Training in Wagga, NSW. From there, she undertook on-the-job training at RAAF Base Amberley, Qld to develop her skills and became fully qualified as an aircraft technician.

To highlight the impact ADF personnel can make and the unique roles available across the ADF, LACW Phan participated in the filming of a new ADF Careers campaign called Unlike Any Other Job.

"The ADF Careers campaign is special as it shows everyone the environment and experiences that members have in an ADF career," she says. "The campaign highlights our people alongside what we usually see, such as ships, vehicles or aircraft.

"Representation is really important to me – I wanted to show young Asian women they can do anything."

LACW Phan's biggest passion is the ADF and its people. With almost seven years of aviation experience under her belt, she wants to continue her career in the ADF with a focus on gender and cultural diversity.

"It is amazing to inspire someone and let them know this is an opportunity and a possibility for them."

Making friends has been another highlight of LACW Phan's career.

"When you're with your mates having a laugh and getting to work on incredible assets, it is the perfect combination," she says. "Whether you're Navy, Army or Air Force, there are always things that link us together. Human connection is so important and I think that is what binds us all together. After all, people are the ADF's biggest asset."

Chelsey Ballard

• To learn more about a career in the ADF, go to adfcareers.gov.au.

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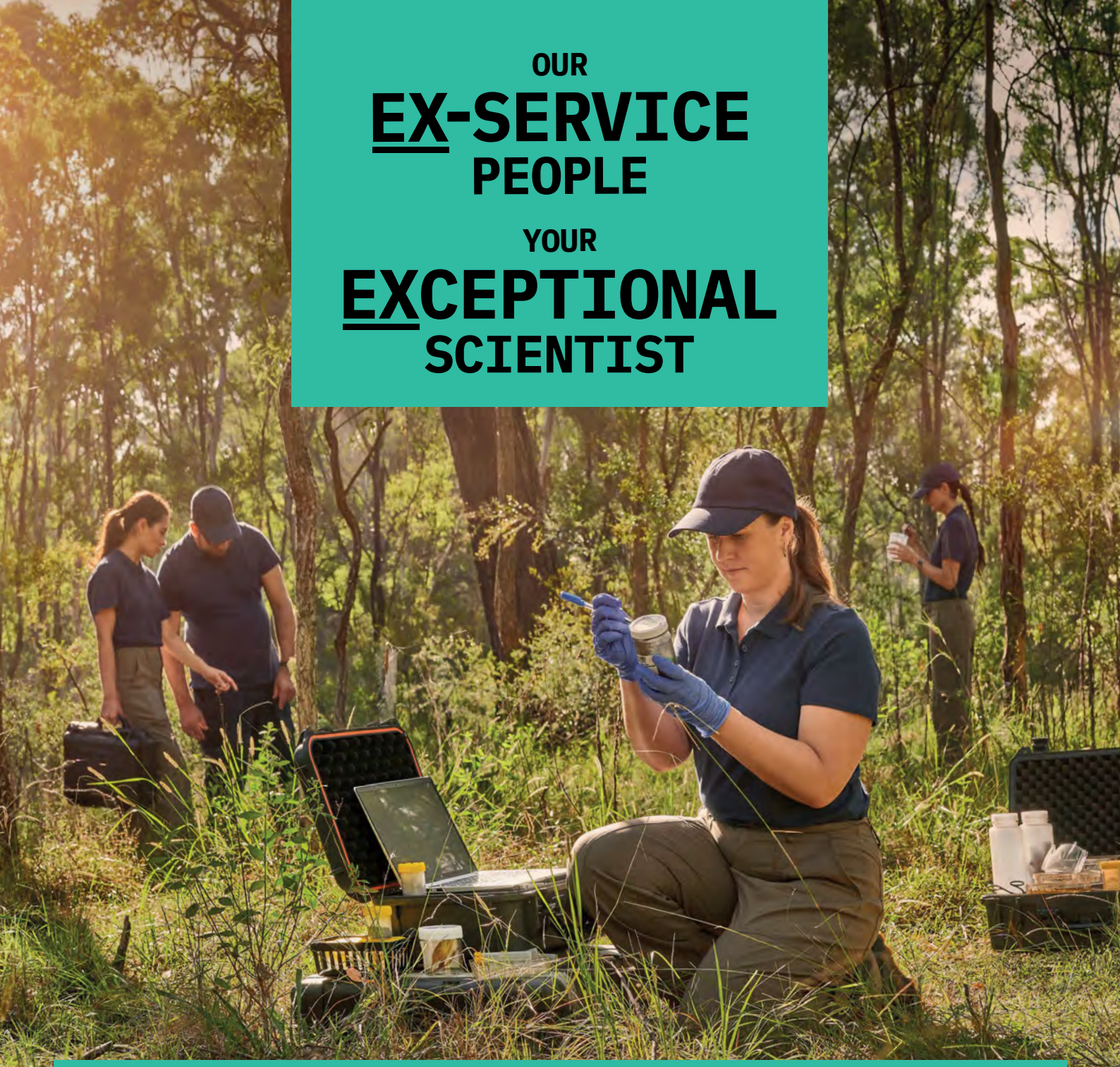

Being an ex can be a good thing. The “ex” in ex-service people stands for exemplary employees who make exceptional leaders and excel at problem-solving. Like Hannah Elliott who, following her career in the Royal Australian Air Force, now leads a team of scientists working to protect the environment. Ex-service people like Hannah are extraordinary assets for any workforce and could be exactly what your organisation needs.

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AP-3C ORION

WINGS VOLUME 76 NO.4

A No. 10 Squadron AP-3C Orion electronic warfare aircraft departs RAAF Base Edinburgh for one of its final missions. Photo: SGT David Cotton.

CONCLUDING OUR INTERVIEW WITH **AIR MARSHAL LEON PHILLIPS OAM, CHIEF OF GUIDED WEAPONS AND EXPLOSIVE ORDANANCE (GWEO),** WE DIG DEEPER INTO PLANS TO DELIVER MISSILE MANUFACTURING IN AUSTRALIA.

RISING TO THE CHALLENGE

A recommendation of the 2023 Defence Strategic Review (DSR) was to consolidate Guided Weapons and Explosive Ordnance (GWEO) needs across the services and expand weapons systems, including land-based maritime strike and long-range missile strike. What progress has been made?

In October, we released the Australian GWEO Plan, the government's blueprint to rapidly deliver missile manufacturing in Australia and accelerate the acquisition of long-range strike over the next decade. We are seeing real and rapid progress, getting these capabilities into the hands of the war fighter as quickly as possible. So far as part of the enterprise, we have announced:

- A commitment to manufacturing missiles in Australia from 2025, with the co-production of Guided Multiple Launch Rocket Systems (GMLRS) munitions and a new Australian Weapons Manufacturing Complex.
- $850 million to build a facility near Newcastle in partnership with Kongsberg Defence Australia, to manufacture and maintain the Joint Strike Missile (JSM) and Naval Strike Missile (NSM).
- A new domestic forging capability for 155mm M795 artillery ammunition.
- Up to $60 million over five years to develop hypersonic and long-range strike capabilities.
- $22 million over three years to seek options from industry to establish a manufacturing complex to produce rocket motors in Australia.
- Increased capacity for the domestic production of the BLU-111 aerial bombs.
- A $7 billion agreement with the United States to acquire the Standard Missile 2 Block IIIC and Standard Missile 6 long-range missiles.
- A $142 million acquisition of Joint Strike Missiles for the Royal Australian Air Force.
- $1.6 billion to expand and accelerate the acquisition of High Mobility Artillery Rocket System (HIMARS) for the Army, bringing the total number of HIMARS to 42.
- $1.3 billion for up to 220 Tomahawk cruise missiles for the Navy.
- $431 million on Advanced Anti-Radiation Guided Missile – Extended Range.
- A $220 million investment in munitions factories at Mulwala, NSW and Benalla, Vic.
- New Spike Long-Range 2 anti-tank guided missiles for Army's Boxer Combat Reconnaissance Vehicles.
- Delivery of the first batch of modern, smart sea mines.

What is the current focus involving industry, domestic manufacture and war-stock holdings?

In April 2023, the government committed $2.5 billion over the forward estimates to invest in Australia's GWEO Enterprise. A further $16-$21 billion has been committed over the next decade as part of the 2024 Integrated Investment Program (IIP). This investment prioritises the development of a sovereign ability to produce, maintain, repair and overhaul selected weapons. It also includes the acquisition of a sufficient stock of weapons and munitions to support sustained operations in a time of conflict and the expansion of storage and distribution facilities to accommodate Defence's growing GWEO inventory.

We are focused on building the industrial infrastructure needed to underpin domestic manufacture of GWEO. These foundational elements include securing facilities and explosive ordnance certification, manufacturing and handling equipment, employing qualified personnel, establishing tests sets and qualifying production lines.

AIRMSHL Phillips listening to the Minister for Defence Industry and Capability Delivery Pat Conroy address the National Press Club in Canberra.

The government recently announced it will establish a new Australian Weapons Manufacturing Complex, in partnership with Lockheed Martin Australia (LMA). The facility will be capable of producing up to 4,000 GMLRS missiles a year, which equates to more than a quarter of current global GMLRS production and more than 10 times current ADF demand. GMLRS are a long-range surface-to-surface missile that's fired from a HIMARS. The government will invest an initial $316 million for the new complex to be built in NSW or Victoria. It will be the first outside the US to produce GMLRS. Our $37.4 million contract with LMA to manufacture GMLRS munitions also includes a commitment to build technical skills in the local LMA workforce. This will be conducted via training in the US. We are looking to build and ensure the critical knowledge needed to establish and certify locally assembled GMLRS missiles in collaboration with industry partners.

The GWEO Plan provides certainty to the Australian defence industry on its role to boost domestic manufacture of munitions.

In August, Kongsberg Defence Australia was announced as a GWEO Strategic Partner. This partnership will enable domestic manufacturing of the NSM and JSM. The Newcastle facility will be only the second factory in the world capable of producing these missiles, the other is in Norway.

We have also started the process to establish domestic manufacturing of solid rocket motors, a critical component of some of the world's most advanced missiles. We are seeking options from industry, and look forward to hearing what they come back with.

The government is rapidly progressing new opportunities to forge 155mm M795 artillery rounds in Australia. This includes our $220 million investment into the Benalla munitions production factory to support future production demands for 155mm M795 artillery production and other key capabilities. The government is also investing up to $60 million over the next five years to develop the next generation of guided weapon subsystems and components, such as hypersonic and long-range strike missiles, so there is quite a lot happening.

Finally, the accelerated batch of JSMs from Norway will be in the hands of the ADF in 2025, which is a great boost to RAAF capability.

The DSR identifies a number of gaps in ADF capability. Is the GWEO Enterprise mature enough to sufficiently identify and manage the gaps?

Australia faces a number of challenges in maintaining and growing the ADF's materiel and strategic materiel reserves. Recent international conflicts have highlighted how vital the supply of munitions is to modern armed forces, how quickly stockpiles can be depleted in conflict and the fragility of supply chains for global weapons. The government is pursuing a comprehensive approach to building Defence's GWEO stocks, strengthening supply chains and supporting the establishment of a domestic manufacturing capability, in line with National Defence. I have been appointed as having responsibility for leading the GWEO Enterprise, and have been given the appropriate, underpinning, organisational structures to support this. I am leveraging the deep expertise already inside Defence, to make sure we are properly identifying and managing any gaps in this vital ADF capability.

What is the initial focus in implementing the 2024 IIP and what are the priorities and challenges?

The IIP outlines the specific capabilities the government will invest in to achieve the requirements set in the National Defence Strategy (NDS) and prioritises a generational uplift in Defence's capabilities. It will invest $16-$21 billion in Australia's GWEO Enterprise over the next decade, that represents five percent of the entire IIP over that time. The investment prioritises the development of a sovereign industry to produce, maintain, repair and overhaul selected weapons. It also includes the acquisition of a sufficient stock of weapons and munitions to help ensure sustained operations in a time of conflict and the expansion of storage and distribution facilities to accommodate Defence's growing GWEO inventory (see table, below).

The GWEO Enterprise includes two projects and two products: Joint Project 2087 – development of sovereign weapons manufacturing; Joint Project 2092 – GWEO Enterprise; GWEO 01 – Explosive Ordnance Manufacturing Facilities; and GWEO 02 – Test And Evaluation Equipment. Taking into account investments targeting long-range strike, as well as missile defence, the government has committed to $58-$74 billion in the IIP over the decade towards capabilities that integrate with GWEO and contribute directly to enhancing our strike capabilities.

AN OVERVIEW OF PLANNED GWEO INVESTMENT FROM THE 2024 IIP

Capability element	Approved planned investment (2024-25 to 2033-34)	Unapproved planned investment (2024-25 to 2033-34)	Total planned investment (2024-25 to 2033-34)
GWEO Enterprise	$820m	$15bn - $20bn	$16bn - $21bn
Total	**$820m**	**$15bn - $20bn**	**$16bn - $21bn**

The NDS committed extra Defence spending of $5.7 billion over the forward estimates, and $50.3 billion over a decade. The strategy was underpinned by a revamped IIP, outlining new and upgraded weapons and systems to be acquired at a cost of $330 billion over the next 10 years. To what extent does that commitment help to develop the required future capability, create sovereign capability and build and consolidate war stock holdings?

The additional funding allocated by the government, as outlined by the NDS and IIP, enables Defence to focus its efforts to deliver against the articulated priorities. The government's priorities, together with the additional funding, give Defence a clear direction and the capacity to seek accelerated delivery schedules from our industry and international partners.

Defence has a reputation for underachieving in expending funds to acquire capability. That is disturbing, given that the government continues to indicate that Australia faces its greatest crisis from an external threat since WWII. How do you propose to address this issue?

When you consider the GWEO Group has only been in existence for about 18 months, we have achieved a lot to uplift capability. The $16-21 billion for GWEO in the IIP will go a long way to acquiring the capability we need to achieve our strategy of denial.

I mentioned earlier the great strides we're making towards manufacturing GMLRS in 2025.

Recent announcements on sovereign manufacturing of NSM and JSM and establishing a local solid rocket motors program add to this work and show how serious we are about rapidly establishing the domestic manufacture of GWEO in Australia.

GWEO Group has been working with Navy and industry to quickly deliver outcomes, which can be seen in the recent firing of the first NSM from HMAS *Sydney*, during Exercise Rim of the Pacific. Our people are also proud of the successful firing of an SM-6 from HMAS *Sydney* during Exercise Pacific Dragon, in cooperation with US Navy colleagues. It is a fine example of what can be achieved in a short time.

We will continue to acquire and sustain more capable guided weapons and uplift our war stock for the ADF as quickly as possible within the approved funding.

Can Australian industry take up the challenges, and over what timeline?

I'm confident that we can build a strong Australian munitions manufacturing industry, but of course it's going to take time. We are coming off a low base and we must take small steps and build upon those as we go.

While we are starting with domestic manufacturing of GMLRS munitions, the aim is to build a flexible and scalable guided weapons production capability that can be reconfigured for different weapon types.

We are also seeing positive engagement between primes and Australian small-to-medium enterprises, with some already engaging in contracts. I am confident that as we build on these foundations, Australia's industry will be able to achieve more in this space.

Defence has also established a GWEO Enterprise Partner Panel comprised solely of Australian-owned and controlled entities to help develop and deliver for the GWEO Enterprise.

Recent reports that have unpacked the figures for the 2024 NDS and 2024 IIP indicate that recent announcements of increased funding for Defence and the increases over the forward estimates and decade only cover part of the cost. Where does this place Australia in acquiring new and additional GWEO?

Acquisition of GWEO is only part of the equation when delivering capability; sufficient qualified personnel, and an industrial capacity to delivery are also critical factors. The 2024 IIP budget figures, including the $16-21 billion for GWEO, are a realistic and achievable amount of forecast expenditure.

Australia will realise a significant increase in capability over the coming decade. GWEO Group will prioritise the uplift of industrial capacity and the growth of the GWEO workforce. Focus will be directed within Defence and in industry to better position us for the future.

How is AUKUS enabling Australia to acquire the new skills and capabilities that are required?

The establishment of a licence-free environment among the AUKUS partners will streamline the flow of defence trade between US and Australian defence industrial bases. This will have a positive impact for the GWEO Enterprise, by supporting Australia to develop its skills and capabilities through deeper collaboration with the US Government and industry.

Under AUKUS Pillar II, there are also opportunities to collaboratively develop and test advanced capabilities. Increasing interoperability of military capability and supporting deeper integration of the defence industrial bases will prove paramount to achieving integrated deterrence.

Australia is planning to acquire a range of strike missiles to hit distant targets. What is the impact on acquisition plans given the DSR and budget, particularly in the case of acquisitions for the Air Force i.e. F/A-18F Super Hornet, F-35 Joint Strike Fighter and P-8A Poseidon?

In accordance with the NDS, Defence is developing options to integrate a range of strike missiles onto air platforms/aircraft at the earliest opportunity. This includes the recent announcement that we are accelerating the acquisition of the JSM to receive these missiles in 2025. This acquisition has been made possible thanks to the forward-leaning and innovative approach of Norway and Kongsberg Defence & Aerospace.

A KEY INFLUENCE AND A TRAILBLAZER

One of the most key influences in my journey to this level has been my wonderful wife, Air Commodore Angela Castner. A loggie by trade, she has been a real trailblazer as a woman who joined a very male-dominated organisation in the 1980s. To be able to share this journey with her, to bounce ideas off her, has been a real growth opportunity for me. To have someone who understands the complexity of life at senior levels has really helped lighten the burden and challenges that come with this role. She has definitely shaped my approach to work and my engagement with people, especially women.

EDITED BY Bob Treloar

SUSTAINABLE **FUEL FUND**

QANTAS HAS JOINED the Sustainable Aviation Fuel Financing Alliance (SAFFA) to help accelerate global production of aviation biofuel. The SAFFA fund has been formed with anchor-investor Airbus as well as Air France-KLM, Mitsubishi HC Capital Inc., BNP Paribas, Associated Energy Group and Burnham Sterling Asset Management (as fund manager).

The initial partners have committed about US$200 million (AU$297 million), with Qantas initially committing US$50 million (AU$75 million).

The fund made its first investment in April 2024 in US-based technology company Crysalis Biosciences, which aims to renew chemical manufacturing infrastructure with innovative fuel and chemical production technologies. The company has acquired and renovated an ethanol plant in Illinois that was closed in 2019 and has now been approved to produce low carbon intensity SAF and biochemicals. SAF is one of the most effective tools airlines currently have to reduce their emissions.

AUSSIE DRONES **BATTLE ZOMBIE FIRES**

AUSTRALIAN DRONE COMPANY CARBONIX is deploying drones to detect Canadian bushfires started by smouldering embers in tree root systems following a bushfire, labelled 'zombie fires'.

The Volanti, an electric fixed-wing uncrewed aerial system (UAS) can execute rapid aerial surveys across large areas of rugged Canadian terrain. The drones are equipped with a variety of sensors including photogrammetry and infra-red with radiometric data.

The drone is part of a five-year project to develop long-range UASs to enhance situational awareness for early bushfire detection

AVIATION **WHITE PAPER**

THE 2024 AVIATION WHITE PAPER, released in August, contains a dedicated general aviation (GA) section, which advances two main initiatives, along with other issues scattered through the paper, which could impact the future of GA in Australia.

The paper indicates the government will protect GA's access to leased federal airports by setting expectations for airport master plans and establishing a statement of expectations concerning the Department of Infrastructure, Transport, Regional Development, Communications and the Arts' function as a regulator under the *Commonwealth Airports Act 1996*. It also states that the Civil Aviation Safety Authority is refreshing its GA workplan, and adjusting its practices to reduce the regulatory burden on GA, while keeping the community safe.

Initiatives aimed at other sectors that have peripheral consequences for GA include strategies for advanced air mobility, expanded UAV use and the inappropriateness of sustainable aviation fuel for GA.

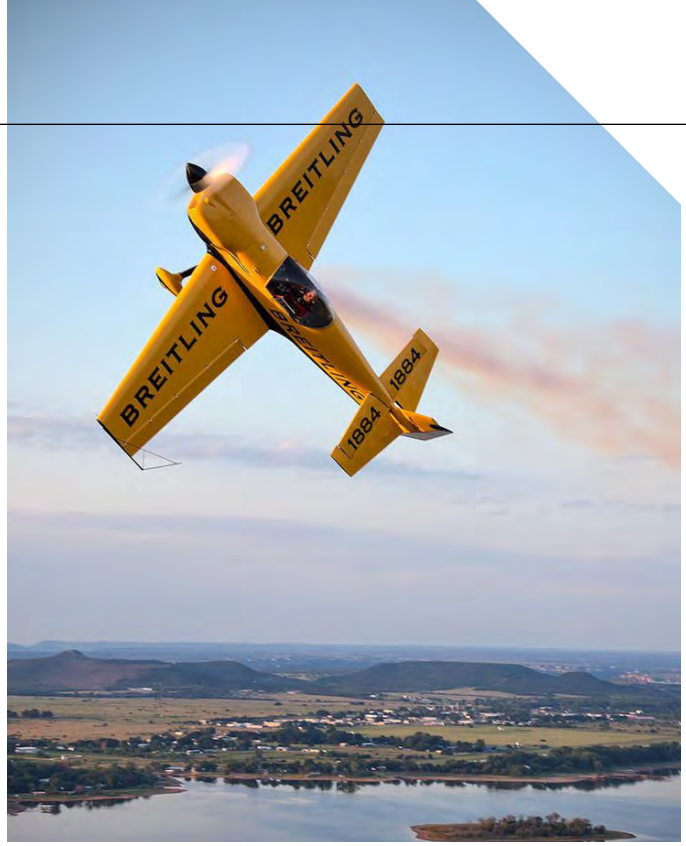
Source: Australian Flying

FLEXIBLE **FLIGHT ROUTING**

AIRSERVICES AUSTRALIA IS collaborating with air navigation service providers (ANSPs) and airline operators from Australia, New Zealand, Indonesia and Singapore to trial an initiative allowing airlines to choose their own routes between selected destinations to take advantage of prevailing winds to shorten travel and save fuel. User Preferred Routes is already in use in Australian-managed airspace over the Pacific and Indian oceans and across large areas of upper airspace in Australia. International use has been limited due to the complexity of coordinating routes across international boundaries of airspace managed by different ANSPs.

The trial commenced in August and, as an example, user preferred routing is expected to save about 100kg of fuel between Melbourne and Denpasar, or 26 tonnes a year, if the route is flown five times a week – equivalent to 82 tonnes oof carbon emissions.

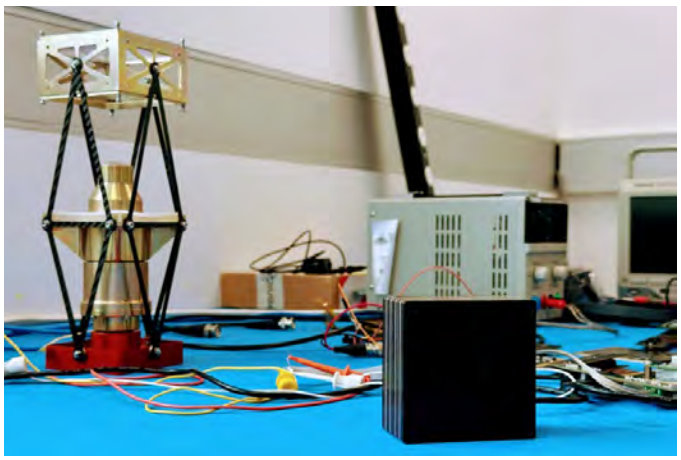
Source: Airservices Australia



QUEENSLAND AEROBATIC CHAMPIONSHIPS

THE 2024 QUEENSLAND AEROBATIC CHAMPIONSHIP, held at Watts Bridge in August, showcased the skill and precision of aerobatic pilots from across Australia. Pilots competed in multiple categories and provided impressive aerial displays. The sport of aerobatic flying is growing and attracting more pilots and spectators to events.

SPACE CAMERA



THE AUSTRALIAN DEFENCE AND SPACE INDUSTRY is set to gain onshore manufacturing of a space camera that can provide images back to Earth at high speed and will aid in disaster operations, land management and defence activities. AI software and laser communications support will increase the efficiency and accuracy of satellite imaging, leading to greater space observation capabilities that will enable automated processing and downlinking of critical data at high speed, in a low- bandwidth environment.

This multi-sensor camera for Earth observation is in development with Leonardo, Spiral Blue, Nominal Systems and the Australian National University, brought together under an iLAuNCH Trailblazer project. Application of these technologies will create an opportunity to commercialise a space solution that is capable of remote imaging and high-speed data communication.

AIRPORT CYBER RISKS

AIRPORTS OPERATING AT MAXIMUM CAPACITY, due to surging domestic passenger numbers and staff shortages, are automating as many processes as possible, with measures such as self-service check-in and facial recognition technologies. The use of digital systems results in passenger and employee data being stored in a growing number of locations, increasing the opportunity for cybercrime. Airports have been identified by hackers as an ideal target for phishing, malware and ransomware attacks.

Last year, the Australian Security Intelligence Organisation noted airports are a key target for security threats, and brought attention to a 'nest of spies' from a foreign intelligence service that was operating locally. Airports now face the challenge of maintaining service by leveraging interconnected digital technologies, while improving their cyber resilience against attack.

Source: Australian Aviation

777X TEST FLEET GROUNDED

BOEING GROUNDED ITS B-777X test fleet in late August after a routine post-test flight inspection in Hawaii revealed a severed thrust link on the aircraft. Inspections of two other test aircraft found cracks in the assembly that transfers thrust between the General Electric GE-9X engines and the pylons that secure the engine to the air frame.

The Federal Aviation Administration had recently cleared Boeing to conduct B-777X aircraft certification test flights. The grounding is expected to result in a delay of initial delivery of B-777 aircraft to airlines until 2026.

Source: Forbes

Ensuring Aviation SAFETY

SCHEDULED EXTINGUISHING AGENTS AND ENVIRONMENTAL RESPONSIBILITY IN THE AVIATION SECTOR.

SAFETY IS PARAMOUNT in the Australian aviation sector and one critical aspect is fire suppression. The use of scheduled extinguishing agents in mitigating risks while in the air and on the ground in carriers or the tarmac is vital in ensuring safety to passengers, crew and property. Given the potentially catastrophic consequences of a fire on an aircraft and the potential loss of life, property damage and environmental pollution, it is of utmost importance to have the most stringent fire safety protocols possible.

Aviation fire safety measures are put in place to prevent, detect and suppress fires in various areas of an aircraft, including the cabin, cargo hold and engine compartments. These measures include the installation of fire detection and suppression systems, emergency evacuation procedures and crew training in fire safety protocols.

One of the key components of aviation fire safety is the use of scheduled extinguishing agents. These agents are specifically designed to suppress fires in aviation settings and are classified based on their effectiveness in combating different types of fires, such as Class A (ordinary combustibles), Class B (flammable liquids), and Class C (electrical) fires. Common scheduled extinguishing agents used in aviation include halon and Halotron, with each agent playing a crucial role in the safe containment and extinguishing of fires in aviation settings. While not a scheduled agent, water-mist systems are also used commonly within fire suppression systems.

Halon is exclusively used within the aviation sector, as the production and import of recently developed or 'new' halon is banned globally. Though a widely used extinguishing agent in the past, and highly effective in suppressing fires and preventing reignition, it has particularly high ozone-depleting properties and has been phased out under the Montreal Protocol (see right). As fully halogenated chemicals that have relatively long lifetimes in the atmosphere, halons, when extinguished, have reactions involving bromine that are estimated to be responsible for 25 percent of the chemical destruction of ozone over Antarctica and 50 percent over the Arctic. The ozone-depleting potential of halons is 10 times greater than chlorofluorocarbons (CFCs) and because of those detrimental environmental consequences, it is critical that the scheduled substance is highly regulated and monitored when used.

Despite its damaging impacts on the environment, due to the unique and specific safety requirements of aircraft, specifically around weight and spacing requirements, aviation applications of halon are among the most demanding uses of the extinguishing agent. Aircraft, in particular, require the beneficial characteristics of halon, especially its dispersion and suppression effectiveness, acceptable toxicity, its highly efficient weight and space containment, and

ABOVE Gas fire training at RAAF Base Amberley, Qld.

ABOVE RIGHT Applying fluorine-free foam to extinguish a demonstration aviation fuel blaze.

LEFT A Transfield Fire Services aircraft firefighting demonstration. Photos: © Department of Defence.

its unique ability to fight fires at the flame chemistry level. Other desirable characteristics of halon are avoidance of clean-up problems, minimal thermal decomposition products, suitability for use on live electrical equipment, and effectiveness on hidden fires. It is no surprise that replacing halon for aviation use is proving technically difficult.

SAFETY STANDARDS

Acting on behalf of the federal Department of Climate Change, Energy, Environment and Water, the Fire Protection Industry Board (FPIB) plays a pivotal role in setting guidelines and recommendations to ensure the aviation industry adheres to the highest standards of safety around scheduled substance use. In line with global environmental initiatives, the FPIB administers the fire protection division of the Ozone Protection and Synthetic Greenhouse Gas Regulations 1995, managing the permit and licensing systems of individuals, workers and businesses who handle scheduled extinguishing agents for fire protection. This includes the use of halon in the aviation space and any company trading in halon must hold a Halon Special Permit.

An Extinguishing Agent Handling Licence must be held by any individual handling or managing halon in any capacity. In essence, it is an offence to be in possession of halon unless it is contained in fire-protection equipment installed in, or carried in, an aircraft, and all applications for its use should be made to the board.

To mitigate the risks of fire on board aircraft, the FPIB has developed comprehensive guidelines for fire suppression systems, while working to ensure all fire suppression agents adhere to environmental regulations set by the government. Firstly, the board recommends that builders, operators and owners of aircraft with gaseous fire suppression systems containing scheduled extinguishing agents ensure the installation and maintenance of the systems is done by licensed technicians. Regular maintenance and service of gaseous fire suppressions should be conducted frequently to ensure full functionality in the event of a fire and all technicians working with scheduled extinguishing agents must hold the appropriate licence, authorisation, or permit. Under the regulations, licensed aircraft maintenance engineers and aircraft maintenance engineers handling scheduled extinguishing agents must complete a specific unit of training (CPPFES2043A – Prevent ozone depleting substance and synthetic greenhouse gas emissions), or an equivalent assessment to achieve full competency. Ultimately, the value and effectiveness of aviation gaseous fire suppression systems requires that they be properly designed, installed, commissioned and maintained effectively. Put simply, if you don't get those elements right, your fire protection system is more likely to fail when you need it. Taking these steps will also help ensure you are acting in compliance within relevant government acts and legislations.

Following the recommendations outlined by the board is not only an important way of keeping aircraft and crew members safe, it is critical in helping Australia uphold its international duty and obligations in reducing ozone-depleting substances and synthetic greenhouse gases under the Montreal Protocol. The environment is protected by strictly controlling the discharge of scheduled extinguishing agents (other than for putting out fires) and federal regulations govern the acquisition, possession, handling, storage and disposal of scheduled extinguishing agents such as halon, being used in Australia.

THE MONTREAL PROTOCOL

The Montreal Protocol is an international treaty adopted in 1987, which aims to protect the ozone layer by phasing out the production and consumption of ozone-depleting substances. While the primary focus has been on substances such as CFCs and halons, recent attention has also moved towards synthetic greenhouse gases due to their impact on climate change. Compounds within the scheduled gases used within many fire suppression systems and extinguishing agents, when exposed to intense UV light in the stratosphere, destroy ozone molecules, which creates large holes in the ozone layer. Through multilateral international agreement, the Montreal Protocol seeks to stop the release of those gases into the atmosphere.

Fire Protection Industry Board

A Mk Vb Spitfire similar to that flown in the European theatre during WWII. This aircraft was built as a Mk I and later modified to the Mk V standard, circa 1942. Photo: Defence.

INNOVATION AND INVENTION

HOW BRITAIN AND ITS ALLIES GAINED THE EDGE IN WORLD WAR II.

TO WIN THE BATTLE OF BRITAIN, the British and their allies needed timely information to make rapid decisions, access to capable flying staff and ground crew to respond rapidly to German attacks, and an integrated network of people to transmit real-time information to the headquarters of the Royal Air Force (RAF).

As we mark 84 years since Australian pilots flew in the Battle of Britain and 80 years since Germany dropped its first V1 bombs on London, it is worth reflecting on the important role innovation played in World War II and its legacy today.

The Dowding System, chain radar and the tactical flexibility employed by Air Vice-Marshal Keith Park, combined with the innovations in the Spitfire and Hurricane provided Britain and its allies with a much needed edge during the Battle of Britain.

Innovation and inventiveness were critical factors in shaping the tactics and strategy that led to the Allied victory in the Battle of Britain. The integration of new technologies and strategic thinking allowed the RAF to effectively counter the German Luftwaffe's attacks. The activation of both ground-based and flying innovations were key to the success of the RAF.

DOWDING SYSTEM

Air Chief Marshal Sir Hugh Dowding implemented an integrated air defence system that combined radar, ground observers and fighter control centres. The Dowding System enabled the RAF to efficiently manage its resources and respond to threats in a coordinated manner. By centralising command and control, Dowding directed fighter squadrons to the most critical areas, maximising their impact.

CHAIN RADAR SYSTEM

The Chain Home radar system was a groundbreaking innovation that provided the RAF with early warning of incoming German aircraft. The network of radar stations along the British coast could detect enemy planes at long distances, giving the RAF crucial time to scramble fighters and intercept the attackers. The radar system's ability to provide real-time data on the location, altitude and direction of enemy formations allowed for more efficient and coordinated defensive tactics.

TACTICAL FLEXIBILITY

The leadership of Air Vice-Marshal Park, who commanded No 11 Group, was instrumental in the tactical flexibility of the RAF. Park's approach emphasised rapid response and adaptability, allowing his squadrons to engage the enemy effectively.

His ability to make quick decisions based on real-time information from the Dowding System was crucial in countering the Luftwaffe's attacks.

THE SPITFIRE AND HURRICANE

The Supermarine Spitfire and Hawker Hurricane aircraft, both powered by the Rolls-Royce Merlin engine, were pivotal in the RAF's defence strategy, allowing the RAF to deploy a versatile and resilient air defence force.

The Spitfire's speed and agility made it highly effective in dogfights and a versatile fighting machine. This was due, in part, to the constant improvements to Spitfire models (Marks) and different ways the Spitfire was used in combat. Meanwhile, the Hurricane's robustness and ease of repair made it a reliable workhorse.

GERMAN INNOVATION

Innovation was a double-edged sword during WWII, as both the Axis and Allied forces sought technological and tactical advantages. The German development of the V1 and V2 rockets represented a significant leap in warfare technology, introducing the world to early ballistic missiles. With their capacity to cause mass destruction from a distance, they posed a new and formidable challenge to the Allies.

In response, the RAF had to quickly adapt, employing new strategies and technologies to intercept and neutralise those threats. The Allies' ability to counter the advanced German weapons with radar and new interception techniques highlights the critical role of ingenuity in warfare.

LASTING LEGACY

Innovation was the cornerstone of the Allied victory in the Battle of Britain. The integration of new technologies and strategic thinking allowed the RAF to effectively counter the Luftwaffe's attacks and secure air superiority. The lessons learnt from those innovations continue to shape modern defence strategies, highlighting the enduring importance of technological advancement in maintaining resilience and sovereign capabilities.

The groundbreaking tactics and strategies devised during the Battle of Britain have had a lasting influence on contemporary warfare. The concepts of early warning systems, integrated command and control, and tactical adaptability remain vital components of modern military operations.

Karen Paterson, The Boson Group

AUSTRALIAN INGENUITY

Facing formidable enemies and often with limited resources, Australian forces consistently found ways to adapt and innovate, turning the tide in critical battles.

Group Captain Clive Robertson Caldwell DFC + Bar, DSO, one of Australia's most distinguished fighter aces, exemplified the ingenuity and resourcefulness that characterised Australian contributions to WWII. Renowned for his leadership and combat prowess, Caldwell introduced an innovative combat technique known as shadow shooting. It involved firing at the shadow of an enemy aircraft rather than the aircraft itself, a tactic that significantly increased accuracy and effectiveness during dogfights.

Caldwell's innovation proved invaluable in the challenging skies over North Africa, where his skill and leadership helped secure crucial victories for the Allies against the Axis forces. His success in North Africa set the stage for his continued impact in the Battle of Australia and across the Asia-Pacific theatre, where his strategic acumen and combat techniques contributed to the broader Allied war effort.

The impact of Caldwell's shadow shooting remains a powerful example of how innovative thinking and tactical flexibility can change the course of history.

A Hawker Hurricane MK XII performs a solo aerobatic display during the 2021 Hunter Valley Airshow. Photo: SGT Nunu Campos.

LONG & VARIED SERVICE

A formation of AP-3C Orions over the northern training area, near Adelaide, South Australia. Photo: CPL David Gibbs.

A YEAR AFTER THE P-3'S RETIREMENT FROM THE RAAF, **AIRCDRE (RET'D) IAN PEARSON** LOOKS BACK OVER ITS 56 YEARS OF SERVICE.

SINCE NO 11 SQUADRON'S FIRST ORIONS ARRIVED at Edinburgh in May 1968, the Lockheed P-3 Orion delivered a versatile, long-endurance, maritime and land surveillance and response capability to the RAAF. Larger and faster than the P-2 Neptunes they replaced, the Orions provided a far more comfortable crew environment and the opportunity for further capability development as technology evolved. Ten P-3C Update II Orions replaced 10 Squadron's ageing SP-2H Neptunes in 1978 while 11 Squadron's P-3Bs were replaced with 10 P-3C Update II.5 Orions in 1984/85. Three second-hand P-3Bs, redesignated as TAP-3s also flew with 92 Wing as training aircraft between 1997 and 2004.

While originally fielded as a land-based maritime patrol aircraft, in RAAF service the P-3's low-profile missions, largely conducted remote from base and shrouded by confidentiality, evolved in response to changing threats and national security requirements.

Inheriting their anti-submarine warfare role from the P-2 Neptune, the Orion's greater reach and speed saw active RAAF P-3 involvement in Cold War operations far from home, from the North Pacific to the North Atlantic to the Indian Ocean and elsewhere. Flying from the USA, Canada and further afield as part of the Cold War operations, RAAF P-3s located, classified and tracked Soviet attack and ballistic-carrying nuclear submarines. Similar operations were conducted against Soviet attack submarines transiting the waters of our region.

The 1968 introduction of the P-3B, with its greater speed and reach, enabled Australia to fulfill its surveillance obligations under the 1951 Radford-Collins Agreement that provide for the shared responsibility for the protection of shipping and sea lines of communication in strategically important South Pacific and Indian Ocean areas. Similarly, when our Exclusive Economic Zone was declared in 1973, we now had the capability to surveil the associated maritime expanse, an area exceeding that of Australia's land territory. The P-3's developing capabilities were subsequently exploited in a host of intelligence, surveillance and reconnaissance (ISR) operations in the traditional maritime domain and, later, over land.

Commencing in 1980, Operation Estes involved P-3s in round-the-clock surveillance of Bass Strait oil rigs against an assessed terrorism threat. Further afield, Butterworth-based Operation Gateway commenced in February 1981. Still running 43 years later (now with P-8A Poseidons), Gateway is the ADF's longest continuously active operation, involving the location and tracking of submerged submarines and conducting ISR operations against a variety of targets in the area of operations. The sharing of intelligence from those operations with long-standing allies and regional partners has firmly established Australia as a trusted partner in such long-standing arrangements as ANZUS and the Five Power Defence Arrangements, and more recently, AUKUS and The Quad. These operations are not without hazard: RAAF P-3s involved, while not themselves armed in these missions, were engaged

ABOVE A RAAF P-3B Orion on Operation Gateway flies over the First Penang Bridge in Malaysia during its construction in the early 1980s. Photo: Defence.

by small arms and heavy machine gun fire, flares, lasers and the radars of more potent hostile weapons systems.

RAAF P-3 surveillance operations in the South-West Pacific long fulfilled a broad diplomatic agenda. Safeguarding the natural resources of island states, which lacked the necessary assets to discharge that role, Operation Solania maritime surveillance by RAAF P-3s was a tangible expression of Australia's position as a trusted neighbour and regional partner. Strategically, the presence of RAAF P-3s engaged in these patrols also provided a counterweight to the activities of other nations exploring opportunities in the region.

Over the years, Australia's credentials as a trusted member of the international community have been further reinforced by Orion participation in countless rescues at sea. Prominent among them were the rescue of solo yachtswoman Isabelle Autissier in 1995, some 1,450km south of South Australia, and the even more challenging rescues of three yachtsmen, Raphaël Dinelli, Thierry Dubois and Tony Bullimore in the 1996/97 Vendee Globe solo-handed round the world yacht race, each being capsized approximately 2,000km south of Western Australia.

In their long service life with the RAAF, P-3Cs received increased capability and airframe life through continuous upgrades. Early in their RAAF service life, the P-3C's well established surface surveillance capability was transformed to a maritime strike capability when the aircraft were armed with the AGM-84 Harpoon missile. On Anzac Day 1982, a P-3C (A9-751) flown by a 10 Squadron crew, became the first RAAF platform to fire one of the weapons when it engaged an exercise target at sea near Hawaii. Subsequent upgrade projects included AIR 5140, commenced in 1989 and primarily aimed at installing an advanced electronic support measures system and, commenced in 1995, the multi-phase AIR 5276 program extended the life and enhanced the military capabilities of the redesignatedAP–3C Orion fleet. Along with the introduction of sophisticated electronic warfare self-protections systems and continuing upgrades to the aircraft's electro optics/infrared system, continuing enhancements to the aircraft under AIR 5276 made it a particularly effective ISR platform throughout coalition operations in the Middle East Area of Operations (MEAO). Between 2003-2012, AP-3Cs won great accolades for their operations both over land and more traditional maritime roles in the MEAO, routinely being tasked in both environments on the same sortie. Separately, two aircraft were substantially modified to undertake an electronic warfare role with 10 Squadron.

In view of the P-3's design stemming from the Lockheed Electra passenger aircraft, no description of RAAF P-3 operations would be complete without reference to the Orion's air-mobility roles. Over the years, these have included countless aeromedical evacuations across the region, exploitation of the aircraft's capability to self-deploy with its own support crew, acting as a navigation and communications platform for long transits by less capable platforms and, on occasion, exotic passenger transport tasks.

Throughout almost 56 years of RAAF service, P-3s, employed in three of the four core air power roles, (ISR, strike and air mobility), have epitomised the flexibility of air power.

In 2016, while retaining its maritime role, 11 Squadron transitioned from the AP-3C Orion to the P-8A Poseidon. The RAAF's last two remaining Orions were operated by 10 Squadron in an electronic warfare role until December 2023.

With the roles of the RAAF's Orions handed over to the P8-A Poseidon, MQ-4C Triton and MC-55A Peregrine, A9-753 is the last AP-3C flying in Australia. The aircraft is part of the Historic Aircraft Restoration Society Museum collection at Shellharbour and can be seen at the museum, as well as at air shows and commemorative fly pasts around Australia. Static AP-3Cs can be viewed as the gate guardian at Edinburgh, and in museums at Point Cook, Canberra (AWM), Caloundra, Parkes and Darwin.

PUTTING TOGETHER AN ENTIRE COLLECTION TO SHOWCASE THE RAAF C-130 HERCULES AIRCRAFT FOR THE AUSTRALIAN WAR MEMORIAL.

A HERCULEAN TASK

No 36 Squadron ground crew completing an engine changeover on A97-010 at Camp Snoopy Qatar, 2003.

THE OPPORTUNITY TO BUILD an exhibition at the Australian War Memorial (AWM) is special, but the opportunity to build an entire collection from scratch for the National Collection is rare.

In 2016, a RAAF heritage assessment team, led by Air Vice Marshal Greg Evans and Group Captain Dave Richardson, assessed the C-130H fleet to prioritise a list of historical significance. The report found that A97-010 (which had been in storage since March 2008) was the most historically significant of the H models.

In November 2018, A97-010's nose section and tail found a new permanent home in the AWM's National Collection. As the museum galleries at the time could not accommodate such large objects, they were stored at the memorial's offsite technology and conservation facility in the Canberra suburb of Mitchell, in a huge hangar-type shed.

The C-130 Hercules was part of the list of large technology objects identified in 2019-2020 and slated for possible inclusion in an exhibition. In early 2021, the nose section was nominated as a display in an architectural aperture in the new Anzac Hall. However, the strength required of the structure's ceiling beams for that installation meant it became increasingly difficult to deliver. Simultaneously, concept design testing around the suspension of an F/A-18 Classic Hornet (A21-022), nominated for the Middle East gallery display, was also found to be unfeasible. In response to these issues, a total review of the lower level of Anzac Hall began in April 2022 to incorporate both the C-130 nose section and the Hornet in new prime locations.

HERCULES A97-010

Aircraft A97-010 was delivered to the RAAF on 25 September 1978 and, until 2006, was part of No 36 Squadron before moving to No 37 Squadron for the last two years of its service. On 1 May 2010, it was withdrawn from service and its engines removed. The remainder of the fuselage was combined with A97-012 as a C-130 J Loadmaster training aid at RAAF Richmond.

During its service, A97-010 participated in a number of notable incidents. In July1997, after a coup in Cambodia, 442 Australian citizens and approved foreign nationals were evacuated from Phnom Penh. Six flights were planned and flown by four aircraft, including A97-010 commanded by Flight Lieutenant David Steel. However, by the time of the last lift, a series of delays (one caused by the presence of stowaways on the first aircraft out) meant the final sortie could not arrive in Phnom Penh until after dark. While they were carrying night-vision equipment, the crew were not fully current to use it, as it was intended that lifts be completed in daylight. A rapidly deteriorating security situation combined with a tropical storm, total darkness, and a complete lack of runway lighting combined to create a difficult situation.

In May 1979, A97-010 carried the anchor and cannons of HMS *Sirius* to Norfolk Island.

"It was the biggest thunderstorm I have ever seen on a radar and it was right over the airfield," recalled Flight Lieutenant (later Air Commodore) Bill Kourelakos, map navigator on that flight.

Nonetheless, Flight Lieutenant Steel proceeded to grease the landing on night vision goggles, the stowaways were offloaded, and the last of the evacuees departed safely after just seven minutes on the ground.

Named Stallion Express during its Middle East deployments, on 5-6 September 2002, aircraft A97-010, with Squadron Leader Mick Aspinall in command, was tasked with inserting elements of the United States 82nd Airborne into a Taliban-controlled town in eastern Afghanistan. Due to the ground threat, air support was provided by USAF A-10 aircraft. The load for the first task was a humvee, trailer and ground troops. The sortie was to be flown blacked-out, on night-vision goggles, with absolute minimum time spent on the ground.

"As we came in to the target airfield on very short final, there was light-calibre shooting at our noise, the aircraft's self-defence system went off and all hell broke loose," Squadron Leader (later Wing Commander) Aspinall recalled.

The aircraft experienced a small arms engagement approaching the Initial Point, a missile warning false alarm on short finals, but the landing was completed on time.

As it exited, the humvee struck the rear sloping longeron and two feet of airframe skin was torn from the major structural member. A quick inspection confirmed the aircraft was "probably" safe to fly, but with a high degree of risk. The threat situation on the ground did not allow for a more detailed inspection, nor did it allow the crew to remain. A departure was rapidly planned: it would be complicated by the fire encountered inbound, high terrain, the tactical situation, the need to keep airspeed to a minimum to avoid strain on the damaged tail, and the discomfort of unpressurised flight in mountainous terrain.

At Bagram, RAAF technicians made a temporary air-battle damage repair. The aircraft was flown to the Australian base in the region and, after a crew change, was put back to work. The 'temporary' repairs were excellent, and remained on the aircraft for a number of years.

Aircraft A97-010 was also notably bogged in May 1981 at Koroba Papua New Guinea. It suffered double-engine failure during training in the United States in 1998, was part of Operation Sumatra Assist tsunami relief operations in 2004-5, and repatriated the remains of Australian Federal Police officers killed in the Yogyakarta airliner crash in 2007.

A VERSATILE PLATFORM

For more than 65 years, the Lockheed C-130 Hercules has been the RAAF's workhorse transport aircraft. It is an extraordinarily versatile platform capable of multiple roles; the carriage of cargo, passengers, paratroops, and strange and outsize loads. It also serves as a search and rescue capability, humanitarian assistance and medical evacuation capability. The C-130 can operate from remote, short and unsealed airfields and it can land on dirt, grass, ice and sand. The C-130 Hercules platform also provides Australia and the region with a critical tactical airlift capability. The AWM exhibition will highlight the following themes.

War and peacekeeping operations. 1970s, sustained United Nations support in the Sinai, as well as supplying Australian forces in Vietnam and evacuating the wounded. From 1999, the dominant factor in the history of C-130 operations has been continual commitment to combat operations, first in East Timor (as well as Bougainville and Solomon Islands), and from early 2002, in the Middle East, supporting Coalition efforts in Iraq and Afghanistan.

Emergency evacuation and AME. Cyclone Tracy 1974, Operation Babylift 1975, Bali bombings 2002 (and 2005), Operation Sumatra Assist 2004… Countless lives have also been saved by C-130 aeromedical evacuations (AME) from remote communities.

Humanitarian and disaster relief. Often the first to deliver aid and emergency services and bring people to safety, C-130s have airdropped fodder to livestock and supplies to desperate people. RAAF C-130s have been a cornerstone of Australia's response to regional disasters, including tsunami, cyclone, bushfire, flood and famine.

Search and rescue. C-130s have performed innumerable search and rescue operations in Australia and the region, looking for vessels lost at sea, downed aircraft and conducting searches for illegal fishing.

Civilian airlift. C-130s transported more than 172,000 Australians stranded during two major civilian pilots' strikes. It has also evacuated Australian nationals from hotspots such as Iran, Cambodia, Lebanon, Afghanistan and Sudan. The C-130 carries out *ad hoc* tasking such as scientific support to Antarctica, and the carriage of strange and outsize loads including the Popemobile, Entombed

Warriors, the Gemini Space capsule and large zoo animals.

The C-130 Hercules is a big humanitarian platform. It is the cornerstone of our response to regional disasters, and has remained accident-free in some of the most challenging environments on earth.

BUILDING A COLLECTION

When it was decided the C-130 would have its own permanent gallery space in the new galleries, work began with a dedicated curator. A collection survey of the memorial's vast holdings revealed little of a platform that is ubiquitous and has worked hard in our ADF for over six decades. There were surprisingly few objects associated with the C-130 in the National Collection.

Unlike other galleries that focus on a specific campaign, war or defined period, the C-130 exhibition covers the 65 years of operations. As curator, my key priority was to understand and break down the narrative of the platform.

Understanding the chronology and types of tasking allowed me to identify key moments in the timeline of the C-130. I could then make a museum list of desiderata: the things I thought I would need to enable me to tell the story of RAAF C-130s through objects. Of course, when you are building a collection from scratch, you can only hope to acquire various objects. Worse, at the start I did not even know what I wanted, if it existed, or how to get it.

Although large pieces of technology are impressive in themselves, it is the human stories that connect the visitor to the narrative and make an exhibition poignant and interesting. The day I started on the project, I began stakeholder engagement and have maintained a high level of engagement ever since. Meeting those who were there, listening to their experiences and acquiring objects has been key to my work.

After working on the new Bomber Command exhibition for several years, I found engaging with the C-130 community a completely different challenge. The Bomber Command stakeholders I work with are all first or second-generation descendants of the men who were part of that epic campaign. Members of the Herc community are alive, have intact memories and, in many cases, they are still in uniform. In some ways, that makes things easier, but in other ways more complex, as the curator's task can carry a great weight of expectation.

There are publishing gaps on C-130 operations, so in a historical sense, access to the C-130 community has been invaluable. Though many have helped, two people have played key roles in assisting my understanding of the platform and connecting me to the right people: Air Commodore Bill 'K9' Kourelakos and Wing Commander Michael 'Gus' Garside. K9 generously shared his excellent nearly published book, *Air Mobility Workhorse,* and has been an indispensable source. Gus's contacts in the RAAF and his commitment to Air Force have been my entrée to the C-130 community.

Hundreds of emails, meetings and phone calls followed. I have also been doing something we do not usually do at the memorial, soliciting objects. Precious objects, personal objects, varied objects the visitor will want to look at, and that will tell the story of what Australian C-130s have done over 65 years.

I have tried hard to represent the RAAF C-130 community from the beginning until the present. I have tried to represent diversity, musterings and ranks. I have met the C-130 Herc community in their homes, in cafes, museums, in the back of a J model overflying the Blue Mountains, and in their natural habitat of the Clarendon Tavern. I have met a 'baby' airlifted out of Vietnam 50 years ago, and the crew who flew him out.

I try to capture the essence of experiences I have not had. Engaging with veterans and curating new galleries has been an extraordinary opportunity, and I hope the visiting public and all those who have served in our Defence Forces will be pleased with the results.

Emily Hyles, curator, Australian War Memorial Military History Section

LEFT A97-010 flew the 1000th Hercules flight in the Middle East in support of Operation Catalyst in Iraq on 1 September 2005. Crew, from left, FLTLT David Jackson, FLGOFF Mark Saurins, FSGT Randall Law, FLGOFF Conan Brett, WOFF Huey Baldwin and WOFF Dennis Matthews. Photo: Able Seaman Phillip Cullinan.

BELOW FAR LEFT RAAF aviators carry a patient from a C-130 which flew victims to Melbourne after the bombings in Bali on 12 October 2002; the largest Australian aeromedical evacuation since the Vietnam War. Photo: SGT Troy Rodgers.

BELOW LEFT Australian Aid relief is loaded onto a RAAF C-130J at the ADF's main operating base in the Middle East Region in 2020. Photo: CPL Tristan Kennedy.

UNSUNG HEROES

AUSTRALIA'S LARGEST AVIATION MUSEUM HAS A STRATEGIC PLAN TO DEVELOP A UNIQUE VISITOR EXPERIENCE AND CONTINUE TO PRESERVE A RICH AVIATION HERITAGE.

AMID THE DISHEARTENING REALITY OF many out-of-service aircraft being dismantled for scrap, aviation museums have emerged as the unsung heroes, diligently preserving Australia's rich aviation heritage. They offer visitors a unique, educational experience spanning the realms of civil and military aviation.

The 1970s through to the 1990s saw fledgling museums take on the challenge of obtaining aircraft previously written off, often requiring hours of renovation work to bring them to a level of authenticity. These early pioneers paved the way for the museums we see today, which are enjoyed by visitors from all age groups.

Moorabbin Aviation Museum set the benchmark as early as 1962, rescuing a DAP Mk21 Beaufighter from the scrapyard and restoring it to running condition. It remains the only one in the World capable of a runway run.

Currently, there are more than 40 Australian museums dedicated to aviation in some form, each offering an inspiring aviation experience. Some exhibit only a small number of aircraft, while others have expanded their museum to include multiple aircraft displays and interactive experiences, along with engines and aviation artefacts. These museums are a treasure trove for aviation enthusiasts and history buffs alike.

While most museums have survived through careful budgeting and attracting paying visitors, the task is far from easy. The ongoing challenges, from the high costs of preservation to the constant need for funds to obtain and maintain aircraft, underscore the importance of individual donors in supporting these institutions.

At the heart of these not-for-profit aviation museums are dedicated volunteers who contribute their skills and time, from the workshop to greeting visitors and providing guided tours. Their unwavering commitment and passion for aviation preservation are not just inspiring but also integral to the survival of these organisations.

A key challenge for most museums is to compete with other local tourist attractions. Many of those experiences are profit-earning businesses with a larger income stream and greater marketing budgets than private aviation museums.

In addition, museums have seen a reduction in donations, and their greatest

asset, volunteers, has been in decline. So, how do they attract more volunteers while boosting visitor numbers to enable sufficient expenditure to preserve our aviation heritage?

QUEENSLAND AIR MUSEUM

Queensland Air Museum (QAM) is a case in point. It started with a single Canberra bomber placed in a field in 1974, and 10 years later, it still had only six aircraft at a temporary location at Brisbane Airport. On several occasions, the museum could easily have folded, but being moved on from Brisbane Airport provided an unexpected opportunity.

In 1984, land at Caloundra on the Sunshine Coast was made available, thanks to the generosity of Landsborough Shire Council and, in particular Councillor John Harrison. That was the springboard needed to expand the museum and in 2024, it celebrates 50 years with a museum boasting over 80 aircraft, 40 plus stand-alone engines, multiple uniforms, models, and countless items of memorabilia. The museum also houses the largest aviation library in Australia, with more than 18,000 books and 50,000 photographs, together with technical manuals and journals. The valuable collection has national and worldwide significance.

Expanding the number of aircraft brings additional pressure on the restoration team, as visitors expect to see historic aircraft maintained in good condition. Housing all exhibits under cover is not practical for most museums, and ultimately, the decision comes down to preserving the more valuable airframes undercover and protecting outside exhibits from the elements by following a program of cleaning and repainting.

QAM would be the first to acknowledge that difficult decisions must be made in that respect. When you are trying to maintain more than 80 aircraft, progress is determined by two key factors, the number of volunteers available and having the infrastructure in place to carry out the required preservation program.

To this end, QAM assembled a team of experienced volunteers and set up workshops over six months, during which volunteers could contribute to the details behind the museum's six-year strategic plan.

The process required an appraisal of key performance indicators and an assessment of the museum's strengths, weaknesses and opportunities. The completed plan has been divided into four categories: volunteers, infrastructure, strategic relationships, and digital capability. It includes a list of recommendations for each category to serve as action points.

ABOVE Queensland Air Museum hangar.

LEFT Some of the museum exhibits.

The first stage has been to appoint a volunteer coordinator whose role is to attract new volunteers, maintain recruitment levels, and create an environment where individuals can see they are making a valuable contribution. Supporting and developing key volunteer skills can help them achieve their own personal goals.

Improving the profile of any museum will depend on additional initiatives to any marketing plan. Developing new and existing business relationships with like-minded organisations, involving sharing facilities and resources, will further improve the museum's public perception and awareness.

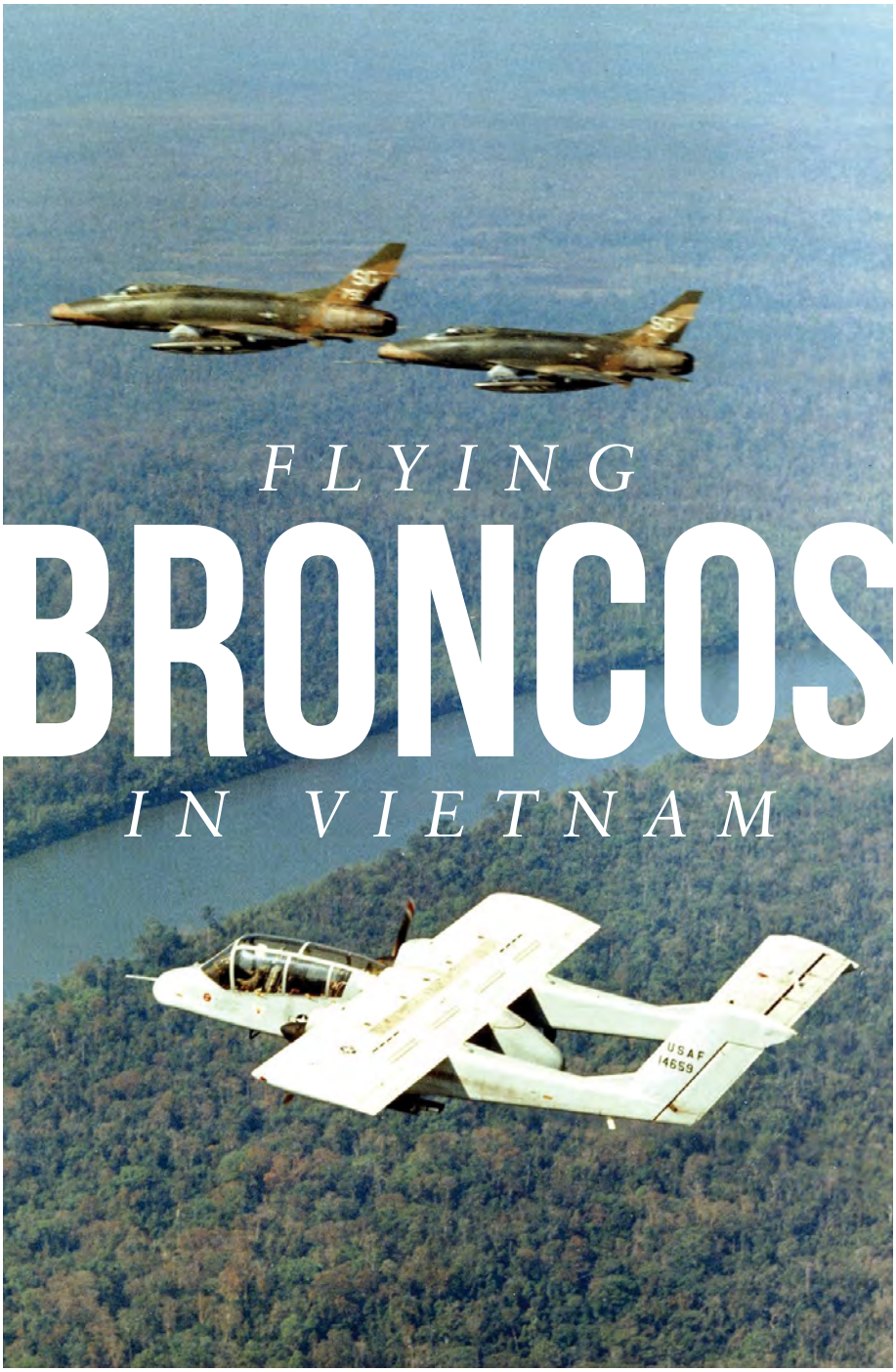
Maximising commercial opportunities, QAM offers its facility for staging other events, such as concerts and musicals, all with the backdrop of iconic aircraft. It also stages several theme days each year and has covered fast jets, warbirds, helicopters, planes, trains and automobiles. The family events have been a resounding success and are supported by strategic partners. Being relatively low-cost to stage, they offer regular public access to aircraft, educational talks, helicopter flights, Defence Force recruitment, and other family activities.

Adding interactive exhibits and simulators has been part of museum development for several years, but opportunities also exist for using museum facilities to develop education experiences, leading to an aviation school of excellence.

President Garry Hills believes focusing on the four key strategies of the QAM's six-year strategic plan will provide the springboard for further growth and ensure the museum continues to flourish. "As the largest aviation museum in Australia, we aim to continue to develop and showcase iconic exhibits providing a unique visitor experience that demonstrates, educates, and excites all generations," he says.

Details of the QAM strategic plan 2024-2030, supported by the Sunshine Coast Council Art and Heritage Levy, are published on the museum's website, qldair.museum.

Christopher Rees



FLYING BRONCOS *IN VIETNAM*

FIFTY YEARS AFTER THE END OF MILITARY INVOLVEMENT IN THE VIETNAM WAR, **CHRIS MIROW** RECOUNTS HIS TIME AS ONE OF JUST 36 AUSTRALIAN FORWARD AIR CONTROLLERS (FACS) SERVING WITH THE AMERICAN FORCES.

IN MAY 1971, I WAS POSTED TO VIETNAM, and attached to the US 7th Air Force. I completed training on the North American OV-10 Bronco with the 20th Tactical Air Support Squadron at Da Nang before attachment to the 11th Brigade of the 23rd Infantry Division Americal at Chu Lai.

I departed Sydney in a chartered Qantas Boeing 707, destination Saigon, now Ho Chi Minh City. I was the only RAAF member on board, the rest being Army. Having already spent some years in South-East Asia, the climate and the cooking smells in Saigon were familiar, but the French influence on the architecture was interesting. I was met in Saigon by a RAAF Squadron Leader, who was waiting for me at the bottom of the 707's boarding stairs. He assured me my luggage would catch up and we could go over to the terminal building and have a few beers while we waited. We jumped into an RAAF staff car and took off straight across the aerodrome, heading for the terminal.

Unfortunately, the long grass we were motoring through was hiding a rather large monsoon drain that we managed to nose into with all four wheels locked up. Being the dry season, we didn't get wet, but it was a little embarrassing. Anyway, we quickly sorted that and I found myself drinking copious quantities of the local beer for the remainder of the day and evening. Next morning, I was rather the worse for wear when I had to board a Vietnamese transport aircraft (I think it was a C-123 Provider) to fly from Saigon to Phan Rang to do my in-country indoctrination with the US Air Force (USAF). I think the South Vietnamese Army guys on board thought I had already had a long hard war.

At the USAF headquarters at Phan Rang, I noticed among the myriad chinagraph boards one listing where pilots were destined to go for their in-country aircraft endorsements. I was on the board to go to Cessna O-2s. I had always thought I was going to fly the OV-10 Bronco, so when nobody was looking, I rubbed my name off the O-2 board and added it to the OV-10 board. The next day a USAF major told me he thought I was going to fly O-2s, but I assured him all Aussies were now going to fly OV-10s (as was the policy). Unbelievably, that's where I ended up.

We were flown to Da Nang by a USAF C-130. We were strolling across the tarmac towards the Air Movements area when a siren started up, and people were running

everywhere. That was my first experience of a rocket attack, and everybody was headed for the nearest bunker.

The Viet Cong had a variety of rocket types which they normally fired from the small mountain range to the west of Da Nang. A delay system ensured they were well clear when the rockets went off, so there wasn't much to be gained by shooting back or trying to locate them. The rockets weren't accurate enough to specifically target bomb dumps, fuel storage, flight lines or accommodation areas, but Da Nang was a large base and they could normally get a hit somewhere inside the perimeter. For the next five days, we were getting sporadic rocket attacks, mainly at night. Their intensity was not normal for Da Nang, but it certainly set the scene for the start of my Vietnam tour.

My OV-10 conversion complete, I headed off for Chu Lai, a large base divided into two parts. There was a large concrete runway and all manner of infrastructure to the west, but we had the little bit to the east – a very pretty bit of beach coastline if it hadn't been for the barbed wire and sentry towers! The boundary wire was patrolled day and night by Huey helicopters.

Our section was a US Army camp with lots of grunts, helicopters they called air cavalry, a field hospital, and a battery of 155mm howitzer artillery, just to make sure you didn't sleep all night. Our runway was short and constructed of perforated steel matting which was used extensively during World War II to construct temporary runways. I was attached to the 11th Brigade of the 23rd Infantry Division Americal, US Army.

Our accommodation, located under she-oak (Casuarina) trees which grew in the sand next to the beach, had unpainted plywood walls and floors with corrugated iron overhanging roofs. The walls had large sections that could be propped open to allow cooling breezes to blow through. It never got really cold, but it was cool during the wet season. My hut had a sleeping room with three beds for two Kiwi FACs and myself, without the privacy of walls between us, and a living area that had a fridge, sink and a table for sitting around with a quiet ale at the end of the day or for reading and writing letters.

There was an external shower and toilet block, and we had a local employee, a lady of indeterminate age and yellowed teeth, who cleaned and washed for us. The locally employed civilians were, I believe, the source of drugs for the base. Without the barbed wire and all the military gear, our camp would have made ideal cheap backpackers' accommodation.

Our meals were provided by the Army, and the mess dining area was a large concreted area with a roof but no walls. Every meal came with a large brown pill that we were ordered to swallow, but were never told what it contained. I suspect it was bromide to keep our minds on the job. I remember reading a letter to the editor some years later, written by a 92-year-old ex-WWII soldier, saying they had been fed bromide pills during the war to stop them thinking of the lassies. "And I do believe they are starting to work," he wrote.

A typical day started with a quick drive in our jeep to brigade headquarters for a briefing prior to flying. We were given a code book for the day so we could communicate with the Army without being understood by the bad guys. Then we were given the latest known positions of friendly troops, and any set tasking for the day. That might include specific areas for visual reconnaissance, and sometimes pre-planned airstrikes on a grid reference for a suspected enemy location. Quite often it was just visual reconnaissance of our area of operations (AO) and being on standby for whatever came up.

We frequently teamed up with an air cavalry helicopter team. That consisted of a light observation helicopter (LOH) which

ABOVE
Accommodation at Chu Lai.

OPPOSITE
An OV-10A Bronco with F-100C Super Sabres over Vietnam, c1969. Photo: National Museum of the USAF.

RIGHT
Chris Mirow and Bruce Wood writing letters in the 'living room'.

got down in the weeds and looked for trouble, two UH-1H Hueys carrying troops for possible insertion if the LOH found something of interest, and two Huey Cobra gunships for defence of the grunts on the ground and also for attacking light targets. If they needed some heavier armament, they would ask us to call up an instant airstrike.

After the morning briefing, it was down to the flight line to put on a survival vest and a gun belt containing an old .38 revolver in a holster. The survival vest contained all sorts of bits and pieces, but most importantly a survival radio. We were then allocated a Bronco and would be off for typically a two-and-a-half to three-hour flight. I was a smoker in those days, and three hours without a 'durry' would have been terrible. Fortunately, the Bronco had an air vent on the canopy that very neatly took the ash off a cigarette, and even whisked the butt away when finished. We flew most days of the week, and weekends were just more of the same. Although the Bronco had front and rear tandem seats, we seldom flew with another FAC in the rear seat – there weren't enough of us for that. I did have a week off once, called rest in country, in Songkhla in Thailand – beaches and lots of cold beer.

ABOVE
Chu Lai Airfield, 1966. Photo: US Marine Corps archives.

LEFT US helicopters destroyed by typhoon at Chu Lai.

BELOW LEFT
OV-10 taxiing at Chu Lai.

RECONNAISSANCE & TARGETING

Our AO had fixed boundaries which we weren't authorised to cross. We carried detailed maps, and could map read positions on the ground to within 100m. We became very familiar with our AO and could detect any new bridges, trails or heavy usage of existing roads and trails. At that stage of the Vietnam War, the Americans were happy just to maintain the status quo, and weren't looking for trouble. Our visual reconnaissance frequently revealed heavy activity, but the brigade never seemed terribly interested. We put in air strikes to create landing zones for helicopters, and on grid references without knowing what we were targeting. Sometimes we even got good results. I have one entry in my log book showing bomb damage assessment results of nine killed by air, 31 bunkers, 10 hooches (native huts), two tunnels and one bridge destroyed – but that was definitely not the norm.

Sometimes to help pass the time, the air cavalry team would request an aerobatic display. The Bronco could put on a reasonable show. The first time I tried using asymmetric thrust to do a better stall turn, the result was an unidentified manoeuvre that I was unable to repeat, despite much encouragement from the highly amused Army helicopter pilots.

I was once given the task of flying down to the RAAF detachment at Vung Tau for a resupply of Australian beer. Getting there was easy. I just got airborne out of Chu Lai and called up the local radar controller, informing him of my destination, and then all I had to do was follow his radar vectors until I got there. There weren't any air routes to follow. The track given was constantly changing in altitude and direction as you came into conflict with military traffic, but was still very efficient.

I overnighted at Vung Tau and caught up with some mates who used to fly Mirages, but were now flying helicopters. Being young, inexperienced and stupid, when heading home to Chu Lai, I decided to take the scenic low-level coastal route. No maps and no planning, because I had plenty of fuel, didn't I? The take-off run was unusually long, which should have given me a clue that all that beer down the back was quite heavy and would cause considerable drag and increased fuel consumption in the air. I called Chu Lai on HF radio as soon as I got airborne, and they kept a search-and-rescue watch for me. I thought I would just relax, keep the coast on the left and enjoy the scenery. I would obviously know where I was when we reached the Chu Lai AO, because I knew that area so well. I was carefully watching the fuel consumption and sluggish performance, but not having any distance information, I had to cross my fingers and hope for the best that the fuel would be sufficient. I did make it – just.

The weather became an issue at times, particularly typhoons. We practised typhoon evacuations to Thailand, but when a real typhoon came along, the decision was made not to evacuate. We did move all our OV-10s to Da Nang where they were securely tied down under open-ended concrete revetments. The eye of the storm passed directly over Chu Lai, and the damage created was huge. I heard that one hanger, structurally rated to take winds of over 190kph, was packed with over 100 helicopters and collapsed when the winds gusted to over 210kph. All the helicopters were destroyed. The base was badly knocked around, and was never fully repaired. I was fortunate to be in Da Nang where the winds gusted to over 180kph, but apart from the terrifying noise, we survived alright.

The final exciting Vietnam episode for me was departure for home from Saigon aerodrome in another chartered Qantas 707. There didn't seem to be any control over carry-on baggage, and the aircraft was overloaded. The take-off roll seemed to last forever, and we didn't get airborne until the last brick of the runway. A white-knuckle ride for me, but I don't think the Australian Army guys even noticed.

An edited extract of an account by Chris Mirow from Hit my Smoke *by Peter Condon with Chris Clark, 2021. Mirow (callsign Helix 36) served in Vietnam from May to December 1971.*

ETHICAL LEADERSHIP

LEADING TECHNICALLY QUALIFIED PEOPLE MARRIES TWO COMPLEX AND ENIGMATIC CONCEPTS, ETHICS AND LEADERSHIP.

AS A FORMER SENIOR ARMY OFFICER who spent most of my time in the Royal Australian Corps of Signals, as an engineer, an ICT and latterly cyber practitioner, I've had the privilege of leading some of the smartest people in the ADF. The leadership of technically qualified people marries two complex and enigmatic concepts, ethics and leadership.

ADF doctrine defines leadership as 'the process of influencing others in order to gain their willing consent in the ethical pursuit of missions'. Slightly closer to my heart is the Australian Army definition: 'the art of influencing and directing people to achieve willingly the team or organisational goal'.

I believe six components comprise the essence of leadership.

- **Influence.** Leadership is about influencing, motivating or inspiring others. This influence is multi-directional and is not restrained by position. To be truly effective, verbal and written communication and behaviour must be non-coercive.
- **Followers** – a necessary component of leadership, holding responsibilities and obligations to leaders.
- **A goal.** Leadership is related to a mutual goal, mission or vision. Without that goal, it is unlikely that a group will form or stay together.
- **Purposeful action.** Leadership involves taking action towards the achievement of the group's goal.
- **Consent.** For leadership to be effective, it requires the consent of the followers. This consent suggests a direct relationship between the leader and the followers, and as a consequence, there are responsibilities on both parties. In some circumstances, the leader is expected to use pressure to achieve the goal, but in others, followers will resist force and coercion.
- **The ethical dimension.** Follower willingness or conviction is related to the concept that leadership has a moral or ethical component. Followers see the difference between striving for a goal they consider ethically sound and a goal that is ethically bankrupt, and therefore know the difference between leaders who are morally sound, and those who are morally bankrupt.

Let's now talk about the relationship between power, authority and influence. While influence is central to leadership, it is also related to the roles of power and authority. Power is defined as the capability of doing, or affecting something. This definition has been extended, perhaps unhelpfully, in managerial contexts to mean the ability to change the behaviours, attitudes and beliefs of others.

But what about the difference between leadership and authority? Although sanctioned and at times completely appropriate, the use of legitimate authority is not an example of leadership, but rather an example of command or management.

Author John Gardner notes that confusion between leadership and official authority has a deadly effect on large organisations. Corporations and government agencies everywhere have executives who imagine their position has gifted them a body of followers. Of course, it hasn't. They have been assigned stewardship of subordinates; whether the subordinates become followers depends on executives acting like leaders.

Another often confused pair of terms is leadership and management. There is a distinct difference between the two, perhaps described best by Viscount Slim

of Burma, who said: "Leadership is of the spirit, compounded of personality and vision; its practice is an art. Management, however, is of the mind, more a matter of accurate calculation, of statistics, of methods, timetables and routine; its practice is a science. Managers are necessary. Leaders are essential."

Leadership is an influence process that energises followers. Management is a control process aimed at bringing coordination and efficiency to people and organisations. Is management, therefore, subordinate to leadership? I would argue, yes.

Effective leadership facilitates change. If there is no goal, objective or vision, there is nothing to move towards and the requirement for leadership is significantly reduced. In order to have a positive effect on an organisation, implementing change must be undertaken with the willing consent of those being led. I have learnt that being out the front driving change is a hard and lonely experience.

There are three key considerations that enable leadership outcomes.

- **Leadership function.** Leadership is about relationships and achieving something that would normally be beyond the individual.
- **Values-based leadership.** While the behaviour of a group may be governed by external rules, it is guided by internal group values. The advantage of values over rules is the adaptability they provide in ambiguous situations, especially in the absence of legislation or contemporary policy (e.g. cyber). The behaviour of leaders reflects both the values of the group and their own personal values. It does not, however, automatically follow that leadership outcomes are universally good; values-based leadership can apply equally to a criminal organisation or a hospital.
- **Ethical leadership.** The quality and substance of the group values (the ethics) that underpin the leadership function will determine the nobility of the outcome. Positive leadership is characterised by socially accepted values such as integrity, honesty, humility, empathy, fairness and self-awareness. Negative leadership is characterised by self-centred and personalised values such as elitism, individualism and cunning.

The positive/negative concept has been referred to as the moral or ethical component of leadership. Different situations call for different behaviours from leaders and followers. A single leadership approach will not serve all individuals – leadership is exercised contextually, considering the situation, culture and organisational values. This is especially true of leadership of a technical workforce. Time, place or situation is a key determinant of who will lead, and the manner in which they do so.

History shows that some leaders who were very effective in wartime (Churchill, for example), were markedly less effective in times of peace.

If we now focus on leaders themselves, there are four interrelated elements in play.

- **Character.** The behaviour of leaders will be closely observed by their followers, as directly affects the relationships between them. Studies have shown a worker's immediate supervisor has more influence on that worker than any other person.
- **Competence.** A leader's perceived and demonstrated competence also has a direct bearing on their credibility, as viewed by followers.
- **Values.** A leader's individual's decisions, behaviour and interactions are interpreted by others as reflecting the values of that leader. This is an important consideration for those who wish to influence others.
- **Motivation.** Potential leaders must be motivated and confident to lead.

So, why is ethical leadership important? Writing about his leadership experiences during combat operations, Major-General Stephen Day wrote: "Soldiers are involved in unspeakable events. And the constant fear of danger can slowly drain one's inner strength. A soldier's humanity and compassion for fellow human beings can begin to erode. In this atmosphere, the wall of integrity and discipline that separates an honourable soldier from an armed thug is severely tested."

We live in a time when the ethical foundations for many institutions in our society are being questioned. However, the nature of the military profession means we must have a basic set of guiding ethical principles which guide us in the 'grey', when we must make a decision.

It's appropriate here to mention the trap of 'likership', as opposed to leadership. Everyone likes to be liked, but playing too heavily to that has ramifications. Leaders make the hard decisions knowing they will not always be popular. Likers always make the easy play. That doesn't mean being a constant hard arse; empathy is critical.

This brings us to the link between leadership and ethics.

Ethics is a set of principles or standards by which personal, community and global actions may be judged good or bad, right or wrong. Military ethics, therefore, is the application of ethics to military endeavours. It is not an optional extra, it is the core of what defines a warrior. Ethical restraint makes the distinction between a professional soldier and a barbarian.

Life itself is one continuous series of ethical challenges. Ethics involves considering and assessing the influences on our own responses to issues, and analysing and assessing the impact of our actions on others.

Through these processes, we clarify our own positions, but it's not easy. You might commit to never lie, but what about situations where telling the truth would cause greater harm? You might commit to never steal, but what if it was necessary to feed a starving family?

Leadership is not in itself a moral concept, but the practice of leadership should have a robust moral foundation. Ethics, however, is as much an attitude as it is a set of skills and knowledge.

Of course, all of this can lead to problems. A 'can-do' attitude or a singular focus on outcomes can lead to an ethos of 'getting the job done at any cost' which can lead to reprehensible conduct, as we've seen with the outcomes of the Brereton Inquiry into alleged war crimes of Australian special forces soldiers. As leaders, we must determine the ethical appropriateness in terms of the means.

At the end of the day, we have to live with our decisions. Decision-making tools can provide assistance, but personal fortitude, moral courage and a reliance on sound ethical values are equally, if not more, important.

I would like to wrap up today with a quote from our former Chief of Army Lieutenant General (ret'd) David Morrison. "Be prepared to stand up and be counted, be prepared to lead because there are people who are waiting for your contribution."

An edited transcript of a presentation given by Major General (ret'd) Dr Marcus Thompson AM, founder of cyber security advisory firm Cyber Compass.

SEEDS IN SPACE

AUSTRALIA'S NATIONAL FLOWER IS MAKING AN IMPACT AROUND (AND AROUND) THE WORLD.

ABOVE US STEM teacher Laura Tomlin on a Zero-G flight with the seed packets.

THE CONCEPT OF PLANT SEEDS IN SPACE is nothing new to science fiction aficionados. John Wyndham's *The Day of the Triffids* and the 1976 *Doctor Who* serial, 'The Seeds of Doom', thrilled children of the past. However, today, planting seeds in space has a much more benign and practical application.

From 2020 to 2022, space and STEM education organisation One Giant Leap Australia (OGL) embarked on a unique experiment that involved Australian school children, wattle seeds and the International Space Station (ISS) with the help of the Japanese Aerospace Exploration Agency (JAXA) and the Australian Space Agency. They sent a consignment of wattle seeds, Australia's national flower, into orbit for six months on the ISS. The seeds orbited the Earth 3,186 times.

Initially devised as a program to keep students connected to STEM education during COVID, the Seeds in Space program soon became an important and logical scientific study into the dynamics of growing plants in space. The Japanese Ambassador to Australia said the program was the biggest space science program ever done between our two countries.

"Space agriculture is going to be vitally important as our collective journey into space continues," says Jenna McCarthy, Education and Outreach Manager for OGL. "We are going to need space farmers in the future for long duration missions and human habitats on Mars, for example. It's not feasible to keep sending food to space, we need to be sustainable for the future of space travel."

Students in 300 locations throughout Australia received a sample of "space seeds" (which had been in orbit) and "Earth seeds" (which had stayed on Earth) to compare how, and if, they germinate. The experiment went on for more than a year, with COVID impacting on school and student feedback due to school closures. Once analysed, OGL will report the findings, providing growth information that will be important for the space sector.

Preschools got involved in the project as well as primary and high schools. A preschool in Blaxland NSW developed a floorbook and education materials for their students. Even before the wattle seeds arrived, the children had been involved in many discussions about the wattle project. Their ideas, theories and understandings about wattle, space, the ISS and planets have all been documented using the floorbook approach – their version of a science journal. Space STEM education reaches across many industries and subject areas in school and the floor book, and associated video, is a wonderful example of cross-curricular programming.

Meanwhile, to celebrate National Wattle Day in 2021, Apollo Bay P-12 College celebrated the program by painting rocks with wattle designs. The rocks were then hidden along the great Ocean Road for students to find.

"This [Seeds in Space] program is the most diverse, exciting and inspirational space science experiment our country has ever seen," says Jackie Carpenter, Director of OGL Australia Foundation. "It has captured the imagination of our communities across the country. Schools and communities celebrating Wattle Day has been revitalised by the program."

As part of the JAXA Kibo Asian Beneficial Collaboration, the Asian Herb in Space program was delivered around the same time. The experiment allowed 150 groups around Australia to grow basil seeds, supplied by JAXA, as a control experiment and the results are to be compared with the basil seed growth experiment conducted on the ISS. The results have been mixed and a full report is to be published in the next few months. One hundred kits were sponsored by the NSW Chief Scientist and Engineer's office.

In 2024, the Seeds in Space program was expanded. OGL, in partnership with Mr Fothergill's Seeds and the Wisconsin Space Grant Consortium, sent seeds to the United States. Three sets of seeds were chosen, holy basil, calendula and sage. They were exported to the US and

BELOW Students learn about space agriculture.

BOTTOM Japanese Consul-General Junji Shimada and Caulfield Primary School students with their space seeds. The students received a special message from Astronaut Soichi Noguchi.

transferred to teachers who were flying on a Zero-G flight. One package each was flown while a second package remained on the ground. The seeds are now being sent to US and Australian school students.

Serrano Intermediate School in Lake Forest, California has already received seeds for planting and they were due to be re-flown in November.

Meanwhile, the OGL Seeds in Space program has been making noise in artistic circles. Australian composer Joe Twist and lyricist Jodie O'Regan joined forces to compose 'Wattle Sky', a 15-minute choral piece celebrating Australia's national flower to be performed by choral group Tonraumfünf10 in Berlin, conducted by Christopher Bradley.

O'Regan said she was inspired to include the unique science experiment when writing lyrics for the choir after seeing footage of the Dragon capsule returning the seeds to Earth.

"When I told Joe Twist that wattle seeds had travelled to space, he asked me for some words directly from the mission," she said. "I therefore used some of the words from mission control for the piece."

Federal Member for Macquarie and Special Envoy for the Arts, Susan Templeman was inspired by the piece. "I've been a big supporter of [OGL], a locally grown, internationally significant space education program, and as Special Envoy for the Arts, I'm delighted that an original piece of music has been written to mark the wattle in space project.

"The music is as inspiring as the gesture it commemorates. This program has expanded kids' minds with science and now we get to touch their hearts with music. It's shown us that great things are possible when we bring science and the arts together."

Next time you see a wattle tree, cast your eye to the sky and think of the possibilities that human space exploration can offer.

For more on OGL and Seeds in Space, see onegiantleapfoundation.com.au and seedsinspace.com.au.

WORDS Flight Lieutenant (AAFC) Paul A Rosenzweig OAM

HONOURING SERVICE & SACRIFICE

AIR FORCE CADETS took part in a service at RAAF Edinburgh on 28 March, marking the 103rd Anniversary of the formation of the RAAF and the 70th Anniversary of the opening of RAAF Base Edinburgh on 22 March 1954 by His Royal Highness Prince Philip, Duke of Edinburgh.

The service was conducted in the presence of Her Excellency the Honourable Frances Adamson AC, Governor of South Australia, Honorary Air Commodore of No 24 (City of Adelaide) Squadron. It was jointly hosted by Air Commodore Adrian Maso AM, the Senior Air Force Representative South Australia, and Lawrence Ng, President of the Air Force Association (SA Division), of which Her Excellency is Patron.

Among the organisations which placed a tribute was the Honourable Company of Air Pilots (SA), represented by Rob Moore OAM AMRAeS and Mackenzie Rogers, an AAFC instructor of cadets and pilot. Rob holds the Australian Cadet Forces Service Medal with four clasps, recognising a total of 35 years of qualifying service, and he received the Medal of the Order of Australia in the 2000 Australia Day Honours List, "For service to youth, particularly through the South Australian Squadron Air Training Corps, and to gliding".

The SA & NT Branch of the National Malaya & Borneo Veterans Association Australia (NMBVAA) also attended and state president, Major Paul Rosenzweig OAM (ret'd) placed a tribute to honour the sacrifice of RAAF members and RAN aviation personnel during the general period of the Malayan Emergency and Confrontation.

The NMBVAA honours personnel from Australia, New Zealand, the United Kingdom and Commonwealth military and police forces including Malaya, Malaysia and Singapore who served in the post-WWII "Malayan wars" and fought on the Malay Peninsula and in Brunei, Sabah and Sarawak. The branch recognises 17 aviation personnel who lost their lives on operational service during that post-war period.

The Australian War Memorial (AWM) Rolls of Honour include the names of 10 RAAF members who lost their lives during the 'Malayan Emergency 1948-1960'. A further two members died immediately following that campaign and are not listed by the AWM as their deaths occurred after 31 July 1960, when the government of Malaya officially declared the emergency over.

The Rolls of Honour include one death listed under the title 'Indonesian Confrontation, 1962-1966', and two RAAF members who died at Ubon in far eastern Thailand under the title 'Thailand, 1965-1968'.

Two RAN aviators lost their lives overseas during the general period of those campaigns, and both have no known grave. Sub-Lieutenant John Hutchison RAN, a Fleet Air Arm pilot, died in a flying accident in the Strait of Malacca, Malay Peninsula on 24 March 1965. Following an anti-submarine patrol, his Fairey Gannet Mk1 ditched after a night landing on HMAS *Melbourne* due to the failure of the arrestor hook. The aircraft and his body were never recovered. His name is listed under the title 'Malay Peninsula, 1964-1966'.

Lieutenant Edward George Kennell RAN, a Fleet Air Arm observer, died in a flying accident in the Philippine Sea on 28 April 1966. During an attempt to land, his de Havilland DH.112 Sea Venom crashed off the deck of HMAS *Melbourne*; the pilot and observer both ejected at near sea-level, but Kennell was lost at sea.

The sacrifice of these Australians was not in vain, serving to uphold the sovereignty of the Federation of Malaya allowing the successful attainment of independence on 31 August 1957, self-governance in Singapore on 3 June 1959, the creation of Malaysia on 16 September 1963, and the early development of Malaysia and Singapore as independent nations. Others served in equivalent geographically related operations promoting regional stability.

ABOVE Members of No 604 Squadron, AAFC at the RAAF Anniversary commemorative service, from left, Mackenzie Rogers, representing the Honourable Company of Air Pilots (SA), CDT Manroop Kaur (member of the AAFC Honour Guard) and Major Paul Rosenzweig.

SOLO GLIDER PILOTS

FOLLOWING TWO GLIDER flying courses run by Bathurst Glider Training Flight earlier this year, 25 Cadets flew their first solo flight in the DG1000S Glider. Among them was LCDT Luca Lamaro, from 322 (City of Ryde) Squadron, who praised the DG1000S.

"When you're in the cockpit, you really feel the craftsmanship that went into the sailplane, the decades of aviation technology that culminated to bring it to life," he said. "The plane is really responsive, and thanks to its lightweight construction, we're able to pull up to seven G, which is quite incredible."

The Best Cadet on Course (4A) was CSGT Joseph Portelli from 320 Squadron at Windsor, NSW. The Most Improved Pilot was LCDT Oskar Adamse from 305 (City of Northern Beaches) Squadron at Dee Why, NSW.

The Best Cadet on Course (4B) was LCDT Rohan White from 309 Squadron at Holsworthy, NSW, and the Most Improved Pilot was LCDT Dan Weerapperuma from No 313 (City of Dubbo) Squadron.

"Before my solo flight I was stressing out, but later I realised that I have done this a million times and it is just the same," LCDT Weerapperuma said: "After I calmed down and got strapped up and released from the Tug at 4,500 feet, I looked at the amazing view of the sunset while doing a couple of turns looking at Bathurst city.

"I finally turned in for downwind. I absolutely flipped out of my mind because there was three to five knots of lift. Flying gives that boost in mental health; it lets you feel how amazing the world can get."

ABOVE LCDT Luca Lamaro about to launch for his first solo.

ABOVE CSGT Joseph Portelli, Course 4A.

BELOW LCDT Dan Weerapperuma (left) and LCDT Rohan White.

FURTHER ACHIEVEMENTS

HAVING ALREADY FLOWN their first solo flight in a DG1000S glider, several Cadets attending Bathurst Glider Training Flight courses 4A and 4B continued their aviation training. As Gliding Australia's website states: "Going solo is just the first step in your gliding journey. New solo pilots can work towards achieving their A, B and C certificates".

The FAI A Certificate qualification can be granted after completing five solo flights, as well as a theory exam and some refresher flights with an instructor. Four pilots were awarded A Certificates: CWOFF Tony Winspear (302 Squadron), CWOFF Tim Armitage (338 Squadron), CFSGT Marcus Ward (327 Squadron) and CCPL Ryan Bower (308 Squadron).

The FAI B Certificate qualification can be granted after completing 15 solo flights, one of which has been of 30 minutes' duration, and a theory exam. That was achieved by CCPL Sam Unger (326 Squadron), LCDT Flynn Wright (303 Squadron) and Defence Approved Helper (Civilian Instructor) Jared Bignell – now an Aircraftman (AAFC) with 328 Squadron at Bathurst.

To be awarded the C Certificate qualification, a pilot is required to complete 20 solo flights, with two of them over one hour in duration, an outlanding check away from the launch airfield, and have various competencies recorded in the logbook. This qualification was achieved by LCDT James Walker (302 Squadron) and LCDT Flynn Wright.

Leading Cadets Walker and Wright also completed specific additional requirements and were presented with their AAFC Cadet Pilot Wings.

ABOVE LCDT James Walker with his AAFC Cadet Pilot Wings and FAI 'C' Certificate badge.

LCDT Flynn Wright following his outlanding.

FLYING CAMPS

THE OCTOBER SCHOOL HOLIDAYS saw Australian Air League cadets take to the sky with flying camps in Victoria and New South Wales. The camps provide cadets with the opportunity to undertake flying training in gliders and powered aircraft. A great way to spend the holidays.

In Victoria, the annual gliding camp was held at Bacchus Marsh Airfield over four days. Nine cadets aged 13 and older from Doncaster and Point Cook Squadron began their gliding training with assistance from experienced instructors of the Geelong Gliding Club who hosted the camp.

Despite a few days of inclement weather, the cadets completed 45 flights over the duration of the camp, completing Unit 1 of the Gliding Australia syllabus and gaining the Air League's Air Activities Gliding Badges.

The cadets undertook both theoretical and practical training and subjects covered including ground handling, lookout awareness, pre-flight preparation and primary effects of controls. They also learnt teamwork by helping to launch and retrieve the gliders after they landed.

Victoria Group Air Activities Officer Gp.Lt. Bryan McGrath said the camp gave cadets a unique opportunity. "The cadets will do around 40 to 50 flights with an instructor and once deemed competent in all the procedures they need to know they get to go solo from the age of 15," he said.

Ideal conditions on flying days allowed some gliders to remain airborne for up to 54 minutes, providing the cadets with extended flight experience.

Volunteer Air League staff looked after and fed the cadets, and members of the Geelong Gliding Club provided the instructors and ground crew and made sure gliders were available each day.

Meanwhile at Camden Airport near Sydney, 11 cadets from squadrons across NSW took part in a five-day powered flying camp at the Air League's Air Activities Centre. Cadets who had started their flying training at previous camps returned to consolidate their training in practical training as well as theory classes.

Unfortunately, a few days of inclement weather prevented flying, however the cadets still logged 42 flights for a total of 44 hours of flying. While there were no first solo achievements on the camp, several cadets should go solo during the coming months.

Australia is currently experiencing a critical shortage of aviation maintenance personnel, so on one of the rain-affected days, the cadets visited GB Aviation, an aircraft maintenance company located at Camden Airport where they learnt about aircraft maintenance and the career opportunities available. While there, they had the opportunity to assist the engineers replacing a tyre and brakes on the Air League's Piper PA-28 Warrior VH-LRA.

Again, the camp would not have been possible without the assistance of the instructors and camp staff.

The Air League's Air Activities Centre at Camden is owned and operated by the NSW Group of the Australian Air League, with a fleet of training aircraft, including a Piper PA-28 Warrior, Cessna 172, and Cessna 152. For nearly 40 years, it has provided thousands of air experience flights and training hours to members of the League, helping to achieve the League's motto A Vinculo Terrae (free from the bonds of the earth).

OUR NEWEST INSTRUCTOR

A HIGHLIGHT OF THE NSW FLYING CAMP was 2nd. Off. Karam Mandwie of Moorebank Squadron passing his Grade 3 instructor test.

Karam had previously achieved his commercial pilots license and had been working hard on adding to this his flight instructor rating. He is the first pilot to accomplish that with the Air Activities Centre at Camden. His examiner on the day was Rodney Hyde, who coincidentally was the first pilot to gain his commercial pilot license with the Air Activities Centre.

Karam joined the Air League as a 13-year-old cadet at Moorebank Squadron.

ABOVE 2nd Off. Mandwie is congratulated by examiner Rodney Hyde.

ABOVE Cadets and officers at the end of the annual Victoria Group Gliding Camp with instructors from Geelong Gliding Club.

LEFT L/Cdt Eugene Toh prepares for launch with his instructor.

ABOVE Student pilots on the first day of the NSW flying camp with Cessna 152 VH-SOX.

BELOW Cadets learnt to change the tyre on a PA-28 Piper Warrior.

ABOUT THE AUSTRALIAN AIR LEAGUE

The Australian Air League is a youth group for boys and girls aged eight years and older who are interested in aviation as a career or a hobby.

In the Air League, they learn about aviation in all its forms through classes in the theory of flight, navigation, aircraft engines and a variety of subjects. The Air League also aims to enable them to achieve their full potential and become better citizens who can effectively serve the community.

With squadrons in most states, the AAL has been serving the community in Australia since 1934. It is entirely self-funding and is staffed by volunteers.

airleague.com.au; phone 1800 502 175

AVOIDING SCAMS

WHILE SCAMS ARE A FACT OF LIFE, THERE ARE WAYS TO PROTECT YOURSELF.

IN DAYS GONE BY, scams were often in the form of a door-to-door hawker of magic potions or snake oil. In the 21st century, they are more subtle, insidious, dangerous, frequently life-changing and sometimes life-threatening. The electronic age has created a huge opportunity for scammers, which has been increased by the advances in artificial intelligence, making it harder for individuals to recognise scams.

Victoria Police offers the following definition. "A scam, or confidence trick, is an attempt to intentionally mislead a person or persons, usually with the goal of financial or other gain. Scams try to exploit human weaknesses, such as greed, dishonesty, vanity, and also virtues like honesty and compassion."

Being aware of tax scams is especially important at tax time, noting that unless you lodge your return through a tax agent, your annual deadline is 31 October. It's a time where you may be expecting a refund and scammers know people are expecting communication from the Australian Taxation Office (ATO).

The following message from the ATO may help you decide if a contact is legitimate. "The real ATO won't send you an email or SMS with a link to sign in to our online services. While we may use email or SMS to ask you to contact us, we will never send an unsolicited message asking you to return personal identifying information through these channels."

Similar scams occur where scammers use the logos of the Australian Federal Police and send emails demanding fine payments. The Australian Competition and Consumer Commission (ACC) Scamwatch website (scamwatch.gov.au) provides this practical guidance: the ATO, other government agencies and any legitimate business, will never threaten you with arrest or demand immediate payment of a tax debt or fine with unusual payment methods like gift cards, Bitcoin or pre-paid credit cards. Hang up immediately even if you're concerned that a call may be legitimate and call the ATO on 1800 008 540 to check. Never make payments or give out any of your personal details.

The ATO website (ato.gov.au) has information about tax refund scams and shows you how to recognise them.

Text messages with links are frequently scams. Scams using WhatsApp are common where the sender mimics the type of message you may receive from a family member. An ATO scam story published on the Scamwatch website, outlines how the perpetrator used WhatsApp to send predatory demands.

Scamwatch is a great source of information about the latest scams, things to look out for and data in relation to scams. The best advice is:

STOP:
don't just react. Visit Scamwatch for ways to spot and avoid scams.

THINK:
could this be fake? Read through the different types of scams.

PROTECT:
act quickly. Learn what to do if you have been scammed.

The ACCC has a National Anti-Scam Centre to build on the work of Scamwatch, to make reporting scams easier and to work with government, industry and law enforcement to better protect consumers and investigate scams. You can report a scam and find out where to get help on the Scamwatch website.

Air Commodore Robert M C Brown AM FCA (Ret'd). ADF Financial Services Consumer Centre

AVIATION EVENTS 2025

JANUARY

30-31

International Conference on Aerospace and Aviation Engineering, Sydney.
Bringing together leading scientists, researchers and scholars to share their experiences and research results in aerospace and aviation engineering.
waset.org

FEBRUARY

19

Bombing of Darwin Day
Marking the anniversary of the day Darwin was first bombed by Japanese warplanes.
anzacportal.dva.gov.au/commemoration

21-22

Pilot Expo, Brussels Airport, Belgian
Europe's largest event for aircrew recruitment and training features a trade show and a conference for licensed pilots and aspiring aviators. *pilot-expo.com*

MARCH

24-26

21st Australian International Aerospace Congress, Melbourne & Avalon
A deep dive into the latest aerospace and space technologies and research
engineersaustralia.org.au

25-30

Avalon 2025 Australian International Airshow, Avalon Airport, Vic
A platform for Australian innovation, aerospace and defence capability on an international stage. A world-class industry exposition and thrilling airshow displays showcase new technologies, inspire future talent and help shape the future of Australian aviation.
airshow.com.au

APRIL

06

Barossa Air Show, Rowland Flat, SA
barossaairshow.com.au

10-13

Antique Aeroplane Association of Australia National Fly-in, Temora, NSW
antique-aeroplane.com .au/events

25

Anzac Day, national
anzacportal.dva.gov.au

MAY

08
Victory in Europe (VE) Day

20-24
Langkawi International Maritime & Aerospace Exhibition, Malaysia
lima2025.com

JUNE

01
Bomber Command Commemorative Day
bccdf.org.au

06
Anniversary of D-Day
bccdf.org.au

07
Reserve Forces Day

16-22
Paris Air Show, Le Bourget, France
siae.fr/en

21-22
Dayton Air Show, Ohio, USA
daytonairshow.com

JULY

21-27
AirVenture 2025, Oshkosh, Wisconsin, USA
eaa.org/airventure

AUGUST

15
Victory in the Pacific Day

18
Vietnam Veteran's Day

31
Malaya and Borneo Veteran's Day

SEPTEMBER

03
Battle for Australia Day

15
Battle of Britain Anniversary, Hobart
raafatas.org.au/battle-of-britain

NOVEMBER

04-6
Indo Pacific International Maritime Exposition
indopacificexpo.com.au

11
Remembrance Day

18-20
MilCIS Expo & Conference, Canberra
milcis.com.au

AIR COMMODORE ROBERT LAING

3 August 1943 - 23 August 2024

ROBERT (BOB) LAING joined the RAAF on 4 July 1963 and graduated as a pilot on 23 October 1964. His first posting was to No 11 Squadron flying P2E Neptune maritime patrol aircraft based at RAAF Richmond. The squadron re-equipped with P3B Orion aircraft at USNAS Moffett Field, California before relocating to RAAF Edinburgh. Bob then completed tours as a qualified flying instructor at No 2 Flying Training School on Macchi aircraft at RAAF Pearce, before returning to No 11 Squadron.

He attended Canadian Forces Command and Staff Course in Toronto in 1975/76 before completing staff duties in Air Force Personnel and then Operations at Russell Offices, Canberra.

In January 1980, he returned to RAAF Edinburgh as Commanding Officer of Maritime Analysis and Training Squadron, renamed No 292 Squadron in October 1980, followed by a posting to No 10 Squadron flying P3C Orion aircraft. Bob and Crew 7 were the first No 10 Squadron crew committed to Operation Gateway, arriving at Butterworth, Malaysia on 21 May after a three-day Burbage patrol through Cocos and Diego Garcia. Bob spent a third of his time at No 10 Squadron on deployments to RMAF Butterworth, conducting Cold War surveillance tasks in the South China Seas and Indian Ocean, mainly against Soviet warships and submarines.

A tour as Director RAAF at the Australian Joint Anti-Submarine School at RANAS Nowra followed. He then completed the Joint Services Staff Course at Weston, ACT in 1985 and a year as the Senior Administrative Staff Officer Headquarters Operational Command/Air Command at RAAF Glenbrook, NSW. Bob returned to Canberra as Director Air Force Development and then Director Air Warfare.

He was promoted to Air Commodore and appointed Commander Maritime Patrol Group, RAAF Edinburgh in June 1992 and returned to Canberra in January 1996 as Director General Policy and Plans - Air Force before retiring on 23 August 1997, after 34 years of service.

Source: RAAF Staff College Association

FLIGHT LIEUTENANT BRUCE RAYMOND KEAN

4 March 1935 - 6 September 2024

BRUCE KEAN COMMENCED his working life at age 14 as an apprenticed aircraft steel worker with Australian National Airlines. While he wanted to join the Air Force apprentice scheme, his father wouldn't sign his enlistment papers. His father eventually relented and Bruce joined the Air Force in 1952 on No 6 Apprentice Course at the RAAF School of Technical Training at Wagga, and graduated as an airframe fitter in December 1954.

He completed the fourth year of his apprenticeship at No 1 Aircraft Depot and the fifth year at Aircraft Research and Development Unit (ARDU), both units were at RAAF Laverton. He subsequently served several postings at ARDU: a squadron tour at No 3 Squadron, Butterworth, Malaya; Headquarters Support Command; and No 482 Squadron, Amberley.

In 1973, he returned to ARDU and was deployed to Woomera in 1974, where his performance earned him the award of a Certificate of Outstanding Service. Bruce served in every rank from aircraftsman up to, and including, warrant officer engineer at ARDU.

In 1976, Bruce was commissioned and returned to Headquarters Support Command for two years before being posted back to No 482 Squadron in 1978 as a flying officer, then flight lieutenant, in charge of the F-111 Flight Line. Retiring from full-time duty in 1982, he continued in the Active Reserve at No 23 Squadron, City of Brisbane, as the Senior Engineering Officer until 1990, when he retired from the Air Force. During his time at No 23 Squadron, Bruce provided ongoing support to the F-111 squadrons, and later, when in Gympie, to the Queensland Air Cadets.

He was rated a very capable tradesman and a well-respected engineering officer. Air Vice Marshal Bill Collins and Wing Commander John Stacey, who were in Bruce's chain of command at 482 Squadron, both commented that Bruce was a fine example of the value that an NCO on commission brings to the Air Force, a sentiment endorsed by those who worked with him. Bruce completed 38 years of service in the RAAF and the Reserve.

AIR COMMODORE RONALD RICHARD TAYLES AFC

18 October 1940 - 24 July 2024

RON TAYLES ENLISTED in the RAAF in January 1958, joining the RAAF Academy. After three years of academic and pilot training, he was commissioned as a flying officer and posted to No 10 Squadron, RAAF Townsville, in January 1962 flying SP2H Neptune aircraft.

After four years on maritime reconnaissance operations, he was posted to the training world, completing a two-year instructional tour of duty at No 1 Basic Flying Training School, Point Cook, in 1968, and two years at Central Flying School, East Sale.

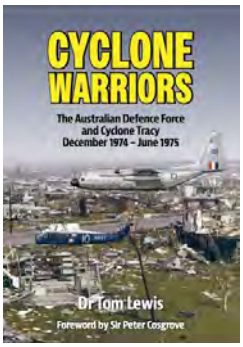
Ron returned to No 10 Squadron in 1970 for two years as a flight commander before being posted to Air Force Office in 1972 for staff duties in Air Force Personnel. He graduated from No 29 RAAF Staff College Course in 1975, was promoted to wing commander, and posted as a member of the Directing Staff.

Ron was appointed Commanding Officer, No 10 Squadron in 1977 and No 292 Squadron in 1979. As CO of Number 10 Squadron, he was responsible for the transition of the squadron from SP2H Neptune aircraft to P3C Orion aircraft and the ferry of the P3C aircraft from the USA. He was recognised in the Queen's Birthday Honours List in 1980 for exceptional devotion to duty while flying as a maritime reconnaissance pilot following his two command tours.

He was posted to the U.S. Air Warfare College, Montgomery, Alabama in 1980 before returning to Canberra and Air Force Office for six months.

In 1982, Ron was promoted to group captain and appointed Commandant, RAAF Staff College, an appointment he held for two and a half years. Returning to Air Force Office in 1985, he served as Director Air Force Development before being promoted to air commodore.

His final posting in the Air Force was Officer Commanding, RAAF Point Cook, where he had entered the Air Force some 30 years earlier.



REVIEW BY LCDR Des Woods OAM RAN (Rtd)

CYCLONE WARRIORS: THE ARMED FORCES AND CYCLONE TRACY DECEMBER 1974-JUNE 1975

By **DR TOM LEWIS**

Avonmore Books; $39.95

BEYOND OFFICIAL REPORTS, this story of the ADF's role in saving Darwin has never been told as a well-researched narrative. *Cyclone Warriors* redresses that oversight. The author, Tom Lewis, lived in Darwin while still serving in the Navy and remained as resident for many years afterwards. His body of work on the bombing of Darwin in 1942 is complemented by *Cyclone Warriors* which reminds those who remember Cyclone Tracy, and reveals to those who do not, the scale of the destruction wrought on an unprepared town and its residents about to celebrate Christmas in 1974.

The three separate services, RAN, Army and RAAF, would not be badged collectively as the ADF until 1976, but they operated effectively as a joint command in the first days and weeks of this civil emergency. They were subordinate to the newly formed and very small Federal National Disasters Organisation, not under martial law but as military aid to the civil power.

Cyclone Warriors concentrates on the first intense period of rescue in January and February 1975, but also points out that the Army stayed on undertaking infrastructure recovery until May, and did a superb job of reconstruction that enabled civilian contractors to rebuild the much more resilient Darwin that exists today.

Cyclone Warriors is a good social history and a reminder that, on this island continent, in an age of climate change, we can expect severe and unpredictable natural events which will test the limits of the state and federal agencies, including the ADF. They will no doubt be expected to emulate in skill, hardihood and endurance those who responded when Tracy blew in, just in time for Christmas, half a century ago.

REVIEW BY Bob Treloar

RELENTLESS SKIES, VOLUME 1: THE MOST EFFICIENT AIRMAN (1910-1942)

By **IAN CAMPBELL**

Leschenault Press, Western Australia, soft cover RRP $34.95

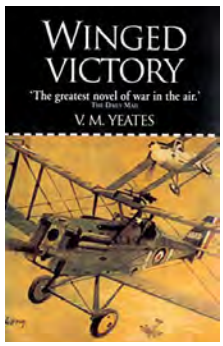
DON BENNETT IS best known as Air Vice-Marshal Don Bennett CB, CBE, DSO, FRAeS, Commander of RAF Bomber Command Path Finder Force (PFF). While previous books concentrate on his command of the Path Finder Force, *Relentless Skies, Volume 1*, examines his exploits as an aviation pioneer.

He joined the RAAF in 1930, but a paucity of places for pilots required him to agree to a short service commission in the RAF on gaining his wings. When posted to flying boats in the RAF, he discovered the challenges of navigation and long-range flight. Leaving the RAF in 1935, he joined Imperial Airways where he honed his navigation skills and he set several long-distance records across the Atlantic Ocean and from Scotland to South Africa.

In the early stages of World War II, Don assisted with the establishment of ferrying aircraft manufactured in the United States to war-torn United Kingdom. Rejoining the RAF to command a bomber squadron, he noted inadequate navigation training for aircrews. He was shot down on a bombing raid against the German battleship Tirpitz in a Norwegian fjord. Volume 1 ends with his escape and return to England.

Don was a brilliant navigator and outstanding pilot, but a restless, impatient person with no tolerance for red tape or bureaucracy. Always striving to find better ways to accomplish tasks, he was difficult to work for and would not countenance contrary opinions. That said, he was an outstanding leader.

This is the story of one of the world's greatest aviators, exploring his character, relationships and approach to leadership. It is an excellent read. Volume 2 will review Don's career as Commander of the PFF.



REVIEW BY Bob Treloar

WINGED VICTORY

By **V M YEATES**

Reprinted by various publishing companies; RRP $33

***WINGED VICTORY* HAS** been acclaimed by many as the greatest novel of war in the air, and by others as a realistic description of aerial combat. Both are right. Although initial publication was in 1934, the novel has been reprinted several times, the most recent in 2016, and copies can be found online.

V M Yeates was a Sopwith Camel pilot in the Royal Flying Corps and *Winged Victory* is a semi-autobiographical account of his wartime experiences, and he rails against the futility of war.

Set in 1918, *Winged Victory* recounts the aerial struggle between the German Air Service and the Royal Flying Corps during the German Spring offensive, and then the Allied final push. The narrative follows the central character, a Camel pilot, who gradually becomes disillusioned with the war as he suffers the continual loss of comrades, causing him to question the futility of his actions and the war in general.

The vivid descriptions of aerial combat will capture the reader's attention, as will the descriptions of life in a fighter squadron at the Front. The author captures the uncertainty of flying in skies, the control of which is keenly competed by young men of both sides striving to make their mark and survive. As the book unfolds, the strain begins to show, eventually becoming a debilitating force. Air combat was challenging, and strafing enemy trenches resulted in very high casualties from a multitude of machine guns returning fire.

Combat, loneliness, fatigue, fear, excitement and comradeship are brilliantly described, providing an excellent presentation of war in the air flying flimsy aircraft powered by temperamental engines. *Winged Victory* is a classic account of the air war in World War I. At 450 pages, a long book, but an excellent read.

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