WINGS

SUMMER 2022
VOLUME 74 NO.4

PROJECT AIR6500
LEADING CONTENDERS

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MANAGING EDITOR'S MESSAGE

IN THIS CHRISTMAS 2022 edition of *Wings* we offer a mostly pictorial preview of the Avalon International Airshow 2023 and present the RAAF formation display team, the Roulettes. We also introduce a new initiative to deliver a more in-depth review of major ADF acquisition projects; in this edition Project Air6500 – Joint Air Battle Management System. We hope you find that addition enlightening and interesting.

I would like to take the opportunity to thank Katie and Sandy for their design and production effort throughout the year to produce the quality magazine *Wings* has become. Many thanks also to Sue, Phil and David for their promotion of the magazine to our sponsors and advertising clients and to our loyal supporters whose patronage is essential to sustain the magazine in its modern form.

To close the year, we wish all our readers and supporters a Merry Christmas and a safe and happy festive season. We look forward to seeing you back on the same page in 2023. Please visit our website, ***wingsmagazine.org***, and consider arranging a personal or gift subscription to receive a regular copy in the mail and to access the magazine online.

Ron Haack*, Wings *managing editor

WINGS EDITORIAL DEADLINES 2023

Wings welcomes editorial submissions and letters to the editor. Please note the following deadlines for submissions.

EDITION	DEADLINE
Autumn (March)	20 February
Winter (June)	17 April
Spring (September)	17 July
Summer (December)	16 October

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

air force association

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MESSAGE FROM THE

DIRECTOR GENERAL AUSTRALIAN INTERNATIONAL AIRSHOW 2023

THERE'S NO SHOW like the airshow. That is the advertising bumper sticker used by the AMDA Foundation to promote the Australian International Airshow in 2023 (AIA23) after a four-year hiatus due to the 2021 event being cancelled because of the COVID-19 situation.

The 2023 event will be held between 28 February and 5 March at Avalon airport in Victoria and consists of two components: a trade and defence exposition held over the first three days, followed by the public airshow on the Friday, Saturday and Sunday. Previous airshows have had more than 200,000 attendees, making it the largest airshow in the southern hemisphere.

AIA is a biennial activity coordinated and run by the AMDA Foundation with the ADF and other government agencies and non-government elements in support. AIA23 will provide a significant opportunity to display the ADF's current capabilities and future concepts in a collaborative and integrated manner to government, military allies and partners, defence industry and the Australian public.

The ADF will have a range of static displays at Avalon highlighting the joint nature of the ADF and will conduct a daily flying program to demonstrate the remarkable capabilities of the ADF aviation fleet. Importantly, Defence Space Command and the cadets from the three services will have a presence at Avalon, and an international drone-racing tournament will be held. Aircraft from foreign militaries, including the US and from the region, will also participate at the airshow. Acrobatic displays from several civilian aviators will round out an impressive flying display program.

Due to the international reputation of the airshow, many overseas dignitaries and senior officers from across the world are likely to attend AIA23, providing them the ideal opportunity to view Defence joint capabilities and meet their Australian Government and Defence counterparts.

AIA23 promises to be an outstanding event for all involved, in particular the Australian public and aviation enthusiasts.

AIRCDRE Scott Winchester
Director General Australian International Airshow 2023

ON THE COVER
The RAAF Roulettes aerial display team warms up the crowd before the start of the 2022 Australian Formula 1 Grand Prix in Melbourne. Photo: LSIS James McDougall.

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PRESIDENT'S DESK

SEPTEMBER IS THE ANNIVERSARY MONTH of the Battle of Britain and after a two-year hiatus the Tasmania Division this year hosted its magnificent Battle of Britain Commemoration.

Formally starting with a church service in St David's Cathedral in Hobart, a traditional Air Force dining-in followed later in the evening, and the commemorative services concluded at a morning wreath-laying service at Hobart's cenotaph.

The announcement the day before of Queen Elizabeth II's passing precluded some dignitaries from attending. However, I was pleased to see the Governor of Tasmania and the Air Commander in attendance.

The event, especially its commemorative services, brought a grim reminder of the extreme danger to our freedom at the time and the high cost in human life on both sides.

Unfortunately, we have been involved in subsequent conflicts and, despite our best political efforts, we will again face such challenges. Indeed, we should not overestimate our current level of security. Our Defence Force needs the Australian community's support.

In our last *Wings* edition, I mentioned the revised structure of Air Force Association Ltd – the Association's national entity. The new structure requires a new constitution. The National Board, which includes the divisions' representatives, endorsed a draft constitution at our August meeting in Canberra. The document has been under legal review by Piper Alderman, one of the nation's top law firms, to ensure we have a legally correct document that reflects our objective of becoming a beneficial ex-service organisation. I hope the new constitution will be formally approved very shortly.

Homelessness is a national problem and veteran homelessness is particularly concerning to the Association.

Department of Veterans' Affairs and the recently appointed Minister for Veterans' Affairs, Matt Keogh, have expressed their concerns at the high level of veteran homeless and its connection to mental health and transition difficulties experienced by some veterans. Air Force Association is adamant about alleviating the problem.

Victoria and Western Australia divisions have plans in place to develop veteran housing facilities. Victoria has engaged PwC Australia to review its business model before proceeding.

Hopefully, in the future, the service of caring for such veterans will be adopted by other divisions.

Take care and stay well.

Carl Schiller
National President

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To join the Association, visit raafa.org.au and follow the JOIN US link. For assistance, contact the Association by phone or email. See page 15 for the contact details.

EDITED BY Bob Treloar

New Chief of Air Force

AIR MARSHAL ROBERT CHIPMAN joined the RAAF in 1989 as an Officer Cadet at the Australian Defence Force (ADF) Academy, graduating from Sydney University with an honours degree in aeronautical engineering in 1992.

He completed Pilot's Course in 1994, F/A-18 Operational Conversion in 1995 and Fighter Combat Instructor Course in 1999. Following various operational and instructor assignments, he commanded No.75 Squadron from 2006-2009 and No.81 Wing from 2013-2014. In 2008, No.75 Squadron was awarded the Duke of Gloucester Cup for the most proficient flying squadron and the Kittyhawk Trophy in 2009 for the most proficient fighter squadron.

AIRMSHL Chipman has staff experience in capability development roles within Capability Development Group and Air Force Headquarters. He has completed a tour as Director of the Australian Air and Space Operations Centre within Headquarters Joint Operations Command. He was an inaugural Director of Plan Jericho in 2015, an Air Force transformation program intended to deliver joint, integrated air and space capability for the ADF.

On promotion to Air Vice-Marshal in 2019, AIRMSHL Chipman served as Australia's Military Representative to NATO and the European Union. He was the Head of Military Strategic Commitments, responsible for the strategic level management and situational awareness of current and potential ADF engagement from January 2021, until his selection as Chief of Air Force and promotion to Air Marshal in July 2022.

AIRMSHL Chipman deployed on Operation Slipper in 2012 as a Battle Cab Director in the United States Air Force 609th Air and Space Operations Centre. He deployed on Operation Okra in 2014 as inaugural Commander Air Task Unit 630.1, for which he was awarded a Conspicuous Service Cross in 2015.

He was appointed a Member of the Order of Australia in 2019 for his exceptional service to the ADF in coalition air operations, air combat capability preparedness, and strategic capability development and sustainment.

AIRMSHL Chipman has completed a Master's in Business Administration and graduated as a fellow of the Defence and Strategic Studies Course in 2016. He is a graduate of the Australian Institute of Company Directors and Oxford Advanced Management and Leadership Programme. He is also an alumnus of the Cranlana Institute, a Monash University ethical leadership faculty, and has completed the United Nations Senior Mission Leaders Course.

Source: RAAF

ABOVE AIRMSHL Chipman getting to know his staff.

B-2 strategic BOMBERS DEPLOYMENT

THE US AIR FORCE (USAF) deployed four B-2 Spirit bombers to conduct Bomber Task Force missions in the Indo-Pacific region with key allies and partners from 10 July to 12 August. Assigned to the 509th Bomb Wing at Whiteman Air Force Base, Missouri, the aircraft flew to RAAF Base Amberley to conduct training, interoperability and strategic deterrence missions in the region.

The B-2 deployment was part of the Enhanced Air Cooperation agreement which enables a rotational presence of the USAF personnel and aircraft in northern Australia to modernise and strengthen military-to-military relationships, facilitate interoperability, exercise combined capabilities and increase regional engagement.

The B-2s trained and integrated with RAAF F-35A Lightning II and F/A-18F Super Hornet aircraft, conducted aerial refuelling with RAAF KC-30 tankers and hot turnround refuelling operations on the tarmac at Amberley. They also participated in Exercise Koolendong 22, a joint exercise focused on expeditionary advanced base operations by US and ADF personnel across northern Australia.

Source: US Strategic Command

ABOVE USAF B-2 Spirit bombers fly astern a RAAF KC-30A Tanker over RAAF Base Curtin, WA during exercise Koolendong 22. Photo: Technical Sergeant Dylan Nuckolls/USAF.

FOUR MORE F-35s

THE RAAF RECEIVED another four F-35A Lightning II aircraft in September bringing the fleet total to 58 and marking the third delivery of Lightning IIs for the year. All four were allocated to No.77 Squadron.

The fighters were flown from Luke Air Force Base in Arizona with transpacific stops in Hawaii and Guam. Nos 33 and 36 Squadrons provided the KC-30A Multi-Role Tanker Transport and C-17A Globemaster support for the transit to Australia.

Source: Defence Post

F-35A Lightning II aircraft at Hill Air Force Base, Utah, 2017. Photo: Paul Holcomb/USAF.

RAAF teams with INDONESIAN AIR FORCE

THE RAAF AND INDONESIAN AIR FORCE teamed up at RAAF Base Townsville in late September for Exercise Rajawali Ausindo, an air mobility exercise supported by a C-27J Spartan for the first time. Australia and Indonesia have shared responsibility for hosting the exercise since the inaugural activity in 1994. Activities included the aerial delivery of supplies and cargo to a drop zone and rehearsal of non-combatant evacuation operations.

The exercise coincided with more than 1,600 Australian and Singaporean armed forces taking part in amphibious military training exercise Trident during which the Royal Australian Navy HMAS *Adelaide* operated alongside Singapore Navy vessels RSS *Persistence* and RSS *Endurance* off the Queensland coast.

Source: Australian Aviation

ABOVE An Indonesian Air Force Hercules lands at RAAF Base Townsville. Photo: LACW Annika Smit.

ABOVE Air Marshal Chipman and General Brown sign the joint vision statement in Washington, DC. Photo: Andy Morataya.

Australian and US air forces strengthen partnership

THE LONGSTANDING RELATIONSHIP BETWEEN THE RAAF AND THE USAF was strengthened with the signing of a joint vision statement by Chief of Air Force, Air Marshal Robert Chipman and Chief of Staff of the USAF, General Charles Q. Brown, Jr in Washington, DC in September.

The statement builds on the Australian and US strategic partnership, and conveys the two countries' intent to work together to direct and support the development and operation of their air forces.

Air Marshal Chipman said that in today's rapidly evolving, competitive environment, Australia and the US must be ready to meet any challenges that arise, and do so with friends and international partners around the world.

The objective, included in the statement, is to generate air power that supports mutual national security approaches to deter aggression and confront threats to a free, stable and open international system. That will be accomplished through regional engagement, effective information sharing, shared approaches to security challenges, and credible, sustainable and interoperable air forces across the Indo-Pacific region.

Source: Defence News

BATTLE OF MILNE BAY

MEMBERS FROM THE Papua New Guinean (PNG) and Australian Defence Forces commemorated the 80th anniversary of the Battle of Milne Bay at Alotau on 28 August 2022. Chief of Air Force, Air Marshal Robert Chipman attended on behalf of the ADF and said it was an appropriate time to reflect on the longstanding bonds between Australia and PNG – forged in times of crisis but sustained in peace.

The Battle of Milne Bay, fought between 25 August and 7 September 1942 was an important victory for the Allies. It was the first time PNG, Australia and the US combined in the defence of PNG.

Source: Department of Defence

ABOVE A P-41 Kitty Hawk from No.75 or No.76 Squadron at Milne Bay.

Long-range cruise MISSILE TEST

A B-2 BOMBER SUCCESSFULLY released a Joint Air-to-Surface Standoff Missile – Extended Range (JASSM-ER) cruise missile during a December 2021 weapons test, contractor Northrop Grumman revealed in August. While the baseline JASSM has a range of roughly 200nm, JASSM-ER has a range of more than 500nm and future versions will allow it to re-target mid-flight.

JASSM-ER has been qualified for employment from B-1B and B-52 bombers and F-15E and F-16 fighters, according to Pentagon sources. The B-2 test is the first publicly known instance of the USAF testing JASSM-ER on a stealth aircraft. There are plans to integrate the missile onto the F-35A.

In further B-2 developments Northrop Grumman said it has integrated a new Radar Aided Targeting System onto the bomber that improves weapon guidance accuracy in a GPS-denied environment and allows the aircraft to fully employ the latest version of the thermonuclear bomb.

Source: Air Force Magazine

ABOVE A B-2 spirit at take-off.

Ghost Bat may pair with NEXT-GEN FIGHTERS

MQ-28 Ghost Bat. Photo: Boeing.

THE USAF IS considering Boeing Australia's MQ-28 Ghost Bat drone as part of a gameplan to team an unmanned platform with the forthcoming Next Generation Air Dominance (NGAD) fighter. USAF officials are in early discussions about purchasing the drone, which could be a "risk-reduction mechanism" for the NGAD platform.

The 11.5m MQ-28 unmanned combat air vehicle, previously known as Loyal Wingman, has a 2,000nm range. It has been in development for the RAAF since 2019 and is considered a foundation of Boeing's Airpower Teaming System.

Source: Flying

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AUSTRALIA'S FIRST TRITON

AUSTRALIA'S FIRST MQ-4C TRITON remotely piloted aircraft system was rolled out of the Northrop Grumman production facility in September. The high-altitude surveillance drone can remain airborne for up to 24 hours and is equipped with sensors that provide a 360-degree view of its surroundings for over 2,000nm.

Triton will complement the surveillance role of the P-8A Poseidon by providing sustained operations at long ranges, and undertake intelligence, surveillance and reconnaissance tasks, significantly enhancing Australia's ability to persistently patrol Australia's north and north-western approaches, the South-West Pacific and south to Antarctica.

MQ-4C Tritons will be based at RAAF Base Tindal in the Northern Territory and controlled from facilities at RAAF Base Edinburgh, SA. There are currently three MQ-4C Tritons on order, with the potential for an additional four. The first is expected to arrive in 2024.

Source: Defence News; Australian Aviation

ABOVE Australia's first MQ-4C Triton aircraft after emerging from the Northrop Grumman Palmdale paint booth. Photo: Alan Radecki, Northrop Grumman Aeronautics Media Services.

A wish takes flight

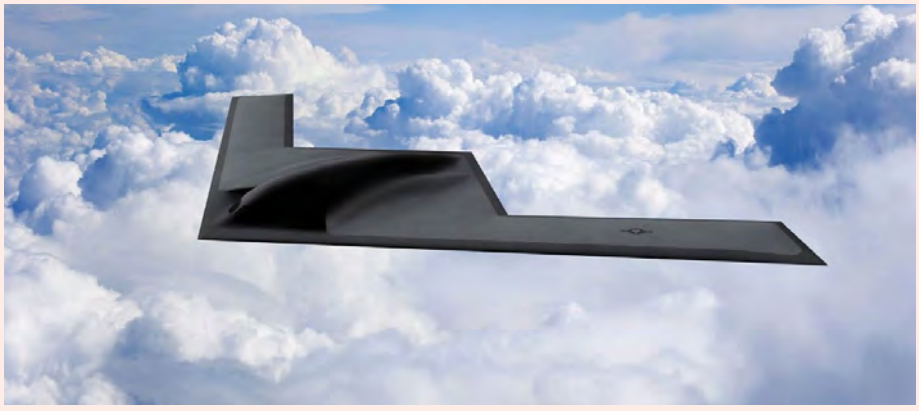
THE FLEET AIR ARM granted the wish of 13-year-old Chau Giang Phan with a flight over the Shoalhaven region. Supported by 723 Squadron – Joint Helicopter School and 725 Squadron, Giang underwent condensed flying training exercise around the Nowra and Jervis Bay area in an EC-135, including a sortie at the flight deck procedural trainer.

The teenager has diffuse intrinsic pontine glioma (DIPG), an inoperable and terminal cancer of the brain stem. Each year, about 20 Australian children are diagnosed with DIPG and current treatment is only palliative. While adulthood remains a dream, Giang can now say one of her wishes has been granted.

Source: Department of Defence

ABOVE Chau Giang Phan prepares to depart for a flight in an EC-135 aircraft at HMAS Albatross. Photo: Leading Seaman Ryan Tascas.

New long-range STRATEGIC BOMBER



NORTHROP GRUMMAN CORPORATION, in partnership with the USAF, will unveil the latest long-range strategic bomber, the B-21 Raider in December 2022 at the company's Palmdale, California facility.

Six B-21 test aircraft are in various stages of final assembly at the plant with the first flight projected for 2023, dependent on ground test outcomes.

The B-21 follows the UFO-like B-2 Spirit, introduced in the late 1980s, which can carry nuclear weapons, costs $2 billion and is seen as a most lethal aircraft. There are just 20 in active service.

Sources: joint-forces.com; Australian Aviation

LEFT USAF artist's rendering of the B-21 Raider. Photo: USAF.

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Space surveillance telescope BEGINS OPERATIONS

A DEEP-SPACE TELESCOPE developed in the US and relocated to Exmouth, WA was declared operational in September. The Space Surveillance Telescope (SST) will join a network of sensors used by the US, Australia and other allies to track objects in orbit. The US owns the 118,880kg telescope and Australia built the site and infrastructure, including a 2.1-megawatt central power station.

SST can track faint objects in deep space to help predict and avoid potential collisions, and can image objects in geosynchronous orbit 35,000km from Earth. The RAAF will operate the telescope in coordination with the US Space Force's Space Delta 2 Unit.
Source: Space News

The SST at the Harold E. Holt Satellite Sensor Site facility near Exmouth. Photo: CPL David Cotton.

ABOVE From left, SQNLDR Jason Gamlin, GPCAPT Tim Sloane, SQNLDR Chris Rogers, FSGT Tim Muehlberg and FLTLT James Denton. Photo: Leading Aircraftwoman Emma Schwenke.

Medals for flypast team

THE TEAM OF RAAF PILOTS behind the Air Force centenary flypast in Canberra last year have been awarded one of the aviation industry's most prestigious accolades. The group, led by Group Captain Tim Sloane, won the Grand Master's Australian Medal, granted by The Honourable Company of Air Pilots.

The flypast included 60 warbirds, along with modern aircraft in a series of formations over Canberra. The aircraft included Spitfire, Caribou, C-130J, F/A-18 Hornet, F-35A Lightning II, E-7 Wedgetail, C-17 Globemaster and many others, supported by air-to-air refuelling assets and a co-ordinating E-7 Wedgetail aircraft. Planning for the event took nine months.
Source: Australian Aviation

Spartans deployed for MARITIME SURVEILLANCE

RAAF C-27J Spartan.

THE ADF JOINED Pacific partner nations to address illegal, unregulated and unreported fishing activity in the Southwest Pacific under Operation Solania. The ongoing operation forms part of the Pacific Islands Forum Fisheries Agency's Operation Island Chief.

RAAF commitment involved the deployment of a C-27J Spartan and a KA350 King Air aircraft, tasked to assist Vanuatu and Kiribati to monitor their exclusive economic zones. The aircraft operated out of Port Vila and Tarawa, respectively.

The King Air crew flew 10 missions, detecting and reporting more than 15 suspicious vessels and helping locate 10 vessels of interest. The C-Spartan flew 11 missions, reporting more than 50 vessels.
Source: Defence Connect

An iconic reminder of 'MATES HELPING MATES'

AIR FORCE VETERANS AND THEIR FAMILIES had the opportunity to reflect on their wartime service and the sacrifices made by those who didn't return at the recent Battle of Britain commemorative services in Hobart.

Superbly hosted by the Air Force Association (AFA) Tasmania Division, the commemorations marked 82 years since the Battle of Britain campaign during World War II between 10 July and 31 October 1940. A total of 35 Australians flew combat operations during the campaign, 10 of whom were killed in action.

AFA National President Carl Schiller said he was honoured to be in Hobart alongside other veterans, current service personnel and their families.

"I felt I was part of the Air Force family, as I am sure other members did also, with the large contingent of serving Air Force personnel including the Air Commander who represented CAF," he said.

"I was proud of our association and in particular the Tasmania Division which hosted this memorable occasion that has attracted veterans, their families and many dignitaries over the years.

"The church service was very moving, and in many ways therapeutic, making veterans proud of their contribution to service and country."

Carl said the Battle of Britain Commemoration was an iconic reminder of all battles, especially air battles of which it was the first major air battle in history.

"In my mind, the Battle of Britain represents a fight for freedom and a reminder of what we are witnessing today with the invasion of Ukraine," he said.

"The battle was essentially fought by youth, many of whom were reservists. Most had VR on their jackets, standing for Voluntary Reserve, indicating the need for defence readiness and the use of a total force.

"Although Australia's participation was minimal, it was about 'mates helping mates'. This battle wasn't 'our' battle, but we came to the aid of the bullied and in danger of losing their sovereignty.

"Aggression cannot be ignored. This was a shared view by the mix of nationalities involved supporting Britain, and this battle has added to the national psyche of Britain as Gallipoli has to ours."

The RAAF supported the Battle of Britain commemorations with personnel from No.29 (City of Hobart) Squadron, Air Force Band and a flypast by an AP-3C (EW) Orion over the Hobart Cenotaph. The Air Force aerobatic team, the Roulettes, also provided a flying display with Pilatus PC-21 aircraft from the Central Flying School at RAAF Base East Sale.

WGCDR Deanna Nott

BELOW AFA Tasmania State President Squadron Leader Alan Robertson (Ret'd) pauses to remember the service and sacrifice of those who flew and fought during the national commemoration of the Battle of Britain at the Hobart Cenotaph. Photo: SGT W. Guthrie.

LEFT The Governor of Tasmania, Her Excellency the Honourable Barbara Baker AC accompanied by 102-year-old Flight Lieutenant Brian Winspear AM (Ret'd) and Air Commander Australia Air Vice-Marshal Darren Goldie AM, CSC on the front steps of St David's Cathedral at the conclusion of the church service. Photo: WGCDR J. Robertson.

Remembering the FEW

ON 17 SEPTEMBER 2022, the Air Force Association - South Australia (AFA-SA) partnered with RAAF Edinburgh in hosting Adelaide's annual Battle of Britain Commemorative Service at the Torrens Parade Ground, Adelaide.

It was a special service honouring the South Australian aviators who served in the epic air campaign fought between July and October 1940 that proved to be such a decisive turning point in the fight against Germany in World War II. Of the more than 30 Australians who flew in the Battle of Britain, eight were South Australian, only four of whom survived the war.

The Governor of South Australia and Honorary Air Commodore, Her Excellency The Honourable Frances Adamson AC was joined by political dignitaries including SA Veterans Affairs Minister Geoff Brock and Senator David Fawcett at the service. Special guests of honour included WWII veteran Don Looker and families of RAAF WWII veterans.

Members of No.1 Remote Sensor Unit (1RSU), RAAF Edinburgh, and the Australian Air Force Cadets (AAFC) provided the key positions of the service.

AFA-SA President Dr Robert Black AM noted the ongoing support of RAAF Edinburgh, stating: "It was wonderful having Air Commodore [Ross] Bender [Commander Air Warfare Centre and Senior Air Force Representative South Australia] and the members of 1RSU supporting and participating in this year's ceremony and connecting with our veterans."

Royal Canadian Air Force Officer at RAAF Edinburgh LTCOL Bill Snyder recited the poem *High Flight* written by RCAF Spitfire pilot PLTOFF John Macgee who was killed in a spitfire accident in 1941 three months after writing the poem.

LEFT From left, Veterans Affairs Minister Geoff Brock, RAAF veteran Don Looker, Her Excellency the Honorable Frances Adamson, Dr Robert Black and Air Commodore Ross Bender. Photo: LAC Sam Price.

BELOW LEFT Air Force Cadets with Dr Black and Air Commodore Bender after the commemorative service.

No.6 Wing AAFC Public Affairs Officer, Wing Commander Fernando Gonzalez, said the cadets, aged 13 to 18 years, embraced the Battle of Britain commemoration. "These events are cherished highlights of the cadet activity calendar, affording invaluable opportunities for our youth to learn from our history and to honour the service and sacrifice of our distinguished veterans," he said.

WGCDR Peter Crookes, CO 1RSU, provided the keynote address recounting the story of young South Australian aviator PLTOFF Clarence Bennett who was killed in action during the Battle of Britain.

After the service, attendees shared morning tea courtesy of AFA and the Combined Services Mess.

It was a special day as young and old came together to remember the few – the aviators, and the many – the ground staff who supported them to grind out an incredible victory in the air over the summer of 1940.

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AF2021 centenarian PRESENTATIONS

AS PART OF THE AIR FORCE CENTENARY, the RAAF acknowledge RAAF veterans who shared their 100th birthday with the Air Force from January 2021 to 31 March 2022. The veterans were presented with a special Chief of Air Force Certificate signed by the Chief of Air Force and the Warrant Officer of the Air Force and their respective coins.

There have been a number of centenarians recognised in South Australia and the Air Force Association-SA (AFA-SA) has been included in all of the presentations. While the COVID pandemic significantly restricted the program, RAAF Edinburgh recently completed centenarian presentations to the last of the designated veterans: Eva Forster and George Petersen.

Eva (Bobbie) Forster was born 15 February 1922 in Mannum, SA. After completing school, she became a stenographer. In January 1942, Eva entered the WAAAF as a clerk and went to Victoria to conduct initial training at Geelong Grammar School. Due to her experience and skills as a stenographer, she did not have to complete any trade training.

After initial training, she completed postings during World War II to RAAF Station Parafield in Adelaide, Bairnsdale, Victoria and Sydney. She rose to the rank of Sergeant and working in Orderly Rooms. Her sad memories were of writing letters of condolence to the families of aircrew who lost their lives in accidents, but her happiest memory was of joining in the celebrations on the streets of Sydney when Peace in the Pacific was declared.

Bobbie married FLGOFF William (Paul) Forster, a pilot who served with No.200 (Liberator) Special Duties Flight, flying Liberators. After the war, Bobbie and Paul raised four children but sadly, Paul died at the age of 49. Bobbie went on to work for 10 years as a medical courier. She also travelled the world and was very active in her community. She volunteered in the shop of a nursing home for 38 years before eventually retiring at the age of 98.

George Sydney Peterson was born in Ambleside, now known as Hahndorf, in the Adelaide Hills on 25 December 1921. He enlisted in the RAAF in July 1942 as a trainee pilot and after completing initial training at Victor Harbor, went to No.1 Elementary Flying Training School, Parafield, flying Tiger Moths. He then went on to continue his training on Wirraways at Deniliquin. After Deniliquin, he was selected to go to Mildura to train on Kittyhawks but decided to go to West Sale as a Staff Pilot for six months. He ended up staying in Sale flying Ansons and Oxfords as an instructor. George's wife Patricia Petersen, who was also born in 1921, joined him in both Deniliquin and Sale and became part of the RAAF family.

George loved flying and maintains one of the greatest moments of his life was when he got his wings. After the war he continued flying as a member of the Royal Aero Club at Parafield in Adelaide and later owned a Cessna 150 which he flew in the Adelaide Hills. After the war, George became an apple orchardist and innovator. He has retired but is still actively maintaining his property. George was a member of the Mitcham Branch of the AFA-SA.

AFA-SA president Dr Robert Black presented each veteran with a copy of South Australian Eagles in recognition of their service. Appreciating the opportunity provided by RAAF Edinburgh to be part of the Air Force Centenarian initiative in SA, he noted: "It was wonderful to be able to connect and spend some time with these RAAF veterans who are as old as the Air Force itself and share in their stories with some current serving RAAF members as they were honoured by the RAAF."

TOP Dr Robert Black with Eva Forster and LACW Madeline Onafria, a RAAF Personnel Capability Specialist, the modern-day equivalent of what Eva was during World War II. Photo: AFA-SA.

ABOVE Eva Forster (right) on the streets of Sydney celebrating the news of the end of the war in August 1945. Photo: AFA-SA.

FAR LEFT Robert Black with George Petersen. Photo: AFA-SA.

LEFT George Petersen in uniform in 1945. Photo: AFA-SA.

FROM TANKS TO TRACTORS

BACKPACKERS AND INTERNATIONAL TRAVELLERS have traditionally provided a valuable source of labour to Australia's agricultural industry. Many had farm work experience with animals and machinery in their home country and easily merged with our farming community while enjoying their exposure to life in Australia. COVID border closures decimated that workforce as travellers were forced to return home.

To help fill the void, a team of volunteer ADF veterans established Operation Grain Harvest Assist (OPGHA) in August 2021. An estimated 250-300 veterans from all three services deployed nationally in late 2021 to assist grain growers with a bumper harvest that was at risk because of the absence of backpackers. Those veterans reported very positively about the experience, one describing it as the best time he had ever had.

Grain growers were equally positive about having veterans on board and were looking to repeat the experience in 2022 even though bad weather has compromised the harvest in some parts of the country.

This year, the OPGHA program grew strongly and in September, 18 veterans, most with deep ADF experience, attended a four-day no-cost industry-sponsored, live-in training course at Longerenong Agricultural College in Horsham, Victoria. The major sponsor was Case IH Australia and the training was conducted on two of its $1.5 million 8250 combine harvesters. First-class instruction and leadership for the course was provided by O'Connors, the largest Case IH distributor in Australia.

The course included visits to some of the most professionally run grain farms in the Wimmera, to learn more about grain growing and harvesting from the experts.

OPGHA is now working to rapidly professionalise its approach to prepare veterans for employment in the grains industry, building on prior ADF training and, where possible, with strong industry support, leveraging the best training capabilities available.

Opportunities to work in agriculture are broad, varied and quite enticing to those seeking a new adventure outside the ADF. Visit opgha.org.au to explore the opportunities to embark on a new and exciting journey.

EDITED BY John Kindler

F135 ENGINE DEPOT FULLY OPERATIONAL

TAE AEROSPACE HAS successfully achieved all initial depot capability requirements for the repair and overhaul of the Pratt & Whitney F135 engine, which powers all three variants of the fifth-generation F-35 Lightning II fighter aircraft. TAE Aerospace's F135 maintenance, repair, overhaul and upgrade (MRO&U) facility at Ipswich, Queensland, is the first fully operational F135 engine depot in the Asia-Pacific region, supporting F-35 operators from Australia, South Korea, Japan and US forces in the region.

TAE Aerospace is now authorised to conduct the full MRO&U process from engine teardown, rebuild and post maintenance test before returning the completed modules or engines to F-35 operators through the program's Global Support Solution.

Source: Australian Defence Magazine

LEFT TAE F135 MRO&U Facility, Ipswich.

Super Hornet TEAMS WITH UAVS

BOEING AND THE US NAVY have completed a series of manned-unmanned teaming (MUM-T) flight tests in which a Block III F/A-18 Super Hornet successfully demonstrated command and control of three unmanned aerial vehicles (UAVs).

Boeing system engineers connected Block III's adjunct processor, known as the Distributed Targeting Processor – Networked (DTP-N), with a third-party tablet to team with the UAVs. Boeing developed new software loads for the DTP-N specifically to run the third-party tablet and enable command transmission. The software development, tablet connection to the fighter and all flight tests were completed in less than six months.

During the tests, F/A-18 crew entered commands into the tablet, which were processed and transmitted through Block III standard hardware. All commands were executed by all UAVs as programmed.

Source: Australian Defence Magazine

LEFT US Navy F/A-18F Super Hornet. Photo: US Navy.

Gloabl contracts FOR ORBITAL UAV

ORBITAL CORPORATION of Balcatta, WA has signed a $3.5 million second-stage engineering contract for the supply of unmanned aerial vehicle (UAV) engine systems with an undisclosed customer based in Singapore. The deal involves advancing an initial engine design, development and integration contract signed in 2020 and follows the acceptance of three prototype engine systems delivered last year.

Orbital UAV will be tasked with conducting further engineering work and delivering three additional prototype engine systems over the course of the 2023 financial year. If successful, it will be contracted to deliver production-quality engine systems in the following year.

The company has also been tasked with supplying its latest heavy-fuel engine for assessment by AeroVironment, a US-based unmanned aerial system (UAS) company. The engine is slated for delivery in the second half of the 2023 financial year.

AeroVironment has been expanding its presence in the global UAS market, acquiring Arcturus UAV in February 2021. It now offers a full suite of Group 1 through 3 UAS platforms, tactical missile systems, high-altitude pseudo-satellites, and unmanned ground vehicle solutions.

Orbital UAV has also been contracted by global defence technology company Anduril Industries to help identify a pathway for upgrades to engines supporting Anduril's UAS programs.

Source: Defence Connect

ABOVE Orbital UAV launch.

ABOVE LEFT AeroVironment T-20 unmanned aerial vehicle.

ORDERS TRIPLE FOR COMMUNICATIONS COMPANY

ABOVE C4i development laboratory.

IN 2021, MELBOURNE-BASED secure communications system company C4i Pty Ltd achieved $33.6 million in defence export orders – an increase of more than 37 percent and the largest value of export orders in its history.

C4i delivers high-tech secure communication system technology to prime contractors and international end-user customers, including the US Air Force and Marine Corps, UK Ministry of Defence, Canadian Department of National Defence, Taiwan Airforce and the Qatar Ministry of Defence. In Australia, the C4i secure voice communication system is being implemented in the RAAF communications network.

C4i offers customers a secure, high-availability communications system that can be expanded from the smallest single-site system to the largest multi-site national system. In addition to providing innovative 'any radio – anywhere' flexibility, voice over internet protocol communications enterprise integrates a range of disparate systems, including data, telephony, facility control, and recording.

Source: Defence Connect

Air-to-surface MISSILE ORDER

THE US STATE DEPARTMENT has rubberstamped an Australian Government request for Lockheed Martin-built Joint Air-to-Surface Standoff Missiles (JASSM) weapons systems for the RAAF.

The Defense Security Cooperation Agency announced the approval of a $340 million purchase request from the government for 80 JASSM-Extended Range (JASSM-ER) weapons systems and related equipment. The deal includes the provision of missile containers and support equipment, JASSM training missiles and technical support and training.

The JASSM weapons systems can be deployed from Boeing F/A-18E/F Super Hornets and Lockheed Martin F-35A Lightning II tactical fighter aircraft.

Source: Australian Defence Magazine

B1 Lancer releases a JASSM. Photo: Lockheed Martin, courtesy USAF.

BDA & Rosebank Engineering team up

BOEING DEFENCE AUSTRALIA (BDA) has signed a component repair framework contract with Rosebank Engineering, aimed at enhancing Australia's sovereign aircraft maintenance, repair and overhaul capability.

Specifically, Rosebank Engineering has been contracted to carry out intermediate-level repair on an initial three components for F/A-18F and EA-18G Growler aircraft including the main and nose wheel hubs and a component from the environmental control system, currently repaired in the US via the US Navy's foreign military sale program.

BDA is currently under contract to sustain the RAAF's F/A-18F Super Hornet, EA-18G Growler, C-17A Globemaster, P-8A Poseidon, E-7A Wedgetail, CH-47F Chinook, EC-135 training helicopter and future AH-64E Apache fleets.

Source: Defence Connect

ABOVE BDA Air Combat Electronic Attack Sustainment program manager Chris Gray, left, and Rosemont Engineering's Business Development senior manager, Paul PingNam.

ANTI-RADIATION MISSILES

AN AUSTRALIAN PROPOSAL to acquire a stock of Northrop Grumman-built anti-radiation missiles has been approved by the US State Department. The Defense Security Cooperation Agency has endorsed a US$94 million (A$135.7 million) foreign military sale of advanced precision strike capability to Australia. The sale will deliver 15 AGM-88E2 Advanced Anti-Radiation Guided Missiles together with training and support services.

The Northrop Grumman-built missiles deployed by strike fighters are designed to provide a combination of precision, survivability and lethality, and are reportedly capable of rapidly engaging land and sea-based air-defence threats, as well as striking time-sensitive targets. Specifically, the missile can destroy or suppress air-defence radar systems.

Allectum wins RAAF support contract

CANBERRA-BASED COMPANY ALLECTUM has been selected to provide the sustainment office capability for Distributed Ground Station – Australia, a first-of-type capability for intelligence fusion and dissemination of airborne-generated sensor data for the RAAF.

To service the capability, Allectum employs a diverse range of veterans who will impart their years of service and knowledge of ADF information and communication technology environments to support the RAAF's fifth-generation platforms and key decision-makers.

Allectum, a veteran-owned and operated company, partnered with SME Gateway to win the contract to provide the sustainment office capability.

Source: Australian Defence Magazine

Tracking Australian rocket launches

INMARSAT HAS SIGNED an agreement with Gilmour Space Technologies to support space launches from Australia using its InRange system. InRange is designed to offer launch vehicle operators real-time information on the trajectory of their rocket via satellite rather than ground stations, eliminating blackout zones. The concept uses global coverage from Inmarsat's constellation of ELERA L-band geostationary satellites as a data relay link for launch vehicles.

Ordinarily, new launch providers or locations need to create a ground-based telemetry system to track their rockets during the launch phase, a time-consuming and costly exercise that creates a major barrier to entry and prevents wider competition in the global launch market.

Inmarsat already supports the ADF and has built new ground stations in Australia for its recently-launched I-6 F1 satellite and is looking to deliver for the JP9102 Australian Defence Satellite Communication System project.

Gilmour Space's Eris rocket, due to launch early next year, will be Australia's first orbital rocket and first orbital launch attempt from a commercial Australian launch site.

Source: Defence Connect

See page 62 for more on Gilmour Space.

DroneShield wins European contract

AUSTRALIAN COUNTER-DRONE specialist DroneShield has announced a $2 million order for multiple DroneSentry fixed-site detect-and-defeat systems from an undisclosed European government – the company's largest contract from a European customer.

DroneShield provides artificial-intelligence (AI) based platforms for protection against advanced threats such as drones and autonomous systems including bespoke counter-drone and electronic warfare solutions and off-the-shelf products designed to suit a variety of terrestrial, maritime or airborne platforms.

DroneSentry can be deployed in permanent or temporary installations operating as a single system or as a multiple sensor array. It provides software-as-a-service subscriptions to DroneShield's AI software engines – radiofrequency sensor AI, optical computer vision AI and DroneSentry-C2TM command-and-control sensor fusion engine. The capability is designed to correlate situational data, providing increased situational awareness for automatic identification and response to drone intrusions or threats.

The latest contract comes just after the ASX-listed firm confirmed it had sold and deployed the company's DroneSentry counter-drone capability at a US international airport for the first time.

Source: Defence Connect

BILLION-DOLLAR SOUTHPAN CONTRACT

LOCKHEED MARTIN AUSTRALIA (LMA) has announced a $1.18 billion contract to support operation of the Southern Positioning Augmentation Network (SouthPAN), a partnership between Geoscience Australia and Toitu Te Whenua Land Information New Zealand (LINZ) under the Australia New Zealand Science, Research and Innovation Cooperation Agreement.

The 19-year deal, signed with Geoscience Australia, aims to deliver "instant, accurate and reliable positioning" to industry and community users across Australasia. Specifically, the SouthPAN initiative involves delivery of a signal augmenting GPS and Galileo, designed to improve accuracy from 5-10m, to within as little as 10cm.

The enhanced position capability is expected to be leveraged by a range of users to support: civil aviation; vehicle guidance; precision agriculture for efficiencies in crop management; tracking maritime shipments; and enabling navigation for drones and other unmanned vehicles.

As part of its commitment, LMA is expected to work with the SouthPAN project team to establish a network of Global Navigation Satellite System reference stations and satellite uplink facilities.

Source: Defence Connect

BELOW SouthPAN installation.

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Developing a hypersonic air-breathing missile

RAYTHEON MISSILES & DEFENSE, in partnership with Northrop Grumman, has been selected to develop the Hypersonic Attack Cruise Missile (HACM) for the USAF. HACM is a first-of-kind weapon developed in conjunction with the Southern Cross Integrated Flight Research Experiment, a US and Australia project researching scramjet and hypersonic concepts.

HACM is an air-breathing, scramjet powered munition. Scramjet engines use high vehicle speed to forcibly compress incoming air before combustion, enabling sustained flight at hypersonic speeds – Mach 5 or greater. By traveling at those speeds, hypersonic weapons can reach their targets more quickly than conventional missiles, allowing them to potentially evade defensive systems.

BELPOW An artist's impression of a hypersonic missile.

EXPANDING HELICOPTER FLEET

A PROPOSAL TO buy 40 Sikorsky-built UH-60M Black Hawk helicopters and related equipment, valued at approximately $2.79 billion, for the Australian Army has been approved by the US Defense Security Cooperation Agency.

It is understood six Black Hawks could be available from Sikorsky's 2022 global production line, with the remainder potentially delivered by 2026.

Meanwhile, the Royal Australian Navy (RAN) has placed a second order for 12 MH-60R Seahawk/Romeo helicopters, a deal tipped to be worth over $2.5 billion.

Lockheed Martin subsidiary Sikorsky will produce the additional helicopters with delivery expected between mid-2025 and mid-2026.

The additional helicopters will add to the 24 aircraft acquired between 2013 to 2016 and take the total fleet size to 36, potentially providing RAN's Fleet Air Arm with a third Romeo squadron.

While the expanded fleet of Romeo helicopters and the new UH-60M Black Hawks are rumoured to be replacing the troubled MH-90 Taipan fleet, operated by both the Army and Navy, Minister for Defence Richard Marles said the Taipan program remains "under review".

Source: Australian Aviation; Defence Connect

ABOVE MH-60R Seahawk/Romeo helicopter.

TOP UH-60M Black Hawk.

NOVA TEST AND EVALUATION CENTRE

Test and evaluation planning tool.

NOVA SYSTEMS HAS committed to an initial $2 million investment to establish a local test and evaluation centre of excellence, billed as a hub designed to support sovereign defence capability, as well as research, digital technologies, training and ideas. The aim is to facilitate collaboration between Defence, industry and academia to develop an integrated joint force test and evaluation and capability assurance capability.

The plan also includes the potential for a technology incubator, aimed at fostering a national and international focus on the development of new digital tools and methodologies for capability assurance.

Source: Defence Connect

New Airbus office

AIRBUS DEFENCE AND SPACE has announced it will open a new office at the Defence and Space Landing Pad at Lot Fourteen in Adelaide. It will be Airbus' first Australian office dedicated to space and home to the Resilient Multi-Mission (RMS) STaR Shot program and missions – a strategic research program established to develop future space capabilities for the ADF.

In July, Airbus was selected as the strategic partner to fast-track the development of satellite technologies under the RMS program to ensure the ADF is equipped with ongoing access to resilient and trusted communication, intelligence, and surveillance services.

The company said a permanent presence in South Australia will enable it to engage in collaborative discussions with its partners and provide a focal point for wider engagement with the Australian industry as the program looks to demonstrate and experiment with locally manufactured payloads.

The announcement follows Airbus announcing its commitment to the Australian Space Park in Adelaide, where it will help build the first-ever dedicated satellite assembly and integration manufacturing facility.

Source: Australian Defence Magazine

Locally developed MISSILE SYSTEM

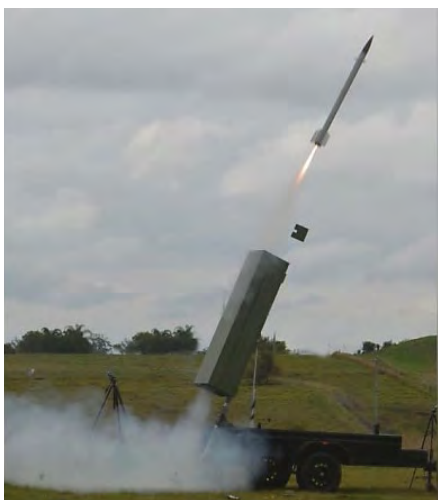
QUEENSLAND'S BLACK SKY AEROSPACE has begun testing of a missile launch pod as part of a plan to develop Australia's sovereign missile capability. Earlier this year, the company was granted $500,000 in government funding as part of the Advanced Manufacturing Growth Centre managed commercialisation fund.

Black Sky Aerospace CEO Blake Nikolic said the company had tested rockets earlier in the year to begin integrating a guidance system in the hope of developing a sovereign guided weapon capability. According to Nikolic, the company is now ready to begin construction of the missile system. Black Sky was driven to develop the systems having analysed the Ukrainian battlefield, observing the need for a "light, portable and versatile missile".

The company remains the only Australian developer of solid rocket fuel, motors, common tactical boosters and launch vehicles for both space and defence requirements.

Source: spaceconnectonline.com.au

BELOW Black Sky Aerospace missile launch pad.



A guide to anodising

SURFACE FINISHING EXPERT DECO AUSTRALIA has released an in-depth educational guide to the anodising process, including the types of anodising, customisation options, benefits and how to identify 'true' hard anodising.

Anodising is a crucial finish for the manufacturing, engineering and defence industries. An electrolytic treatment process for aluminium, which results in the growth of an aluminium oxide coating on the surface of the component, it offers superior durability and corrosion protection.

DECO's educational white paper, *The Ultimate Finish: A Comprehensive Guide to Anodising and its Benefits*, shares the finisher's extensive knowledge of how the finish can benefit projects across a broad range of industries.

To download a copy of the white paper, go to decorativeimaging.com.au and search 'ultimate finish'.

Scandinavian Airshow at the Australian International Airshow 2019.

AFTER A FOUR YEAR HIATUS, THE AUSTRALIAN INTERNATIONAL AIRSHOW WILL BE BACK AT AVALON IN 2023, PROMISING TO BE BETTER THAN EVER.

THE SHOW GOES ON

THE AUSTRALIAN INTERNATIONAL AIRSHOW 2023 (AIA23) will be held in early Autumn at Avalon Airport, Victoria. The event continues a three-decade history of airshows during which the RAAF, with state and federal governments and Australian industry, welcome their international counterparts for six days filled with specialist conference and symposia, a comprehensive industry exhibition, a prestigious innovation awards program, skilling and careers programs, corporate hospitality and electrifying flying displays.

The dedicated trade days at the last Avalon airshow in 2019 attracted 698 companies from 37 nations and more than 39,000 industry attendances, including 161 military, industry and government delegations from around the world as well as a 300-strong flight line of ground aircraft displays.

A comprehensive conference program will be held as part of the AIA23 industry program and will present leading experts in fields covering topical issues, innovations, program updates and visions for the future of aviation, aerospace, space and defence industry.

The flying display will include an eclectic mix of military and civilian performances. The ADF's air power capabilities will dominate the flying presentation, but visitors can expect some surprise appearances by the air forces of our friends and allies. An overflight and brief handling display by a US Air Force B-52 and/or B-2 is possible and some rarely seen vehicles will be parked in the static display.

TOP RAAF F/A-18 Hornets at Airsow 2019.

ABOVE The lead pilot for the Air Bandits aerial demonstration team taxis down the runway after a flight at Airshow 2019. Photo: Staff Sgt. Sergio A. Gamboa/ US Air Force.

ABOVE LEFT Mark Jeffries' Awesome Extra NG.

LEFT Avalon 2019 exhibition.

THE DEFENCE STATE

SOUTH AUSTRALIA IS A HUB OF DEFENCE AND SPACE ACTIVITY, UNDERPINNED BY WORLD-CLASS FACILITIES, CUTTING-EDGE TECHNOLOGY AND A HIGHLY SKILLED WORKFORCE.

Home to a significant presence of Defence infrastructure and expertise including the Edinburgh Defence Precinct and Woomera Range Complex, South Australia is fast becoming the centre of the nation's advanced information warfare capabilities, including intelligence, surveillance, reconnaissance, cyber and electronic warfare.

Building on this capability, the state is at the forefront of Australia's space endeavours, host to the Australian Space Agency, Mission Control Centre, Australian Space Discovery Centre, the future Australian Space Park and more than 100 space-related organisations delivering across the entire space value chain.

With world-class infrastructure, state-of-the-art precincts, innovative research and a highly skilled workforce delivering sovereign capability to some of the nation's largest projects, South Australia is creating a sustainable defence and space industry to meet the future needs of our Defence Force.

So when you think defence, think South Australia – The Defence State.

Visit the website

SOUTH AUSTRALIA | Government of South Australia | DEFENCESA

For more information visit **defencesa.com**

Images courtesy of Department of Defence and DSTG.

The RAAF's Roulettes formation display team will anchor the flying show and a selection of commercial aircraft overflights and civilian solo and formation display teams will demonstrate the breadth and depth of aviation in Australia. In particular, some of the world's acclaimed aerobatic champions will enthrall to crowd with spectacular performances.

Australia's Matt Hall, the 2019 Red Bull pylon racing world champion, always ready to participate in future racing opportunities will take his race team and two aircraft to Avalon. His team will perform three displays comprising solo demonstrations by Matt in an MXS and team member Kris Sieczkowski in an Extra 300L, and formation aerobatics by Matt and his accomplice Emma McDonald in the two aircraft. Matt explains that the MXS is not the average aerobatic aircraft, capable of 500kph, able to roll at 400 deg/sec and manoeuvre at 14g. He notes that it is not just the manoeuvre envelope of the aircraft that allows for a dynamic display, but the ability to pitch at 40g/sec as compared to the last fighter he flew (F/A-18 Classic Hornet) that could pitch at about 6g/sec.

British ace aerobatic pilot Mark Jefferies will return to Avalon and fly a series of sensational world-class displays. He will perform his signature manoeuvres, which include painting love hearts in the sky and 'out-of-control' tumbles in an Awesome Extra NG. Mark is recognised as one of the world's most accomplished aerobatic display pilots, ranked 3rd in the 2011 World Aerobatic Masters and 10 times British aerobatic champion (Advanced and Unlimited Class).

Paul Bennett will also be there with his 400hp Wolf Pitts Pro – the highest performing aerobatic biplane in the world. Paul promises a display filled with high energy, engine screaming precision aerobatics including forward rolls, torque rolls and double hammerheads. Fellow pilot Glenn Graham, flying an Edge 540, is planning "a dynamic, aggressive aerobatic display that is going to come right down to ground level", showcasing the aircraft's manoeuvrability, speed and 420-degree-per-second roll rate. His display incorporates a knife-edge spin, rapid rolling and gyroscopic manoeuvres that will put pilot and machine under as much as 10g and reach speeds of over 400kph.

For tickets and more information, see airshow.com.au

LEFT Paul Bennet Airshows at Airshow 2019. Photo: Mike Locke/Flickr.

BELOW The RAAF Roulettes PC-9 aircraft parked on the Avalon hardstand ready for their last performance at Airshow 2019. Photo: CPL Nicci Freeman.

BOTTOM Matt Hall's MXS. Photo: Masakatsu Ukon/Flickr.

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FIND OUT MORE

FROM METEORITES TO ROULETTES

LEFT The Meteorites.

OPPOSITE The Roulettes aerial display team perform at the Serpentine Air Show 2022. Photo: CPL Brenton Kwaterski.

BELOW The Marksmen.

BOTTOM The Ramjets.

A SHORT HISTORY OF THE RAAF'S AEROBATIC DISPLAY TEAMS.

THREE YEARS AFTER THE KOREAN WAR, in September 1956, the RAAF formed its first jet aerobatic team. Drawn from No.77 Squadron, the team was equipped with Gloster Meteor F8 jet aircraft, an aircraft that had served with distinction during the Korean War. Unsurprisingly, the team was named the Meteorites. The Meteorites flew 23 displays before disbandment when the Air Force commenced Sabre operations.

Several aerobatic teams flew Sabre aircraft during the 1960s: Black Diamonds from No.75 Squadron; Red Diamonds and Black Panthers from No.76 Squadron; and The Marksmen from No.2 Fighter Operational Conversion Unit. Each team flew four-aircraft formations.

At the same time, there were other aerobatic teams at large across the Air Force. The Red Sales team was formed at Central Flying School (CFS), RAAF Base East Sale flying Mk 35 de Havilland Vampire aircraft in late 1961. The team name reflected the red colour applied to the nose of CFS aircraft to enhance aircraft visibility during routine training operations. August 15, 1962 was a black day for the RAAF; six pilots in four aircraft from the Red Sales were lost when the formation hit the ground while training for Air Force week celebrations. They had performed a flypast on 14 June and then commenced work-up for their display routine, crashing on their fifth practice with a new team leader.

A second aerobatic team, the Telstars, was formed by CFS in February 1963. That team also flew Mk 35 Vampires for much of its existence, transferring to Macchi MB-326H aircraft in February 1968, shortly before disbanding in April that year due to an overall reduction in Air Force display flying. In 1970, the Roulettes aerobatic team was formed at CFS using Macchi aircraft.

The Mirage era saw only three aerobatic teams formed, each drawn from 77SQN. The Deltas was formed in November 1970 and disbanded in 1971 after the RAAF Golden Anniversary celebrations. The Miracles operated in 1976 and the Diamond Jubilee Display team flew in 1981.

Drawn from No.3 Squadron, the Purple Cobra aerobatic team flew in the 2008 Defence Force Air Show and was the only aerobatic team formed during the Hornet era, the Air Force preferring to demonstrate F/A-18 handling and performance capabilities in single aircraft displays.

NAVY TEAMS

The Royal Australian Navy (RAN) 724 Squadron (VC 724) formed an aerobatic display team in 1959, the Ramjets, flying de Havilland Sea Venom aircraft. It made the first film of jet formation aerobatic flying in Australia and was a popular attraction at air shows. The Checkmates was formed by the Fleet Air Arm in 1962, again flying Sea Venoms. The team was manned by 805 Squadron based at Naval Air Station (NAS) Nowra and comprised a four-aircraft display. Team members suffered a mid-air collision at the top of a loop when they briefly entered cloud over Sydney Harbour in 1962 during an air display for Navy Week. One pilot ejected successfully and landed in the harbour while the second damaged aircraft returned to NAS Nowra.

The Ramjets was reformed in 1969 by 724 Squadron for the Nowra Air Day that year with a TA4G Skyhawk (two-seat aircraft) lead and two A4G wingmen.

In 1972, the Checkmates team was reformed, this time from VF 805 Squadron at NAS Nowra flying four A4G Skyhawks.

LEFT The Purple Cobras.

BELOW The Roulettes flying Macchi aircraft in formation over Uluru at sunset, 7 June 1977.

VF 805 disbanded in 1982 and the fixed-wing component of the Fleet Air Arm was disbanded on 30 Jun 1984.

THE ROULETTES

Formed to celebrate the RAAF's 50th anniversary in 1971, the Roulettes, drawn from CFS, are the RAAF's formation aerobatic display team. They flew their first public display at Point Cook in December 1970 and have since flown hundreds of displays in Australia and Southeast Asia. Displays consist of several manoeuvres flown in various formations at low altitude. The Roulette presentation is an extension of formation, aerobatic, low-level flying, and airmanship skills, as taught to Air Force pilots and developed throughout their career.

Following on from the Telstars, the team flew the CAC Aermacchi MB-326H (Macchi) aircraft for 19 years before a change of RAAF pilot training aircraft shifted them to the Pilatus PC-9/A in 1989. Flying PC-9/A, they expanded to a six-aircraft, seven-member team completing two display seasons each year.

A further change of pilot training aircraft for the Air Force saw the PC-9/A retired from Roulette operations in March 2019, and replaced with the Pilatus PC-21 aircraft.

MB-326H MACCHI

The Roulettes first display in the Macchi comprised an eight-minute sequence of wingovers, loops and barrel rolls with formation changes such as Box, Tee, Line Astern, Square and Swan. Included in the sequence was a synchronised pairs cross-over, or Roulette manoeuvre, adopted as the teams signature feature.

From 1972-1973 The Roulettes performed mainly at RAAF bases with four-aircraft displays. During late 1973 to early 1974, the team occasionally added a fifth aircraft for a solo display to complement the four-aircraft formation. The display included synchronised manoeuvres between a solo aircraft and two formation pairs, as well as the main four-aircraft formation. The first public, five-aircraft display was performed at a RAAF Academy graduation parade at Point Cook in March 1974.

With five aircraft, the display was extended to 13 minutes and featured five-aircraft formations plus coordinated manoeuvres between the four-aircraft formation and the solo. Five-aircraft formations introduced in 1975 included Card 5, Big Vic, Rhombus, Kings Cross, Swan 5 and Leaders Benefit. The Roulettes toured Papua New Guinea in 1975 to celebrate the nation's independence celebrations. In June 1977, after flying halfway around Australia, the Roulettes attracted significant international attention by flying a five-aircraft Rhombus formation over Uluru – the first time such an event had occurred.

For the RAAF's Diamond Jubilee celebrations in 1981, the Roulettes expanded to a seven-aircraft formation and performed a 16-minute display. Seven-aircraft formations included Southern Cross Arrowhead, Hexagon Jubilee and the

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The Roulettes flying PC-9/A aircraft at the Australian International Airshow 2019.

display incorporated solo and synchronised manoeuvres including a 'thread the needle' manoeuvre that involved a head-on pass between the solo and the formation. After the Jubilee celebrations the team reverted to a five-aircraft formation and its next significant public presentation was at the Bicentennial Air Show at RAAF Base Richmond in October 1988.

Unfortunately, in the late 1980s the Macchi fleet developed unanticipated metal fatigue problems and Roulettes flying hours were reduced while a replacement aircraft type was sought.

The Swiss-designed PC-9/A was subsequently selected for RAAF pilot training and from January to June 1989, a pair of Macchis continued to present displays in Victoria and Queensland while CFS ground staff and pilots converted to the new aircraft. In June 1988, the Roulettes five-aircraft team presented their final display in Macchis at Lakes Entrance.

PC-9/A AIRCRAFT

Completing a work-up training program in October and November 1989, a five-aircraft debut display flying PC-9/A aircraft was conducted at East Sale in December and the first public display was in April 1990 at the Phillip Island Motorcycle Grand Prix.

The Roulettes were fully engaged in providing displays throughout 1991, in Western Australia, and at the RAAF 70th Anniversary Concert at Canberra in March. Later that year, the team celebrated its 20th anniversary.

TOP Telstars Mk 35 Vampire.

ABOVE Deltas A3-66 Mirage III.

In February and March 1992, the Roulettes ventured into the northern hemisphere with a series of displays at the sixth Asian Aerospace Airshow at the Changi International Exhibition and Conference Centre in Singapore.

The Roulettes deployed to the 1996 Indonesia Airshow to perform displays alongside several international display teams, including the RAF's Red Arrows. In addition to the Indonesian deployment the Roulettes displayed for the first time at Norfolk Island to commemorate Anzac Day.

For the RAAF's 75th anniversary in 1996, the Roulettes performed at more than 50 venues – a task that relied on a concerted effort by the team and all CFS staff.

MID-AIR COLLISIONS

On 15 December, 1983 Roulettes 2 and 3 suffered a head on mid-air collision during a practice routine at RAAF East Sale. Both pilots were killed.

Another mid-air collision in 1988 during a practice routine resulted in Roulette 4 ejecting while Roulette 1 performed a successful wheels-up landing. Unfortunately, it was the 1988 bicentennial year and the Roulettes did not perform again until August, cancelling most of the 25 planned events for the year.

In 2005, another mid-air collision occurred during practice, this time while flying PC-9/A aircraft. One pilot ejected safely and the other landed his aircraft, although it was badly damaged. In 2011, engine failure in a PC-9/A during training at RAAF Base East Sale resulted in the aircraft crashing. Both occupants ejected safely.

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LEFT The Roulettes flying Pilatus PC-21 at the Anzac Weekend Air Show 2022.

BELOW LEFT Roulettes PC-9/A A23-061.

BOTTOM Roulettes PC-21 A54-022 at RAAF Base East Sale during the belated celebration of the team's 50th anniversary. Photo: Richard Prideaux

PC-21 AIRCRAFT

The Pilatus PC-9/A retired from Roulettes operations in March 2019. It was replaced by Pilatus PC-21, one of the most advanced training aircraft in the world. It is ideally suited to a very wide training envelope and is used for both *ab initio* pilot training and bridging the performance gap between traditional turboprop trainers and lead-in fighter aircraft such as the British Aerospace Hawk-127. The PC-21 is capable of sustained low-level speeds in excess of 320 knots. Hydraulically assisted ailerons and roll spoilers enable fighter-like rates of roll in excess of 200 degrees per second.

The first Roulette display in the PC-21 was performed over Point Cook on 9 October 2019 with a five-aircraft formation.

DISPLAY ROUTINE

The Roulettes fly as low as 250 feet (80m) at speeds of up to 370 knots (685kph) and pilots can experience up to 6g, or 6 times the force of gravity. Flying as close as 3m between wing tips, the team showcases the level of visual judgement and hand-eye coordination that Air Force pilots achieve.

The type of display depends on the weather at the event location. The High Show is a 15-minute routine for clear conditions and the Low Show is a 12-minute routine for conditions of low cloud or poor visibility. The High Show is the primary display and includes 18 formation aerobatic manoeuvres down to a minimum altitude of 300ft - 500ft.

Roulette pilots are all qualified flying instructors posted to CFS to train line pilots in the art of flying instruction. They have previously completed instructional duties at either No.1 or No.2 Flying Training Schools and between Roulette duties they train experienced Air Force and Navy pilots to qualify as flying instructors.

There are seven Roulettes pilots at any given time and gaining appointment to the team is a rare distinction. Number seven serves as the commentator, ferry pilot for the spare aircraft and films each display for debriefing purposes.

The team is organised in 'seasons' lasting six months; most members serve on the team for three seasons before moving on to other duties. A new team member undergoes three months of intensive formation aerobatic training, starting with relatively simple manoeuvres (such as loops and rolls in echelon or line astern) performed at altitude, and progressing through more complex and demanding manoeuvres (such as corkscrews, ripple rolls and rollbacks), close formation line abreast aerobatics (which requires constant fine attention to power and trim settings), and eventually working up to the full six-aircraft display routines. Only when a routine is well-practised at altitude is it brought down in gradual steps to the minimum safe level of 500 feet (150m). First season pilots fly as Roulettes 2, 3 or 4, while the more experienced pilots fly as Roulettes 5 and 6. Roulette 1 is the team leader.

Each formation position is specialised and it would be impossible for a reserve pilot to be current for all the positions, so a display will be cancelled if a team pilot is unable to fly.

Since the formation of the Red Sales aerobatic team in 1961, CFS has provided display teams for the RAAF for over 60 years. Those teams have enthralled millions in audiences around Australia and for our near neighbours.

In doing so they demonstrate the professionalism of the RAAF and the high skill levels of Air Force pilots. Their displays motivate and encourage people to either join the Air Force or become involved in the aerospace industry.

After a prolonged absence during the COVID pandemic, The Roulettes were welcomed back by audiences around the country in 2022. They also held a belated 50-year anniversary celebration with Macchi, PC-9 and PC-21 pilots uniting at RAAF Base East Sale. The Roulettes stand out as a world-class aerobatic display team.

SOURCES: airforce.gov.au; Wikipedia; Exploroz forum; Ron Walpole; ADF Serials; aerobaticteams.net.

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SOVEREIGN MISSILE CAPABILITIES

RAAF F/A-18A/B HORNET CREWS GAINED A SIGNIFICANT AIR COMBAT EDGE WHEN DEFENCE ADOPTED THE THE ADVANCED SHORT RANGE AIR-TO-AIR MISSILE.

THE DECEMBER 2021 retirement of the RAAF's F/A-18A/B Hornet air superiority fighter ended a unique chapter in air-to-air warfare and Australian sovereign guided weapons capability that passed almost unnoticed.

Australia was unique in adopting the MBDA Advanced Short Range Air-to-Air Missile (ASRAAM) as the primary air dominance weapon carried by RAAF's F/A-18A/B Hornet aircraft. Designed by the UK to replace the AIM-9 Sidewinder, ASRAAM was selected by Australia in 1998 ahead of Sidewinder to arm its fighter force. Important selection criteria were ASRAAM's superior operational performance and the opportunity to participate in missile development, work that far exceeded that offered by the United States.

RAAF pilots thus benefitted from a complete appreciation of the missile function and performance and access to a weapon that Australian experts were able to study, modify and upgrade to ensure it could outperform evolving threats.

ASRAAM marked a step-change in the "within visual range" missile engagement envelope that gave RAAF F/A-18 crews a significant air combat edge over their US Navy and US Marine Corps compatriots.

The first air combat missile to feature an imaging infrared seeker, ASRAAM paired it with a 6.5 inch diameter rocket motor that provided over 70 percent greater thrust than the 5 inch rocket motor of the Sidewinder. Those features combined to ensure that if the pilot could see an adversary, ASRAAM could engage and kill before the threat was within the shoot envelope with their slower, shorter-range missiles. The missile's aerodynamically unstable design, combined with extreme thrust and high-off boresight seeker performance enabled the RAAF to develop highly aggressive employment tactics – as was later demonstrated in a world-first engagement of a target manoeuvring behind the launching F/A-18.

Thanks to a governmental memorandum of understanding signed between Australia and the UK, the Australian Department of Defence, Defence Science & Technology Group (DSTG, formerly Defence Science and Technology Office) effectively gained complete access to ASRAAM. Ordered in 2002, ASRAAM integration tests were begun at China Lake in the US, before moving to Australia and completion with support from the Aircraft Research and Development Unit, ahead of entering service with the RAAF in July 2004.

Integration wasn't without challenges. As the missile was carried on a wingtip station, flex of the outer wing panel under manoeuvre load had the potential to degrade seeker acquisition performance. After extensive test and evaluation, the issue was jointly solved through modification of the missile launch software to remove potential acquisition errors even under the high-g loads of a dogfight.

Following integration, Australia exploited its access to ASRAAM to conduct two main strands of sovereign guided weapons work. Firstly, to provide unique levels of in-service support, Deep Maintenance facilities were established; initially at Edinburgh Parks in South Australia then at Defence Establishment Orchard Hills, NSW. Those facilities conducted complete

ASRAAM overview.
Photo: Lockheed Martin

LEFT ASRAAM on a F/A-18A/C Hornet.
Photo: Department of Defence.

disassembly and in-country maintenance all the way down to sub-system repair, replacement and test. With retirement of the Classic Hornet, the Australian support capability has also been wound down. The final ASRAAM will be disassembled and disposed in November this year.

The second element was known as the ASRAAM Australian Software Support Capability, based at Edinburgh Parks. That facility enabled DSTG to undertake research to ensure ASRAAM remained capable against evolving threats. Hardware in-the-loop (HWIL) facilities and airborne ASRAAM seeker pods enabled the practical test of ASRAAM seeker performance against new-generation infrared countermeasures. New algorithms were developed and tested at the Port Wakefield Proof and Experimental Establishment using the Reusable Aerodynamic Flare Ejection Capability, a DSTG designed and operated test facility to evaluate infrared measures, to deploy countermeasures at speeds representative of fighter combat engagements.

DSTG algorithms subsequently incorporated into several new missile software loads developed jointly by the UK and Australia resulted in substantial improvements in weapon performance. Working on the advanced ASRAAM imaging infrared seeker also drove major enhancements to DSTG's own capabilities in electro-optical sensors, seeker function, HWIL and algorithm development.

Co-operation on ASRAAM led to a world first in 2009, when RAAF's Air Combat Group (ACG) successfully carried out the first in-service 'lock after launch' firing of an ASRAAM at a target manoeuvring behind the wing-line of the 'shooter' aircraft. The engagement simulated a 'chase down' situation with a hostile fighter pursuing a RAAF F/A-18 and successfully demonstrated that ASRAAM could provide all-round self-protection well beyond the limit engagement arcs of previous air-to-air missiles. At the time, an ACG spokesperson said the demonstration of ASRAAM capability was a major step forward for the RAAF and "greatly increases the lethality of ACG's F/A-18 fleet".

With Australia now pursuing the development of sovereign missile capabilities through the Guided Weapons and Explosive Ordnance Enterprise, ASRAAM in RAAF service demonstrated what Australian experts can achieve when engaged in an innovative and co-operative enterprise.

B-2 SPIRIT

WINGS VOLUME 74 NO.4

A B-2 Spirit from the 509th Bomb Wing at Whiteman Air Force Base, US, soars over the Pacific Ocean.
Photo: Staff Sgt. Bennie J. Davis III/ US Air Force.

AHEAD OF THE PACK

TWO DEFENCE INDUSTRY HEAVYWEIGHTS ARE LEADING THE FIELD TO BECOME THE PRIME CONTRACTOR FOR THE ADF'S FIFTH-GENERATION JOINT AIR BATTLE MANAGEMENT SYSTEM, WRITES **DR GREGOR FERGUSON**.

IMAGINE THE LAST couple of furlongs at Flemington – two horses, neck and neck, with the rest of the field far behind. That's roughly where we are with the Australian Defence Force's Project AIR6500 – Joint Air Battle Management System.

The two contenders, Lockheed Martin Australia (LMA) and Northrop Grumman Australia (NGA), have submitted their tenders for the clumsily named AIR6500 Phase 1 Joint Air Battle Management System (JABMS), Competitive Evaluation Process (CEP) Stage 2. A final choice of prime contractor is due in 2023 with a contract due by the end of that year. The 2020 Force Structure Plan states its value lies between $1.8 and $2.8 billion with most estimates at the top of that range.

The JABMS will be a sovereign, fifth-generation deployable command and control (C2) system forming the core of an overarching ADF Integrated Air and Missile Defence (IAMD) capability. The need for an IAMD is undisputed: the hypersonic speed and range of the weapons expected to arm potential adversaries poses a significant threat to ADF assets, while such weapons could also be used to attack critical civilian infrastructure and, most distressingly, civilian populations.

The AIR6500 Phase 1 CEP is all about risk reduction and demonstrating the contenders can be a strategic partner of the ADF (though the system will be acquired and managed by the RAAF) and provide an architecture into which legacy sensors and effectors, and other elements to be acquired in the future, can be integrated.

JABMS will be delivered in two tranches. Tranche 1 is already underway: Defence has ordered four Active Electronically Scanned Array sensors from Canberra-based CEA Technologies to replace the existing AN/TPS-77 Tactical Air Defence Radar System. The new sensors, closely related to those equipping the Royal Australian Navy (RAN) Anzac-class frigates, will be able to detect aircraft and missile threats at greater ranges and with increased accuracy to deliver real-

ABOVE Part of LMA's Air Battle Management System proposal. Photo: LM.

OPPOSITE PAGE AIR6500 will connect assets across air, land, sea, cyber and space for enhanced defence against potential threats to national security. Photo: LM

time critical information providing more warning, decision and response time.

Tranche 2 will deliver the remaining JABMS elements and may include additional sensors, says Defence.

JABMS will provide deployed ADF forces with much greater situational awareness and protection in the face of advanced air and missile threats, along with increased levels of interoperability with Australia's coalition partners.

The JABMS will need to integrate some 40 legacy systems, including the Jindalee Operational Radar Network (JORN), the Boeing E-7A Wedgetail, the AN/TPS-77, its successor, CEA's CEAFAR Land, and a host of other air surveillance and response capabilities, both ground-based and airborne.

In the C2 domain, the RAAF seeks automation, decision aids, air battle management, mission-planning and electronic-warfare capabilities, all to be protected by a multi-level and cross-domain cyber security system.

The JABMS requires high-resolution, coherent data fusion, from multiple sources ranging from JORN, ship, aircraft and orbital sensors and rapid, high-fidelity data analytics, meaning lots of artificial intelligence (AI). And it needs secure communications to create a network of tactical datalinks, internet protocol communications and robust tactical communications connecting sensors and effectors. It also needs comprehensive training and simulation capabilities. The composite capability needs to be tested and verified and then updated constantly within a robust test and evaluation (T&E) framework as new technologies and resources come into service.

The CEP has been noteworthy for the level of cooperation contenders have had with the Commonwealth and that marks an important evolution in the way Defence manages software-heavy projects. In the past the contracting or technical models were occasionally deficient, but Defence has become a great deal more sophisticated in the way it acquires complex software systems.

LEFT A RAAF AN/TPS-77 Tactical Air Defence Radar System at Old Bar airfield, NSW, during Exercise Diamond Shield 2022. Photo: LAC Samuel Miller.

NORTHROP GRUMMAN BID

NGA was first to announce it had submitted its response to the AIR6500 CEP.

The company's solution is designed to connect disparate Defence systems and platforms across all domains into a cohesive, integrated operational environment and synchronise air and missile defence operations, improve situational awareness and enhance the speed of decision-making.

The speed and range of incoming missiles in the future mean situations and threats will emerge and evolve much faster than the human brain can assimilate, especially in saturation attacks. It will take an AI-based system to sort incoming threats and trigger an appropriate response – and that's partly the job of Melbourne-based AOS Pty Ltd, which is part of NGA's team, along with 20 other Australian companies including T&E specialist Nova Systems, with whom NGA has formally teamed, and Silentium and Daronmont Technologies, both offering passive radar expertise.

Nova Systems will undertake T&E, verification and validation, certification and assurance and, with NGA, develop the T&E and governance framework to manage the project's undeniable risk and manage future evolution and development of JABMS.

NGA's JABMS solution draws on the C2 expertise and experience its parent developed on the US Army's Integrated Battle Command System (IBCS), says former RAAF officer Terry Saunder, who is now the company's AIR6500 Capture Director. The IBCS core is the basis of JABMS which uses the IBCS open, modular and scalable architecture and flexible interfaces to integrate all available assets in the battlespace, regardless of source, service or domain.

Being a technology company, NGA has invested in its research and development (R&D) capabilities. Two years ago, it established the Australian nodes for its Parallax Laboratory in Australia. Parallax Laboratory is more a technical

AIR 6500 SUPPLY CHAINS

NORTHROP GRUMMAN

AOS Group
Daronmont Technologies
Nova Systems
Silentium Defence

LOCKHEED MARTIN AUSTRALIA

Leidos Australia
Qinetiq Australia
C4i
Consilium Technology
Consunet (secure software)
Daronmont Technologies
Lucid Consulting
Penten (cyber security)
Shoal Group
Silentium Defence (passive radar)
Ultra Electronics Australia

development environment than a physical space, but if NGA wins the AIR6500 prime contract it plans to establish a permanent AIR6500 R&D and integration centre in Australia.

Earlier this year, the company announced it had successfully demonstrated its sovereign JABMS solution for Defence's AIR6500 Program Office. The demonstration validated NGA's agile development approach and flexibility and therefore the company's ability to rapidly integrate Australian sovereign capabilities into the JABMS solution. That flexibility makes it possible to both integrate new sovereign capabilities as they become available and relevant, and evolve JABMS as technologies and threats change in the future.

NGA's JABMS solution includes AOS's C-BDI distributed AI system, to accelerate decision-making and threat response. C-BDI is AOS's fourth generation of intelligent software agent platforms, incorporating the ability to deploy teams of intelligent agents – realising the potential for human/agent teaming. C-BDI underlies nine intelligent agent-based decision support tools that will help AOS to automate the JABMS region-wide surveillance and response system.

In one, the Intelligent Battlespace Advisor (IBA), AOS will assign an individual intelligent agent to each aerial track detected by JABMS sensors, ranging from networked primary radar, passive radar, electronic support measures sensors and JORN, through to data on civilian aircraft provided by Airservices Australia and other aeronautical service providers in Asia. That will enable JABMS to simultaneously monitor many hundreds of tracks, most of them civil aircraft; and if any of those tracks acts in an anomalous way, IBA will automatically warn the operator. Importantly, says AOS founder Dr Andrew Lucas, "Unlike pattern-of-life approaches, IBA keeps 'false positives' at a minimum and can provide an explanation for its reasoning, so operators develop real trust in the system – that's essential for acceptance of autonomous systems."

LOCKHEED MARTIN BID

LMA has been positioning itself for seven years, according to its AIR6500 Program Executive Steve Froelich. There was nothing available on the shelf then or now which can meet the ADF's needs, he says. LMA has signed two key AIR6500

ABOVE JORN project receiver site antenna array, Laverton, WA. Photo: CPL Dave Broos/ Department of Defence.

LEFT LMA STELaRLab. Photo: LM.

Sov·er·eign·ty

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*Figure for FY21/22

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teaming agreements, with Canberra-based QinetiQ Australia and Leidos. QinetiQ will be responsible for T&E, verification and validation, certification and assurance services and will work with LMA to develop the T&E and governance framework to reduce risk in the development and delivery of the JABMS.

The belief at LMA is that its expertise in building, integrating and sustaining advanced technology systems across complex, joint all-domain platforms, combined with QinetiQ Australia's expertise in integrated air and missile defence test, evaluation, certification and systems assurance, makes the LMA team the trusted partner of choice.

Much of the AIR6500 solution will be software; both Leidos and Qinetiq understand Lockheed Martin's agile software development process; the former will help develop the software architecture and the code itself while QinetiQ Australia will be an objective and rigorous T&E contractor.

With nothing available off the shelf, LMA had the freedom to explore Australia's crop of smart small-medium enterprises and build a sovereign supply chain from scratch that sits close to the leading edge of sensor and C2 capability. It has examined more than 130 potential suppliers and named eight sub-contractors, including Penten, a cyber security specialist; Consilium Technology, whose AI is intended to relieve the operator from transactional tasks to focus on higher level system monitoring and situational awareness; Silentium and Daronmont passive radar exponents, both also selected by by NGA; secure software developer Consunet; C4i; Ultra; Lucid Consulting Engineering; and Shoal Group.

LMA has also invited the two non-shortlisted companies from Stage 1 of the CEP, Boeing Australia and Raytheon Australia, to contribute to its team, says Kendell Kuczma, the company's International Business Development Director of Rotary and Mission Systems.

The LMA project team for AIR6500 Phase 1 is headquartered in Adelaide, where the company already has significant software and architectural development capabilities, including the team developing the AN/BYG 1 submarine combat system for the RAN's now-cancelled Attack-class submarines. In Adelaide, it is developing a slightly modified version of the Aegis air warfare system for the RAN's Hunter-class frigates and it is also the home of LMA's JORN team.

ABOVE A RAAF E-7A Wedgetail aircraft taxis prior to departure from RAAF Base Darwin. Photo: LAC Sam Price.

Supporting all of that is the company's long-term investment in R&D. In 2010 it established the STELaRLAB in Melbourne, the company's first non-US multi-disciplinary R&D centre. That was followed by a strategic investment in the University of Adelaide's Australian Institute of Machine Learning.

The next strategic investment was LMA's Endeavour Centre in Canberra, established in 2018 and not dissimilar to Lockheed Martin's Lighthouse integration and demonstration centre in the USA. The Endeavour Centre is set up to provide both customer demonstrations and to undertake operational analysis.

The third major investment was announced in October – a $74 million national IAMD ecosystem, at a location yet to be disclosed, that's intended to develop a sovereign capability and position Australia as a key global player in IAMD systems. The National IAMD Centre will serve as the physical hub of the ecosystem, and as an R&D pipeline that will facilitate sovereign innovation. The ecosystem will include a combination of infrastructure and collaboration tools that help solve problems and field capability faster, says Steve Froelich, offering among other things a setting where the ADF can 'try before it buys' new capabilities. Importantly, say both Froelich and Kuczma, that investment will go ahead whether or not LMA wins the AIR6500 bid.

If the company wins AIR6500 the aim is to export the JABMS capability, says Froelich. Obviously, it would be impossible to provide a conveniently packaged solution for some other customer's sovereign needs (and Australia's own sovereign capabilities need to be protected). But LMA will be adding to an existing in-house capability and providing a pathway to export for Australian members of its supply chain as well. "There are lots of opportunities for Lockheed Martin in Australia," Froelich says.

Regardless of who is selected to lead the development of JABMS, the ADF will get a good solution that will underline its international leadership. Conceptually, the ADF is ahead of many of its peers around the world: it's increasingly a joint force with few artificial demarcation lines. That is where other allied defence forces want to go, and Australia is showing the way, both in how it's organised and how it is setting out to equip itself.

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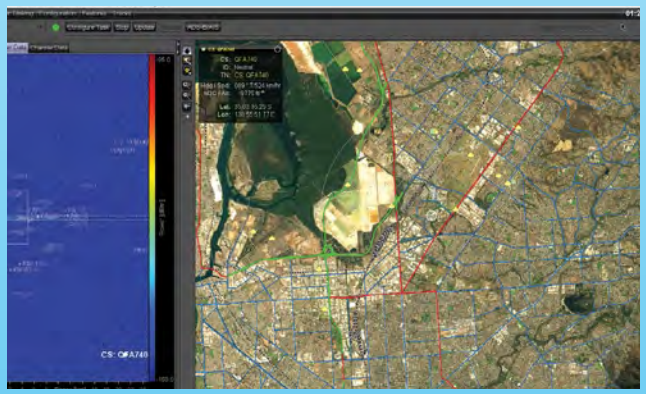

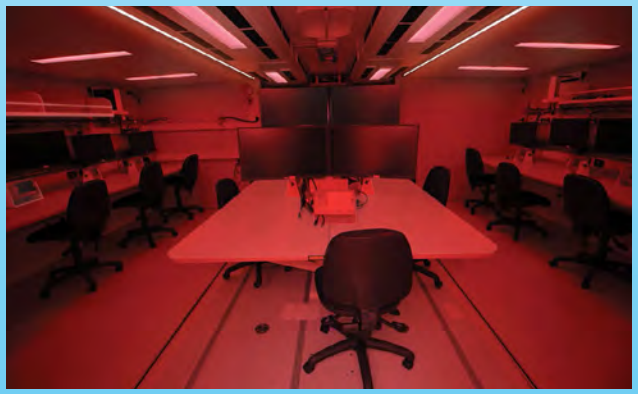

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PERFECT PITCH

MORE THAN 2,500 PERSONNEL AND 100 AIRCRAFT FROM 17 COUNTRIES CONVERGED ON RAAF BASES DARWIN AND TINDAL FOR EXERCISE PITCH BLACK 2022.

ABOVE Mitsubishi F-2 aircraft from the Japan Air Self-Defense Force takes off from RAAF Base Darwin during Exercise Pitch Black 2022.

EXERCISE PITCH BLACK, a biennial, three-week multinational large-force employment exercise is the RAAF's most significant international engagement activity.

Pitch Black 2022 (PB22) exercised forces from a wide range of partner and allied nations to develop and enhance interoperability and military relationships at all levels. Pitch Black is conducted primarily from RAAF Bases Darwin and Tindal. RAAF Base Amberley, near Ipswich in Queensland, was included in the order of battle for PB22.

Pitch Black features a range of realistic, simulated threats found in a modern battle-space environment and is an opportunity to test and improve force integration and application, using one of the largest training airspace areas in the world, Bradshaw Field Training Area and Delamere Air Weapons Range.

Exercise Pitch Black began in 1981 and was initially limited to Australian participation. In1983, the US became the first international participant. Since then, the exercise has expanded steadily and PB22 hosted 2,500 personnel and 100 aircraft from 17 countries: Australia, France, Germany, Indonesia, India, Singapore, Japan, Republic of Korea, UK, the Philippines, Thailand, UAE, Canada, Netherlands, Malaysia, New Zealand and the US. Germany, Japan, and the Republic of Korea participated for the first time.

Control for the exercise was provided from the ground by No.114 Mobile Control and Reporting Unit and RAAF E-7A Wedgetail and Republic of Singapore Air Force Gulfstream 550 airborne early warning aircraft.

PB22 was so successful that before it concluded, the German Luftwaffe indicated its intention to participate again in 2024 and the Philippines' Department of National Defence announced it would participate with a deployment of KAI KA-50 fighters.

PB22 continued the tradition of providing a flypast and handling display at Darwin's Mindil Beach and an open day at RAAF Base Darwin. Thousands attended the open day to inspect military equipment such as the MV-22B Osprey tiltrotor and an Indian Air Force Sukoi SU-30MKI Flanker fighter. Also on display was equipment used by the rotational US Marine Corps contingent, along with armoured vehicles, bomb-defusing robots, border-patrol boats and fighter aircraft from the USAF and European allies.

SAMURAIS OVER THE TERRITORY

For the first time since World War II, the skies over the NT echoed to the sound of Japanese fighter aircraft as No.3 Squadron Japan Air Self Defence Force (JASDF) joined in PB22. No.3 Squadron deployed five Mitsubishi F-2A fighters and about 100 personnel to Darwin in a show of solidarity with regional partners and allies. Painted in the JASDF's distinctive blue maritime camouflage scheme, the F-2As bear the emblem of a Samurai warrior on their fin.

Although JASDF fighter aircraft regularly deploy to Guam and Alaska to exercise with US forces in the Pacific, and RAAF combat aircraft have deployed to Japan for the Bushido Guardian series of exercises, it was the first time the JSDF has participated in Pitch Black. The scale of the multi-lateral exercise was novel for the F-2A pilots. It was the first time JSDF aircrew had participated in a large force exercise at night as there are limited

ABOVE Two US Marine Corps F-35B Lightning II aircraft fly over the NT. Photo: LACW Emma Schwenke.

opportunities to do so in Japan and fighting with more than 30 or 40 aircraft is rare.

To prepare for Japan's deployment, a RAAF KC-30A multi-role tanker transport aircraft visited Japan to qualify the F-2As for air-to-air refuelling.

INTERNATIONAL AIR FORCES

For its Pitch Black debut, the Republic of Korea Air Force participated with eight Lockheed Martin KF-16 Fighting Falcons from the 20th and 38th Fighter Groups based at Seosan and Gunsan, respectively.

The Royal Air Force (RAF) No.6 Squadron deployed 100 airmen and four Typhoons from RAF Lossiemouth, Scotland, which, together with a RAF Voyager tanker aircraft, participated in Pitch Black for the first time.

The RAF Typhoons conducted fighter integration training with other nations' forces to enhance interoperability, before beginning more complex and collaborative training, while Voyager tankers refuelled fast jets from various participating countries.

ABOVE Aircraft from the RAAF and US Marine Corps participate in an elephant walk on the RAAF Base Tindal flight line. Photo: LACW Annika Smit.

Republic of Korea Air Force KF-16U Fighting Falcon and RAAF F-35A Lightning II aircraft conduct a flight together. Photo: Republic of Korea Air Force.


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The complexity of PB22 provided the planning staff at 11 Group and personnel at various embassies and high commissions the opportunity to demonstrate the RAF's ability to project and deliver combat power in the Indo Pacific.

Following completion of PB22, the RAF contingent returned to the UK via India to conduct bilateral training with the Indian Air Force.

The Indian Air Force (IAF) deployed four Sukhoi-30 MKI and two C-17 strategic transport aircraft, and more than 100 support personnel to PB22. The IAF first participated in a Pitch Black exercise in 2018.

France deployed three Rafale fighters, a multirole A-330 tanker and a New Caledonia-based CASA CN-235 twin-engine transport plane along with spare parts and maintainers for a 60-day mission to PB22.

NATO members sent 13 Typhoon and Rafale fighters, seven tankers or transport aircraft and more than 350 airmen, demonstrating they are ready and able to work with allies and partners anywhere in the world, despite pressures of the Russian invasion of Ukraine.

Long-time participant, the Republic of Singapore Air Force (RSAF) deployed over 400 personnel, eight F-15SG Eagle and eight F-16D Fighting Falcon fighter aircraft, one Gulfstream 550 Airborne Early Warning aircraft and an A330 Multi-Role Tanker Transport (A330 MRTT) aircraft to PB22.

ABOVE Crowds at RAAF Base Darwin during Exercise Pitch Black 2022 Open Day. Photo: CPL Kieren Whiteley.

ABOVE From back, USAF F-22 Raptor flown by Gen. Wilsbach, Eurofighter flown by Lt. Gen. Ingo Gerhartz, and RAAF EA-18G flown by Air Marshal Chipman. Photo: SMSgt Christian Timmig, HQ Luftwaffe.

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US RAPTORS

USAF Raptors from Joint Base Pearl Harbor-Hickam, Hawaii, supported a "dynamic force employment" exercise with the RAAF. Dynamic force employment, a concept laid out in the 2018 National Defence Strategy, commits a major combat force into a fight while retaining options to counter emerging threats while acting strategically predictable but operationally unpredictable.

In a demonstration of friendship and cooperative leadership, USAF Gen. Ken Wilsbach, Commander Pacific Air Forces, RAAF Chief, Air Marshal Rob Chipman and German Air Force Air Chief Lt. Gen. Ingo Gerhartz flew in formation. Wilsbach flew a USAF F-22 Raptor, Gerhartz a Eurofighter, and Chipman a RAAF EA-18G Growler.

The air chiefs noted that allies and partners are an asymmetric advantage when it comes to long-term competition with adversaries that seek to undermine our shared values and international norms.

AIR-TO-AIR REFUELLING

For the 2022 exercise, a significant effort was made to advance the air-to-air refuelling (AAR) capability of participating nations. Seven Airbus A330 multi-role tanker transports, including two RAAF KC-30As participating with two US Marine Corps KC-130J Hercules tankers, enabled large forces of combat aircraft to range and engage in prolonged battle each day.

The RSAF A330 MRTT, on its inaugural deployment to Australia, also conducted air-to-air refuelling operations with participating nations' fighter aircraft to help accomplish the PB22 large-scale air combat training objective.

Sources: RAAF; Australian Defence Magazine; Defence News; Stars and Stripes; AviationPros; Air Force Technology; Indian Express; Singapore Ministry of Defence.

ABOVE Three USAF F-22 Raptors arrive at RAAF Base Tindal. Photo: LACW Annika Smit.

BELOW French Air and Space Force multi-role tanker transport from the 31st Strategic Air Supply and Transport Wing refuels a Republic of Singapore F-16D Fighting Falcon as part of PB22. Photo: Julien Fechter

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MISSION: SUSTAINABILITY

SCHOOL STUDENTS SHOW THEY ARE READY TO WORK IN SPACE.

SUSTAINABLE FOOD PRODUCTION, construction and development are at the forefront of today's social, community and business objectives. However, sustainability on Earth is one thing, sustainability in space is an altogether different proposition.

An international celebration of science and technology, World Space Week 2022 focused on space and sustainability. The week was "dedicated to raising awareness both on how space benefits society and contributes to sustainable development on Earth, and on the challenges ahead to keep space activities and the space environment safe and sustainable".

Chris Boshuizen was the ambassador for World Space Week. He has had an expansive space career, including working with NASA Ames Research Center. Recently he made world news with his trip into space with Blue Origin and a special passenger, the original Captain James T Kirk, William Shatner. Chris is an advocate of space exploration and utilisation and is keen to create or support any project that facilitates that process.

During the planning of a recent Women in Space event, hosted by One Giant Leap (OGL) Australia and Optus, Chris and OGL Australia Managing Director Jackie Carpenter discussed ways they could inspire young people to not only think about sustainability in space, but to actively participate in problem solving. They came up with a simple competition for school students using the design thinking process.

Collaborating with Moonshot and RMIT Space Industry Hub, they launched Mission: Sustainability. Students were invited to design a sustainable space station and were given five basic requirements for a habitable station: air, water, food, power and a toilet.

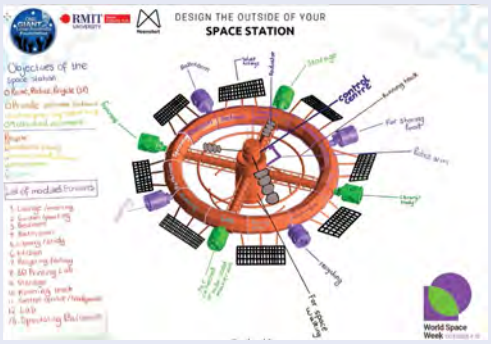
Eleven designs were selected to be presented on the OGL website and the space architects were asked to make a two-minute video explaining the finer details of their sustainable space station.

For today's young people working in or adjacent to space industries is a tangible possibility, and the entries from across Australia reflected the young designers' perception of living in space as a natural extension of living on Earth. The designs demonstrated their depth of understanding about space. They considered the practicalities of air circulation, gravity, food, energy and safety on board.

Jackie says the designs and videos show imagination, innovation and diverse thinking. "It is a good beginning for a long-term project that will give voice to young Australian space architects. Maybe one day their design will be in space," she says.

On his website, Chris says: "My goal is to make space travel as easy as catching a bus". His dream appears to be achievable. While the idea of living in space was once the stuff of science fiction, for the past 20 years the International Space Station has been orbiting the Earth every 90 minutes at a speed of 28,000kph, with teams of mission specialists on board conducting all sorts of experimentation.

View the successful designs and videos at onegiantleapfoundation.com.au/mission-sustainability



ABOVE Space station design by Charlotte, 8-11 age group.

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ALL ORBITS, ALL PLANETS

GILMORE SPACE TECHNOLOGIES IS ON TARGET FOR AUSTRALIA'S FIRST COMMERCIAL ORBITAL ROCKET LAUNCH.

GILMOUR SPACE TECHNOLOGIES has a simple motto, All Orbits, All Planets, which sums up where the venture-capital-backed organisation is heading.

CEO Adam Gilmour is aiming high to develop reliable, low-cost low earth orbit (LEO) rockets by taking an innovative approach to design and manufacture, linked to a rigorous test program.

Development of their pioneering orbital hybrid rockets will meet the demand for increased satellite launch capacity and will contribute to alleviating a crowded launch market.

Gilmore's realisation that a rocket-based business would be achievable goes back to 2004 with the announcement of the XPrize, a bold initiative by a major donor group to entice companies to privately finance the production of a spaceship. On offer was a prize of US$10 million for an organisation to design and build a spacecraft capable of carrying three people to 100km above the Earth's surface and to repeat that exercise within two weeks.

Scaled Composites, funded by Mojave Aerospace Ventures, scooped the US$10 million prize with its spaceplane *Tier One*. The technology was licensed by Richard Branson, leading to the formation of Virgin Galactic. That development opened the door for private industry to be involved in a multi-billion-dollar industry.

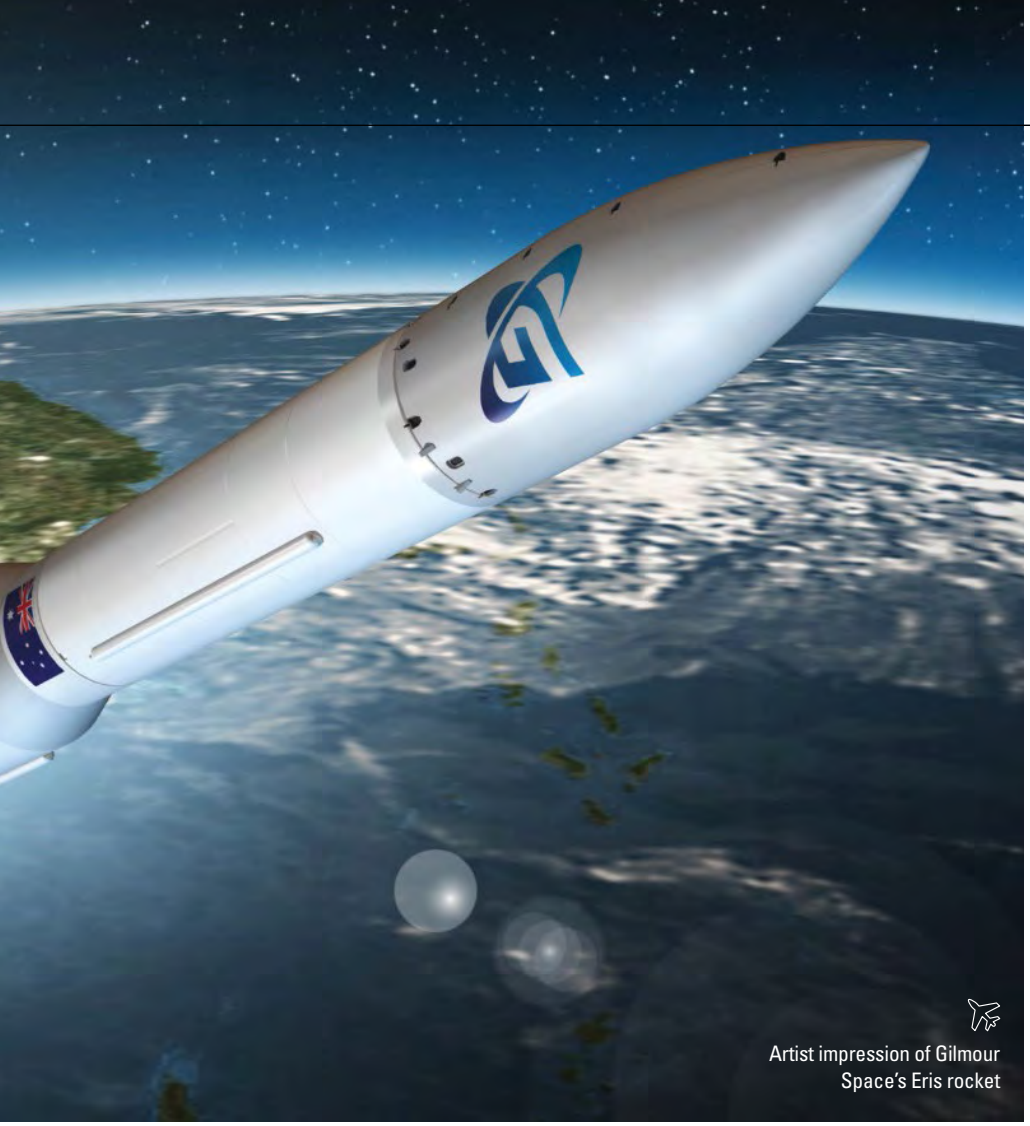
The XPrize competition inspired Gilmour to start a space company with his brother James in 2013, initially to build high-fidelity flight simulators for a spaceflight academy on the Gold Coast. In 2015, after years of research and development into new rocket fuels, the brothers set out on a hybrid propulsion program to provide easier and more affordable access to space for commercial organisations.

Gilmour Space's technology advancements put the Queensland company at the forefront of hybrid rocket development, and it attracted its first venture capital investors two years later.

A HYBRID SOLUTION

Currently, there are more satellites to launch than rockets available and with the small-satellite revolution literally taking off, thousands more launches are planned. The bottleneck in capacity both with the number of available rockets and the cost of establishing a launch site is not likely to ease without the introduction of new technology. Using large rockets to launch light payloads is expensive and a bespoke launch plan for small customers is not always possible.

Gilmour's solution-led hybrid rockets will offer small satellite users a launch option



Artist impression of Gilmour Space's Eris rocket

Adam Gilmore.

that can take them directly to their required orbits when they need it. In addition to dedicated launches, users can opt for rideshare, reducing the cost further.

Satellites have a vital role to play in our lives and they can help us to understand what is happening on Earth. Crop surveillance, land use, pollution, sea levels, autonomous vehicles, bushfire mapping and improving communication systems are just some of the uses of space technology that enable us to make more informed decisions. According to Global Market Estimates, the LEO market up to 500kg payload is forecast to nearly double by 2027 from the current US$9.8 billion.

Building up a 180-strong workforce with staff portraying the same Gilmour zeal and ideology has not been without its challenges. However, the recruitment and training policy adopted has enabled engineers and technicians from industries such as mining, automotive and aerospace to be successfully integrated into the company's structure.

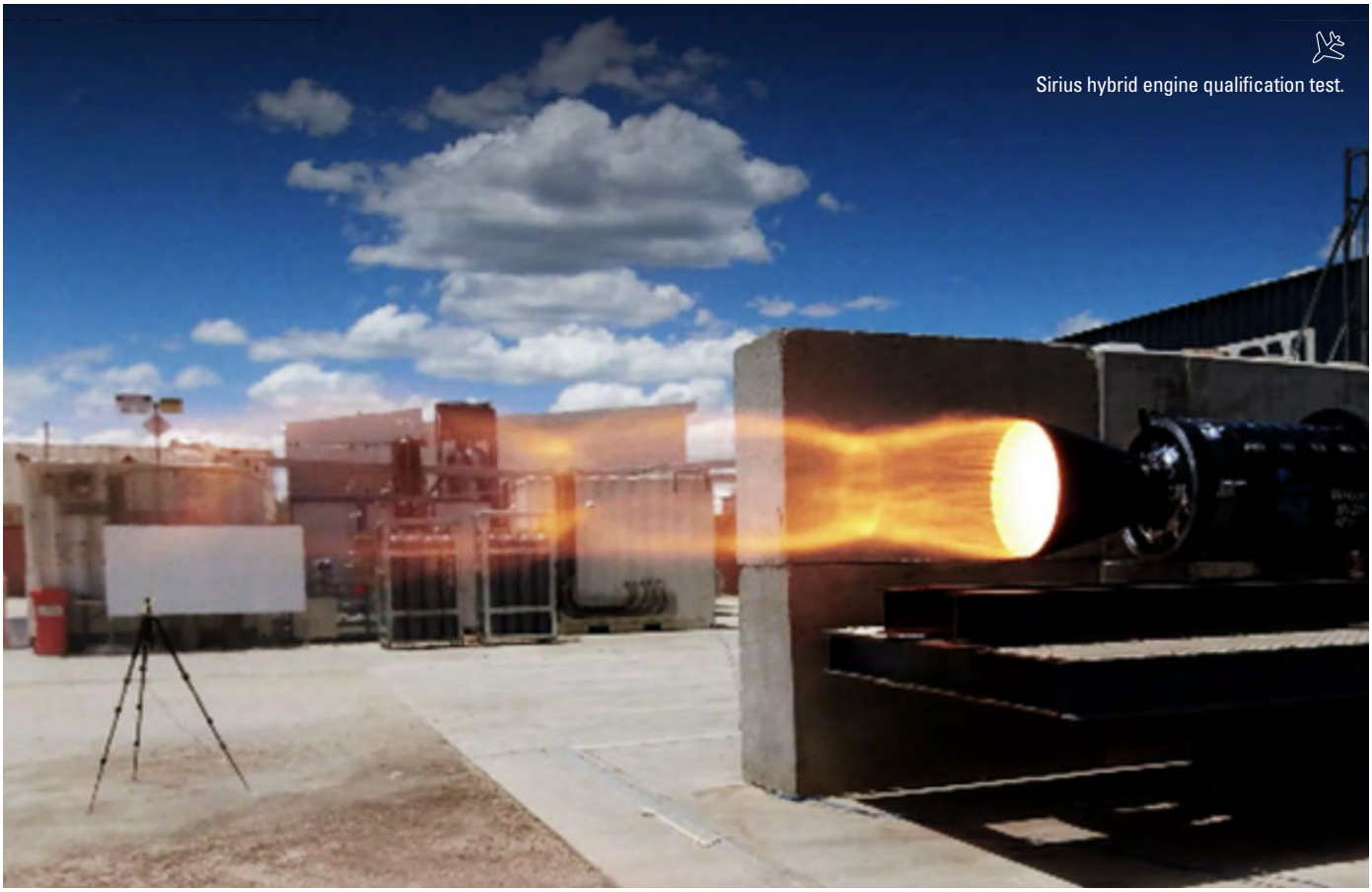
Gilmour also has initiatives with Australian universities and has been recruiting graduate engineers since 2015. Many of them now have seven years of experience from on-the-job specialist training. "Graduates learn fast and after 12 months are working on major subsystems of the rocket or satellite," says Gilmour.

ERIS ORBITAL ROCKET

"Hybrid motor development within Gilmour Space was driven by several factors, not least the relative cost, complexity and capability of their hybrid technologies to be scaled up in performance," Gilmore says. "A large-scale liquid-based rocket propulsion program would have required considerably more investment and development time."

It follows one of the company's key objectives, which is to reduce the high cost per kilogram of payload launched and thus open the space market for commercial users.

Gilmour's orbital rocket, Eris, is a three-stage rocket, capable of carrying payloads of up to 350kg to an altitude of 500km. Developing a 25m high rocket is a complex business that involves the full spectrum of design, prototype, test, manufacture and vehicle assembly. The process is ongoing as improvements are constantly sought in the quest to provide a reliable and affordable Australian launch service to global customers.



Sirius hybrid engine qualification test.

Eris uses hydrogen peroxide as its liquid oxidiser and a solid fuel produced to Gilmore Space Technology specification. Both oxidiser and fuel can be stored at room temperature making them easy to transport and safe to use. That is a significant cost advantage over liquid-based rockets where the propellants must be stored in cryotanks at very low temperatures.

The first Eris rocket is being built at Gilmour's Gold Coast facility and has already achieved an impressive 110 kilonewtons of thrust. Launch is scheduled for the first half of 2023 at the Bowen Orbital Spaceport in Northern Queensland. That will be followed by the production of an Eris Block 2 rocket, which will be capable of carrying payloads of up to 1000kg.

PARTNERSHIPS

Eris is uniquely Australian made. Most of the vehicle is built by Gilmour Space including the motor, structure, avionics and software. The company also works with local suppliers and technology partners to co-develop some of its systems and structures.

Gilmour's rapid rise to prominence in the space industry has attracted several Australian and international partners on projects such as an autonomous flight termination system, lightweight composite tanks, and a prototype G-class satellite for commercial and defence use, to name a few.

A significant partnership recently announced is the Australian Space Manufacturing Network (ASMN), which will support significant space development in Australia,.

Headed up by Gilmour Space Technologies with more than 30 members, a key aim of the project is to create an environment where space technology development can flourish, through:

- The availability of a common test and manufacturing facility that provides access to commonly used manufacturing equipment.
- An advanced manufacturing facility for building commercial rockets and satellites.
- An orbital spaceport that will launch space products to market.

THE FUTURE

Gilmour is in the ideal position to maximise commercial space transportation opportunities. It is currently seeking more factory space on the Gold Coast in line with planned expansion. A longer-term objective to send Australian astronauts into space on crewed missions remains some years away but Gilmour's proactive approach will, no doubt, see it develop the technology and know-how to achieve its aims.

The motto All Orbits, All Planets will remain a reminder, if one is needed, of the direction they are heading.

Christopher Rees, with contributions from Adam and Michelle Gilmour.

Scan the QR code to watch a video of the final qualification test 'to destruction' of Gilmour Space's main Sirius hybrid rocket engine.

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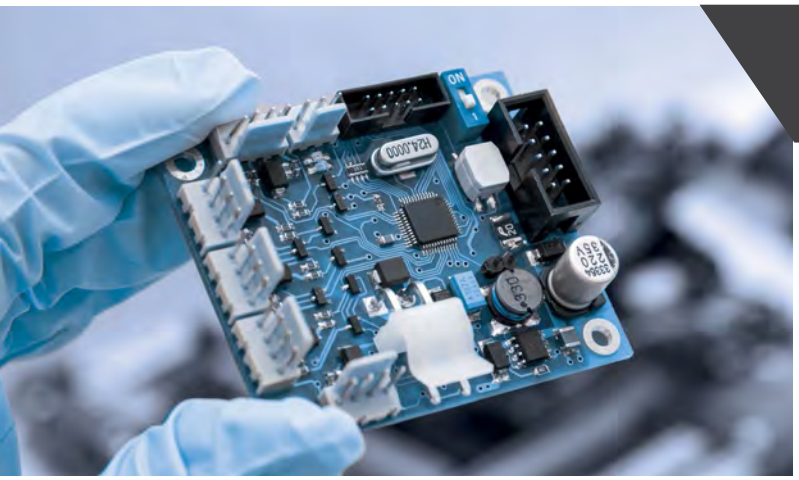

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THE X FACTOR

WORDS Michael Nelmes

CONTINUING OUR SERIES ON THE TECHNOLOGICAL DEVELOPMENTS THAT PAVED THE WAY FOR AMERICA'S SPACE PROGRAM, WE LOOK AT THE NEXT TWO X-PLANES.

BELOW First-generation X-planes and other experimental types in the early 1950s. Surrounding the X-3, clockwise from bottom left: Bell X-1A (achieved Mach 2.44); Douglas D-558-1 Skystreak; Convair XF-92A (USAF's first delta-wing aircraft); Bell X-5; Douglas D-558-2 Skyrocket (first to achieve Mach 2); Northrop X-4 Bantam. Photo: NASA.

The sole X-3 in flight.

X-3 STILETTO

During World War II the Douglas Aircraft Company in California was approached by Air Technical Service Command, US Air Force (USAF), for a design proposal under Materiel, Experimental Project MX-656 to explore the transonic speed regime. A contract for a design study was signed just before war's end.

As Bell's XS-1 was capable of supersonic speed for only short periods, due to limited rocket fuel capacity, Douglas set the goal of sustained flight at Mach 1, and a 10-minute endurance at Mach 2 at 35,000 feet for its XS-3 (later renamed X-3). The thin wing airfoil was optimised for that speed. Interestingly, the wing cores were each machined from a single aluminium slab. Douglas also pioneered the use of titanium alloy to deal with the frictional heating of Mach 2 flight, using it for the skin of the stabilator (the all-moving tailplane) and also the lower tailboom where jet exhaust heating occurred. The end product, despite its futuristic appearance, was both difficult to fly and grossly underpowered. Nevertheless, it pioneered several areas of aerodynamic research.

Model 499, as Douglas referred to the XS-3, initially included several powerplant options: turbojet, rocket, pulsejet and ramjet. By 1946 the company settled on a pair of afterburning Westinghouse J34 turbojets, each of 2,200kg thrust with afterburner, which replaced the preferred J46 engines of 3,000kg thrust because the fuselage could only accommodate the smaller J34s. That factor alone spelt the downfall of the X-3 as a high-speed research craft.

What characterised the X-3 visually was its slender, streamlined (high fineness ratio) fuselage and its extraordinarily short-span (low aspect ratio) wings. With a wing area of just 15sq.m, the craft's takeoff speed was a frightening 420kph. One consequence was its high rate of shedding wheel tyres.

For the pilot to enter the cockpit, the seat was suspended beneath the fuselage and, once the pilot was strapped in, raised on rails into the cockpit. Ejection was downward.

First flight came in October 1952 at Edwards Air Force Base (the new name for Muroc Dry Lake which commemorated the pilot of a YB-49 Flying Wing lost on a test flight), and all went well. For monitoring aircraft skin temperature and aerodynamic effects, hundreds of temperature sensors and strain gauges were installed and connected to an on-board recorder.

The four-year X-3 flight test program focused on investigating longitudinal stability and control. The first half-dozen flights were made by air force test pilots, including Chuck Yeager, to gain experience on an aircraft with wings of such low aspect ratio, before handing over to the National Advisory Committee on Aeronautics (NACA) and test pilot Joe Walker for similar investigations.

A flight by Walker on 27 October 1954, halfway through the program, was especially fruitful though frightening. It led to an understanding of the phenomenon known as inertia (or roll) coupling. Inertia coupling occurs when an aileron initiated roll rotates the fuselage mass about its directional vector rather than its longitudinal axis and control surfaces become inadequate to overcome the gyroscopic inertia of the fuselage. Walker lost control for several seconds. Given the importance of this incident in the future development of high-speed aircraft, it is worth quoting from *The X-Planes* by Jay Miller:

The X-3 had gone berserk. Following Walker's application of left aileron, the X-3 had experienced a large increase in fuselage angle-of-attack [pitch-up]. As a corrective action, Walker had applied right aileron, but surprisingly, there had been no effect. Instead, the pitch angle increased and along with it, the onset of strong sideslip. In a matter of seconds, a peak angle-of-attack of 20 degrees and a peak sideslip angle of 16 degrees were attained. Walker's corrective actions, ongoing throughout this very surprising performance, now began to take effect. Minimal altitude had been lost and the aircraft had slowed considerably. It was all over in about five seconds.

Walker tried another left aileron roll, this time after attaining Mach 1.05 in a shallow dive, with more violent result, but was able to regain control and landed safely. The phenomenon had, in fact, been predicted by aerodynamicists and even encountered over the past 18 months in test flights of the world's fastest aircraft at the time, the North American F-100 Super Sabre.

DOUGLAS X-3 SPECIFICATIONS

LENGTH: 20.30m

WINGSPAN: 6.91m

WING AREA: 15.47sqm

GROSS WEIGHT: 10,814kg

MAX ALTITUDE: 35,000ft+

RANGE: 800km

MAX SPEED: Mach 0.95 (1,046kph) in level flight; Mach 1.2 in 30-degree dive

FLIGHT PROGRAM: 1952-56 (Douglas, USAF and NACA)

ABOVE The X-3's cockpit. The high instrument panel limited the pilot's forward visibility. Photo: NMUSAF.

It caused the death of that company's chief test pilot just a fortnight before Walker's flight. In response, the F-100's wingspan was increased and its tail enlarged, and the problem disappeared. But another inertia coupling incident in 1956 claimed the Bell X-2 and its pilot.

The choice of smaller engines made the X-3 a failure as a high-speed research tool. The USAF cancelled construction of a second example, and it was consigned to history. The final flight of the X-3 in 1956 was to the National Museum of the US Air Force in Dayton, Ohio, where it is on display.

However, the X-3 was influential in several other respects. In addition to inertia coupling research and the use of titanium as mentioned, the X-3 greatly influenced the choice of wings for two notable 1950s designs. The first was the highly successful F-104 Starfighter, developed by Lockheed Skunk Works using X-3 data to create very similar but even thinner wings (3.36 percent thickness-to-chord ratio, against 4.5 percent for the X-3). Similar wings then appeared on the North American X-15 rocket plane, which flew in 1959.

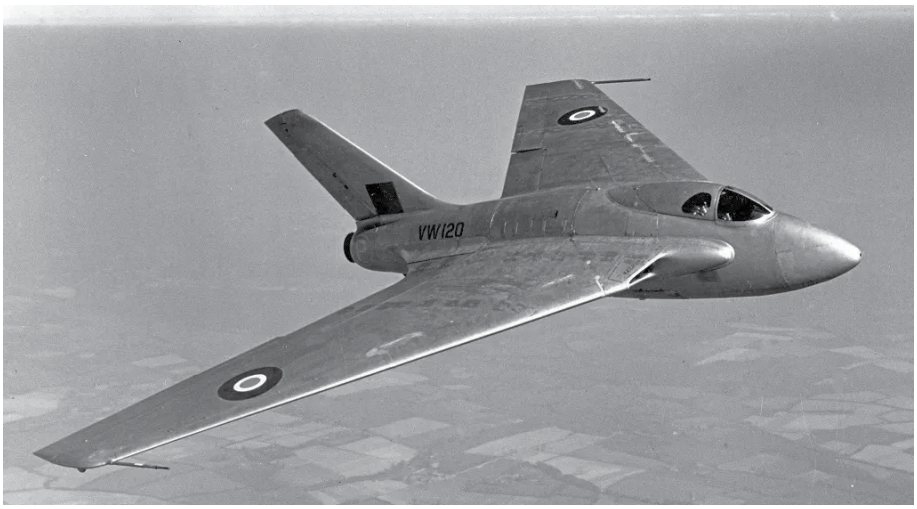
NORTHROP X-4 BANTAM

Northrop Aircraft Corporation of California had produced exceptional aircraft of 'conventional' design before and during WWII. However, it is perhaps best known for its 'tailless' or semi-tailless (lacking a horizontal tailplane) designs, and 'flying wings' which were highly efficient due to their low drag and high lift properties. Jack Northrop's tailless XP-56 fighter prototype, estimated to have a top speed of 750kph, flew in 1943 and was followed by the even more radical XP-79 flying wing fighter. Both were built from magnesium alloy.

ABOVE Entry to the X-3 was via a rail-mounted, downward-firing ejection seat. Photo: NMUSAF.

The XP-79 was intended to be rocket-powered, however a pair of jet engines substituted. The pilot lay prone in order to reduce the effect of g-forces in tight turns and, even more interestingly, the wing featured armour-plated leading edges in case it ran out of ammunition and had to ram enemy bombers. Its only flight, at Muroc just weeks after the war, ended in a fatal crash. Northrop's flying wing concept culminated in the XB-35 piston-engined and YB-49 jet bombers of 1946-47, and was revived decades later as the B-2 Spirit.

Intrigued by Britain's tailless de Havilland DH.108 Swallow jet of 1946 and its German predecessor, the Messerschmitt Me 163 Komet tailless rocket fighter which saw combat during 1944-45, NACA and the USAF commissioned Northrop to build a pair of tailless aircraft to investigate their performance at transonic speed. Designated X-4, they first flew in 1948-49 and thus predated the X-3. In place of tail elevators, elevons on the wing trailing edges doubled as both elevator and ailerons.



BELOW Britain's DH.108 Swallow influenced the X-4 design. Photo: BAE.

Aerodynamicists had theorised that a lack of tailplane might improve stability at the speed of sound, by eliminating the interaction of supersonic shock waves from the wings and tailplane. Although the two X-4s never flew supersonic, the question became moot when in flight tests at Mach 0.87 and above, they were unstable in all three axes of pitch, roll and yaw. Pitch instability was especially marked, manifested as porpoising and nose down 'tucking' pitch oscillations. The problem was partly solved by shaping the elevons with blunt trailing edges.

NORTHROP X-4 SPECIFICATIONS

LENGTH: 7.09m

WINGSPAN: 8.12m

WING AREA: 27.9sqm

GROSS WEIGHT: 3,547kg

MAX ALTITUDE: 42,300ft

RANGE: 676km

MAX SPEED: 1,014kph / Mach 0.94

FLIGHT PROGRAM: 1950-53 (82 flights by USAF and NACA)

ABOVE First X-4 on the ground and in flight. Photos: USAF.

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CONCLUDING THE STORY OF THE AUSTRALIAN ANTI-G SUIT.

DESPERATE AERIAL DOGFIGHTS over Britain in 1940 inspired University of Sydney scientist Dr Frank Cotton to develop an anti-blackout suit to enable fighter pilots to remain conscious during high-g turns. But just as the Cotton Aerodynamic Anti-G (CAAG) suit was due to be trialled by RAAF pilots flying Spitfires in the defence of Darwin in September 1943, Japanese raids over northern Australia effectively ceased.

As another anti-g suit developed by Canadian Dr Wilbur Franks was still on the secret list in Britain, Allied high command forbade the use of any anti-g suit over enemy territory, ruling out potential tests over New Guinea. Thus the suit was never used in combat. In the end, the only aircraft known to have been brought down by Cotton's invention was a No.452 Squadron Spitfire, which crashed because its pilot had put on his CAAG suit incorrectly and it caught on the controls.

By November 1943, pilots had decisively turned against the suit. It was intolerably hot to wear in the tropics, which made rapid scrambling almost impossible. They also worried about fatally overstressing their lightly built Spitfires. Moreover, many feared wearing a cumbersome rubber suit, connected by a hose to the aircraft, would substantially lessen their survival chances if they had to bail out. Chief of Air Staff AVM George Jones declared that the suit would be withdrawn.

Further technical developments over late 1943 lightened the CAAG suit and improved its appeal to airmen. In particular (as suggested by the abundant 'boots' still extant in the Macleay Museum), removing the suit's feet had minimal effect on its anti-g efficacy while substantially improving pilots' control over their rudder pedals. In May 1944, Jones decreed that returning the CAAG suit to the front line was of the "highest priority". By late July, all three Spitfire units in northern Australia – Nos 452, 548 and 549 Squadrons – were fully equipped. However, by then the chance of dogfighting Japanese aircraft was remote, and the suit was abandoned by September. A year later, most of the CAAG suits in store were marked for disposal, even though Cotton hoped they might play a role in the new high-speed jet aircraft soon to enter service.

Meanwhile, by November 1944, evaluation of the latest American G3 'tropical' suit – which weighed about an eighth of the heavy CAAG outfit – led to it being recommended for RAAF use. In the end, the order for 155 G3 suits failed to materialise before hostilities ceased in August 1945, although some were subsequently used by RAAF pilots in the Korean War of 1950–53.

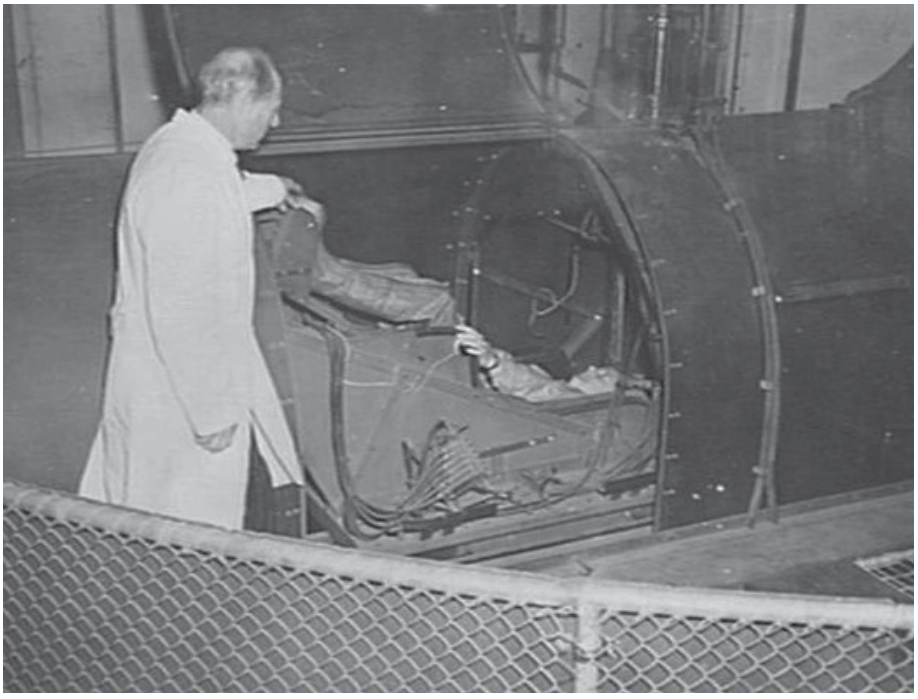
SPINNING OUT OF CONTROL

The CAAG program was never just about the suit and its associated equipment. The project revolved – quite literally – around the human centrifuge built in a ground-floor room at the University of Sydney's old medical school during 1941.

Originally created to evaluate Cotton's ideas and various suit prototypes, the centrifuge embodied a unique design. The test subject lay in a seated position on his back on a rotating turntable. As the device began spinning, building up centrifugal force, the seat could be wound out to its full extent, thus further increasing the apparent force of gravity (g). The unit was eventually enclosed in the hope of preventing the horrendous motion sickness that afflicted many subjects, but it nevertheless led to giddiness, vomiting and fainting in many who experienced a 'spin', which could last up to 30 minutes.

The great problem with the centrifuge was its centrality. In addition to his teaching duties at the university, Cotton had to conduct numerous physiological studies to understand g-induced blackout – often with himself as a guinea pig. Furthermore, every pilot who was expected to use the CAAG suit operationally was also supposed to be 'indoctrinated' via a two-day course in high g, which included several runs in the centrifuge. Ultimately, over 100 British and Australian pilots, non-flying RAAF volunteers and university students took a spin in Cotton's machine.

Every adaptation of the suit – which went through six major versions and many minor variations – also had to be evaluated. Every individual suit, hand-made by Dunlop, had to be checked at high g to ensure it worked to specification; ditto for the distributor valves. Those tests, it was reported, were "necessarily lengthy and tedious, the work was even limited by weather



ABOVE LEFT No.452 Squadron Spitfire.

ABOVE RIGHT No.452 Squadron Spitfire pilot FLTSGT C. Duncan in 1943.

RIGHT Cotton at the centrifuge. Photos: Australian War Memorial.

BELOW FLTLT Ken Robertson wearing a rubber CAAG suit at the Aircraft Research and Development Unit (ARDU) at RAAF Station Laverton, Vic. Robertson, a wartime Spitfire pilot with 452SQN in Darwin, was a test pilot with ARDU from 1951. Photo: Australian War Memorial

conditions [on cloudy days, when many lights are burning in the university, the centrifuge cannot be operated without blowing important fuses]".

Built into a tight space under the strictures of wartime rationing, the centrifuge was designed by engineer Charles Prescott and built by White Elevators under the supervision of the university engineer, Thomas Wilkins. It performed admirably but was simply overworked. Over 1943, and especially into 1944-45, the machine broke down more and more frequently and was out of service for weeks or months at a time. As a result, everything – experiments, prototyping, proving and indoctrination – came to a halt. Pilots who had flown from the NT to be trained found they simply had to return because the machine was unserviceable. By the end of the war the centrifuge was hardly in use and regarded as something of a hazard.

PUSH FOR A NEW CENTRIFUGE

As early as September 1942, Cotton and his supporters on the RAAF's Flying Personnel Research Committee had urged construction of a larger, more

LEFT AND BELOW LEFT When the prototype Australian-built CAC Sabre jet fighter first flew in 1953, its test pilot wore an American nylon G4 g-suit. The P-in-circle painted on the Sabre, signifying prototype, was an identification borrowed from Britain. Photos: *Flying* magazine, August 1953; RAAF.

capable centrifuge. It never happened. While Cotton argued with his colleagues over the preferred format for the spinning cradle, the projected cost grew from £10,000 to £13,500 – more than the price of a Spitfire. After considerable wavering by the National Health & Medical Research Council (NH&MRC), the Air Board and Treasury, the budget was finally approved in July 1943.

Priorities, however, always seemed to be elsewhere. The wartime shortage of engineers and draftsmen meant that technical drawings were not ready until late 1944. It then took six months for a series of local aircraft and automotive firms to decline to build the large, complex, fine-tolerance machine. While the Tasmanian Government Railways finally took on the project in May 1945, four months later the order was cancelled when the war ended.

Although the University of Sydney had originally been willing to host both the original centrifuge and the new one – sketched to sit between the old medical school and the projected chemistry building – the upsurge in post-war student numbers saw a rapid reversal of policy. Now pressed for space, university administrators urged the RAAF to remove 'their' centrifuge. The Air Force eventually paid the NH&MRC to own the device outright and continued to service and occasionally test it through the late 1940s. The last person to be spun on Cotton's machine was probably RAAF officer Robert Tasker in June 1947.

That was not an end to RAAF ambitions, however. Even during the war, Air Force medical officers had questioned both Cotton's civilian status and medical expertise, given that he held a Doctor of Science degree rather than a Bachelor of Medicine, Bachelor of Surgery. By 1945, critiquing the moribund status of the now declassified CAAG suit, they also queried his project-management skills. Certainly, since 1943 the RAAF detachment at the University of Sydney, known first as No.2 Clinical Investigation Section and later as No.2 Flying Personnel Research Unit, had been quite ably managed by a medically trained physiologist, Archie McIntyre.

Moreover, RAAF doctors wanted to establish their own Institute of Aviation Medicine at Point Cook, Victoria, a major training base. As that facility became a reality, both the 'push' and 'pull' to remove the centrifuge from the University of Sydney grew until, in November 1952, it was dismantled and eventually delivered to Point Cook in June 1953 – just as the Korean War ended. While plans for a suitable building to house it were drawn up, the budget for its reassembly escalated to £20,000 – far more than it would have cost to construct a brand-new and more capable device. Surveying the rusting, perishing and peeling remnants – many unidentified and lacking documentation – in April 1957, the RAAF declared that Cotton's centrifuge could be "classed as so much scrap iron and timber". A month later it was unceremoniously sold off for salvage.

INCEPTION TO IGNOMINY

The story of the CAAG suit, from inception to ignominy, illustrated both much that was wrong and much that might have been right in the way Australian scientific and engineering resources were mobilised during and after WWII. As Cotton himself said in recounting the story for the University of Sydney Engineering Club in 1950, "the research on black-out began to spread wider and wider until It became essentially a piece of team work involving more and more help".

No single person, organisation, item of equipment or event led to its failure. But perhaps that was precisely the problem. More than anything else – and despite the often under-recognised efforts of efficient administrators such as George Ellis and Archie McIntyre – the CAAG and centrifuge program failed because it was never appreciated as a complex, integrated system. As its multiple elements waltzed from pigeonhole to pigeonhole, the very lack of a conductor orchestrated its demise.

Dr Peter Hobbins (Department of History, University of Sydney)

Thanks to Nyree Morrison, Jan Brazier, Wilfrid Brook, Roger Dampney, Ian Stewart, Ian Madden and Monica Walsh for sharing their time and resources. Part of Dr Hobbins' research was also supported by a Faculty of Arts and Social Sciences Research Incubator grant. Versions of the article first appeared in *Record*, the University of Sydney Archives magazine (2015), and *Aviation Heritage*, the journal of the Aviation Historical Society of Australia Inc. (June 2017).

FREEDOM OF ENTRY MARCH

ON SUNDAY 25 JULY, Australian Air League (AAL) Squadrons from across Sydney gathered in Liverpool, NSW for the Keith Smith Wing Parade and Freedom of Entry March for the Moorebank Squadron.

In 2021, Liverpool City Council granted the Freedom of Entry to the City of Liverpool to the Moorebank Squadron. After several delays due to COVID lockdowns and bad weather, the squadron was finally able to exercise the right this year with a march through the heart of Liverpool.

Freedom of Entry is a long-standing tradition dating back to ancient Rome when it was against the law for armed legions of the Roman Army to enter the city for fear a rogue general may invade. The Freedom of the City was an honour granted to troops and became a mark of the trust and confidence in which citizens held that unit.

Today Freedom of Entry is an entirely ceremonial honour, but it remains the oldest and one of the highest civic honours bestowed by the elected citizens of a city, town or regional area. The AAL was last granted Freedom of Entry 28 years earlier when that honour was bestowed by the City of Sydney on the 60th anniversary of the Air League's formation.

The Freedom of Entry saw the Air League, led by Moorebank Squadron, march off from Bigge Park before being formally 'challenged' by Chief Inspector Allyson Fenwick of Liverpool City Police Area Command. After inspecting the scroll granting the Freedom of Entry, the challenging officer acknowledged the squadron's right and privilege and permitted it to pass. The parade then continued through the city before returning to Bigge Park for the final parade and presentation of awards.

Upon arrival, the salute was taken by Mayor of Liverpool Ned Mannoun who was invited to inspect the parade. Presentations, including the best squadron, best flag party and best band on the day, were then made to the visiting squadrons by official guests. The parade concluded with a formation flypast by aircraft from the AAL's Air Activities Centre, located at Camden Airport.

The day could not have been possible without the assistance of Mayor Mannoun, Liverpool City Police

MIDDLE Air Force Association – NSW President Ron Glew OAM presenting the best small flag party award to Marrickville Squadron.

ABOVE Chief Inspector Allyson Fenwick formally challenges Moorebank Squadron with 2nd Off. Lachlan Hyde.

Area Command, PolAir – NSW Police Force Aviation Command, Air Activities Centre – Camden Airport, Liverpool City Brass Band, Councillor Nathan Hagarty, Melanie Gibbons MP, Shayne Mallard MP, Liverpool RSL Sub Branch, Ingleburn RSL Sub Branch, Air Force Association – NSW, and squadrons of the AAL NSW Group.

ABOVE Mayor Ned Mannoun preparing to inspect the parade with 2nd Off. Francisco Trostel.

LEFT AAL Squadrons prepare to step off on the Freedom of Entry march.

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 interesting 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 Air League 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

GREED AND DEBT

PROPERTY INVESTORS LEARNT SOME IMPORTANT LESSONS DURING THE GLOBAL FINANCIAL CRISIS.

DURING THE DECADE leading up to the Global Financial Crisis (GFC), the world was awash with greed and debt, both corporate and personal. Stories abounded of ordinary Australians who had borrowed heavily to purchase real estate. It was not uncommon to hear about young couples who owned 10 to 15 highly geared properties where their ownership equity in the total portfolio was 5 percent or less.

Those eternally optimistic people with nerves of steel and sincere (if naive) conviction about their financial position, owed millions of dollars, were paying a small fortune in mortgage insurance (required to protect the lenders) and were receiving rental income that was nowhere near the monthly payments they were making on interest-only loans at a rate of about 7.5 percent per annum.

With fixed-interest loans, the borrowers were comforted to know their interest payments wouldn't change during the terms of their loans (three to five years), but they also knew that, unlike variable interest rate loans, the principals of their loans (the original amounts borrowed) were not reducing.

NEGATIVE GEARING

As a result, the investors were claiming an annual tax deduction for a real and substantial annual loss, being the difference between the incoming rents and the outgoing interest, council rates, repairs, insurance, depreciation and other expenses. The practice is known as negative gearing; a tax-subsidised arrangement that has been a mainstay of Australian property investors and promoters for decades. It still is.

Property investors hope, based on historical data and their love of real estate investing, that their properties will increase in value (after capital gains tax) to such an extent as to make their losses irrelevant and the investment risks worthwhile. While history shows many people have done well using negative gearing, many have not.

Typically, the investors described here were convinced that they were on a winner. They expressed no concerns about the serious risks that most people would perceive in such a highly geared structure. They were convinced about the future of Australian real estate which they believed would rise in value forever, thereby creating the financial independence and early retirement they were seeking.

THE GFC

Then came the GFC in 2008, accompanied by a frightening economic downturn. A 1929-style depression was predicted, but the worst consequences of the worldwide downturn were avoided in Australia, thanks principally to urgent financial stimulus by government (as during the recent pandemic). Nevertheless, many investors lost their jobs, resulting in significant reductions in family income.

The value of real estate dropped, which meant many highly geared investors were left with mortgages that exceeded the value of their properties (in investment jargon, that's described as being 'underwater'). Some of their tenants

failed to pay the rent and did not renew their tenancies. And lenders became understandably nervous about their customers' capacity to make payments on their fixed-interest-rate loans.

Those Australians who were fortunate enough to be in secure employment (such as ADF members) retained a regular income to partly service their loans, even though many of their partners lost their jobs. In many cases, that bought time to renegotiate with lenders, thereby staving off forced fire sales until the property market lifted enough to consider rationalising their portfolio without extreme financial pain.

TWO IMPORTANT LESSONS

The mental strain of those experiences was immense. People who went through them learnt two important lessons (sadly, in the hard way) about borrowing money.

LESSON 1: Ask what if...

Before taking the plunge into debt, ask yourself:

- What if I or my partner lost our job or suffered a major drop of income?
- What if I or my partner became ill and couldn't work?
- What if I or my partner died?
- What if we started a family?
- What if interest rates rose significantly?
- What if property values dropped due to a recession?
- What if I couldn't find a tenant or the tenant stop paying their rent?
- What if my tenant damaged my property and left me with expensive repairs?

LESSON 2: The importance of a nest egg

Consider setting aside a nest-egg bank account of, say, three to six months of easily accessed funds to pay the bills in the event of an unexpected rainy day.

SENSIBLE INVESTING

Our purpose here is not to dissuade you from borrowing money. On the contrary, borrowing to acquire growth assets such as real estate can be a sensible decision. However, when you decide to explore your borrowing options, don't take the first offer that comes along. The real estate lending market is highly competitive, so do yourself a favour and shop around for the best deal.

LIKE TO KNOW MORE?

To learn more about sensible borrowing and investing, take a look at independent educational websites such as *moneysmart.gov.au*.

Air Commodore Robert M C Brown AM FCA (Ret'd)
Robert is a chartered accountant, a financial educator and an independent member of the ADF Financial Services Consumer Centre (adfconsumer.gov.au)

ADVERSARIAL RELATIONSHIPS, GENERALLY INVOLVING CONFLICT BETWEEN INDIVIDUALS OR OPPOSITION TO AN ACTION OR IDEA, ARE RARELY HELPFUL WRITES **PETER RING.**

SURROUNDED BY ADVERSITY

THE WORLD IS RIFE with adversarial relationships. Some have positive results, most have destructive consequences. Many features of life in Australia are so conflicted that we are led to anxiety, anger and frustration, and adversarial relationships become a product.

Telephone calls answered by a computer: "We value your call and will be with you shortly…" and again, much later: "We value your call and will be with you shortly…"

And what happened to the 'news'? It's more like sensational gossip.

Politicians or authorative individuals rarely answer questions forthrightly or objectively. CEOs of large companies take multi-million dollar pay packets while failing to deliver a product or delivering a sub-standard product.

Our nurses, teachers, police, firies and ambos seemingly are not sufficiently supported, and when improvements to conditions and pay enter the discussion, adversarial behaviour rather than engagement and collaboration often prevails.

Traffic regulatory systems are acquisitional, punitive and narrowly focused. We know from generations of experience and academic study that poorly directed/articulated or irrational punishment is not the answer to any problem.

Our law courts are characterised by adversarial strategies. Our system of democracy and government is based on an adversarial model where bullying behaviour is almost a prerequisite and definitely encouraged once 'debate' is instigated.

Too much of our higher education has too little soul content and drives a narrow and preconceived perspective of the human endeavour and our environment.

It's hard in our adversarial society to find a third view, an alternative or even conciliatory interjection. Take journalism, where everything is presented as one person against another. "Now we are going to hear the opposing view…" There is rarely a third view.

Adversarial relationships in this world are not wrong or right: they just are.

Erwin Rommel had an interesting

> It's the action, not the fruit of the action, that's important. You have to do the right thing. It may not be in your power, may not be in your time, that there'll be any fruit. But that doesn't mean you stop doing the right thing. You may never know what results come from your action. But if you do nothing, there will be no result.
> **Mahatma Ghandi**

outlook on relationships in one of the biggest adversarial situations in history, World War II. Rommel espoused a philosophy of humility; there was no need to hate the enemy, the objective was to win. His decency in the treatment of Allied prisoners earned him the respect of opponents including Claude Auchinleck, Archibald Wavell, George S. Patton and Bernard Montgomery.

To quote Einstein: "A human being is a part of the whole identified by us as the universe, a part limited in time and space. A human perceives itself, its thoughts and feelings as something separated from the rest, a kind of optical delusion of the consciousness. That delusion is a kind of prison for us, restricting us to our personal desires and to affection for a few persons nearest to us. Our task must be to free ourselves from that prison by widening our circle of compassion to embrace all living creatures and the whole of nature in its beauty.".

Most frequently, in life's situations that harbour a chance of an adversarial relationship, the only thing that connects us with the other party is an outcome that needs addressing, be it a cause, service, a product or a purchase. We have little other connection with the other party other than 'the problem'. Negotiating to an outcome is therefor chancy as there is no foundation to the communication except that which is the problem.

Possibly in dealing with daily business, we have generated a mindset in which developing a relationship was never front of mind: just achieving what we wanted and if the engagement does not go smoothly, the relationship will most likely be damaged. The goal may even by won, but not the emotional satisfaction goal.

During life, we are led to have a high focus on the physical task and the intellectual objective. Often the spirit of the game and human emotions are subordinated and ignored. Our Australian culture does not easily address, consciously and deliberately, human emotions and the nurturing of your spirited self.

Sir Owen Dixon once gave an answer, in another context: "Experience has shown in every age that a profession cannot proceed without high professional standards. Special knowledge is always suspected by those who do not share it. Unless high standards of conduct are maintained by those who pursue a profession requiring great skill begotten of special knowledge, the trust and confidence of the very community that is to be served is lost and thus the function itself of the profession is frustrated."

For adversarial engagement to work, it needs to be underpinned by a relationship. You can argue with a friend, sometimes vehemently, and the relationship standing is paramount in keeping the adversarial in perspective.

The ability to establish a relationship with all participants before entering an adversarial arena is a big ask.

We know that to listen to begin with and comprehend the position of others in the game without any sign of rejection will go a long way to establishing a positive relationship.

From little things big things grow. You may even find that in the long run you and your adversarial partner have a common interest as well as an adversarial one.

We all need to keep a balance. When you experience the worst of adversarial behaviour, whether it be subtle or overt, and it has a detrimental effect on you, then it is worth recognising that both you and the other party are caught up in it. In essence, maybe both your balances are out of whack.

Addressing the adverse reaction is simple. Despite the provocation, be polite, be respectful, choose your language, have warmth in your approach and listen to the other side intently to understand the other person's perspective. Don't just listen to the words. Listen to the vibes, the emotional undertones. Be understanding; they may have rules for the situation that they did not set and cannot change. Put yourself in their shoes. All very simple and gratuitous advice. When you are cheesed off, this advice kind of just melts away. So unload your cheesedoffedness before you start.

You have to be able to decide, no, I'm not going to be angry; I am going to suppress that impulse. I am not going to be objectionable; I am going to listen and put my point quietly and reasonably. Typically, the other party will then be calmer too.

> I don't want to be just a voice on the phone. I have to get to know these guys face to face and develop a sincere relationship. That way if we run into problems in a deal, it doesn't get adversarial. We trust each other and have the confidence we can work things out.
> **Wayne Huzenga**

GROUP CAPTAIN BRUCE MARTIN CBE AFC

2 December 1925 - 10 July 2022

BORN IN CANBERRA, Robert Hunter Martin, known as Bruce Martin to his Air Force colleagues, was educated at Canberra High School. His father was a returned soldier from World War I whose injuries sustained during the conflict restricted his employment opportunities. Bruce's mother died when he was two, and with four siblings, early childhood was a struggle.

Bruce joined the Air Training Corps in 1941, aged 16, and attained the rank of flight sergeant. His passion for the Air Force was inspired by his older brother who was on No.4 Course in the Empire Air Training Scheme. Bruce enlisted in the RAAF when he turned 18.

He commenced flying on Tiger Moths on 29 August 1944 at No.7 Elementary Flying School at West Junction, just outside Launceston. He gained his wings on Wirraways at No.5 Service Flying Training School at Uranquinty on 28 December 1944, graduating as a sergeant pilot. Several postings followed during which Bruce qualified on Mustang aircraft at No.2 Operational Training Unit, Mildura.

With the downsizing of the RAAF following the end of World War II, Bruce was placed on an Advance Flying Refresher Course at Deniliquin and from 280 participants, he was one of eight to be retained in the service. He was commissioned as pilot officer in 1947.

After brief tours on Air Traffic Control duties, Bruce was converted onto Lincoln bombers at No.82 Wing, Amberley and was posted to No.6 Squadron on October 1949. A posting to No.1 Squadron at RAF Tengah, Singapore, followed on 12 June 1951, and he subsequently flew 50 strike operations against the communist terrorists in the Malayan Emergency.

Bruce returned to No.6 Squadron in February 1955 to fly Lincolns with attachments to No.2 Operational Conversion Unit (OCU) to qualify on Vampire aircraft, No.77 Squadron to qualify on Meteor 7 aircraft, and back to No.6 Squadron to qualify on Canberra aircraft. He was then posted on Royal Air Force Exchange to No.23 OCU where he flew Canberra T4 and B2 aircraft.

Returning to Australia in early 1959, Bruce was posted to Central Flying School, East Sale to complete Flying Instructor Course. After completing a tour as a qualified flying instructor on Winjeels at Point Cook, his flying career took an abrupt change of direction when he was posted No.16 Light Aircraft Squadron at Amberley in 1963 to fly Sioux helicopters. Two months later he was posted to Fort Rucker in the United States as part of the second group from No.9 Squadron to undergo Iroquois helicopter conversion. While in the US he flew the UH-1A and UH-1B Iroquois, Sikorski H-34 Choctaw and H-10 Chickasaw helicopters.

On return to Australia in January 1963, he was appointed Officer Commanding Flying at No.9 Squadron where he drafted the squadron's first standard operating procedures and training syllabus for the new Iroquois helicopter force. In 1964, No.5 Squadron was formed and deployed to Butterworth, Malaysia with four Iroquois helicopters (later six) to support the 28th Commonwealth Infantry Brigade during the confrontation between Malaya and Indonesia. Bruce served as the Commanding Officer for 12 months.

Promoted to Wing Commander, he attended Army Staff College in 1965, marking the start of an illustrious period of joint operations for him and for the ADF. In 1966 he was appointed Commanding Officer of the Air Support Unit at Williamtown teaching joint doctrine. Then followed a world tour to examine the joint procedures followed by allied military forces. He wrote joint doctrine for the ADF and was responsible for the conduct of company commanders' courses for the Army.

Bruce was promoted to Group Captain and posted to Vung Tau, Vietnam, as Task Force Air Commander in September 1970. He was a highly successful commander and used his joint knowledge and the strong ties he had previously developed with Army colleagues to great effect. He led from the front and flew 1,200 sorties and 500 hours in Iroquois and Caribou aircraft. Bruce was well respected and liked by his subordinates, a tribute to his leadership style and personality.

He was appointed Commander of the British Empire for his services in Vietnam, having previously been awarded the Air Force Cross for his actions in Malaya in 1965 with No.5 Squadron. He completed his service career as Officer Commanding RAAF Fairbairn in 1976.

WARRANT OFFICER KERRY JOHN SHIPP DFM

20 November 1948 - 30 August 2022

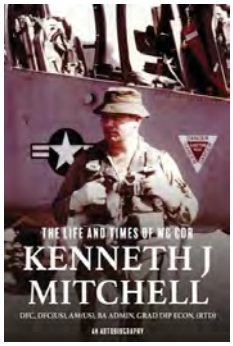
KERRY SHIPP was born in Adelaide and educated at Plympton High School. After completing a motor-mechanic apprenticeship, he joined the RAAF on 13 April 1966 as a trainee aircraft engine fitter. Postings to No.1 Recruit Training Unit and RAAF School of Technical Training followed. After qualifying as an engine fitter, he requested a posting to No.5 Squadron, Fairbairn, to undergo training as a helicopter crewman on No.5 Helicopter Crewman Course. He graduated as a Leading Aircraftman in July 1968.

Posted to No.9 Squadron, Vung-Tau, South Vietnam in May 1969, Kerry quickly adjusted to the demands of a squadron conducting combat and combat support operations. Three weeks later, he was a member of the crew of an Iroquois helicopter tasked to assist in the recovery of the crew of a US Air Force Forward Air Control aircraft that had been shot down by enemy ground fire. The aircraft wreckage was located and Kerry volunteered to be winched into the jungle to search for survivors despite the knowledge that the enemy was in the vicinity and numerous minefields had been sown in the area. He was winched into thick jungle twice, the second time successfully locating the wreckage. There were no survivors. For his courage he was awarded the Distinguished Flying Medal.

Kerry returned to No.5 Squadron in Australia in 1970 for two years before being posted to Transport Support Flight , Butterworth, Malaysia in December 1972 for search and rescue duties in support of the two RAAF fighter squadrons operating from Butterworth. Once again, he was involved in a rescue mission, this time to recover a badly injured pilot of a crashed Mirage. The helicopter crew was awarded a "Good Show Award" for the mission. On return to No.5 Squadron in 1975, Kerry served as a senior check and trainer crewman.

Throughput his time on Iroquois, he had several attachments to various bases crewing search and rescue helicopters. From July to December 1976, Kerry served on the first detachment of No.5 Squadron United Nations Emergency Force II in the Sinai. In 1978, he was posted to No.12 Squadron and crewed the CH-47 Chinook for eight years before retiring in 1986. During that time, he was appointed the lead flight engineer for the squadron, providing outstanding leadership, and that attribute, together with his superior knowledge of the Chinook, culminated in a Category A Aircrew Award, one of very few flight engineers to achieve it.

After a period in the business world, Kerry joined Surveillance Australia as an observer before moving to Customs Coastwatch where he was responsible for tasking and overseeing surveillance operations. He retired from his civilian career in 2007.



REVIEW BY Bob Treloar

THE LIFE AND TIMES OF KENNETH J MITCHELL

By **KEN MITCHELL,**
Green Hills Publishing; RRP $32

THE LIFE AND TIMES OF KENNETH J MITCHELL is an autobiography of a young man who realised his dream of becoming a RAAF pilot. Born in Adelaide, Ken joined the Air Training Corps to further his opportunity to become a service pilot. He joined the Air Force when he turned 18 and served for 31 years.

On gaining his wings, he was posted to fly Long Nose Lincoln and Neptune aircraft at No.10 Squadron, before being transferred to fighter aircraft, initially flying F-86 Sabres. Posted to No.77 Squadron at Butterworth, Malaysia during Confrontation, he completed a tour of duty with No.79 Squadron providing air defence at Ubon, Thailand, against possible attacks from North Vietnam. Ken subsequently converted to Mirage III aircraft.

Trained as forward air controller (FAC), Ken was posted to South Vietnam and flew OV-10 Broncos with the US Air Force 19th Tactical Air Support Squadron based in Lai Khe in III Corps. Among the many combat actions he describes, he provides excellent accounts of the co-ordination required by a FAC when conducting air strikes in support of troops in contact. There is also a very descriptive account made from an Army Command and Control helicopter when observing a night battle defending a beleaguered fire support base. He returned to Australia in 1969 having flown 276 combat missions and 694 hours during a six-month tour.

Ken presents his life and RAAF experience in a vignette style which is easy to read. He relates incidents, both humorous and serious, that he observed while serving in operational fighter squadrons. He concludes his story with his experiences in Customs and private business.

REVIEW BY Bob Treloar

LUCKY POMMIE BASTARD

By **DON MCNAUGHTON**
Self-published though Ingram Spark; RRP $19.99

LUCKY POMMIE BASTARD is the story of three Lancaster crews piloted by Australians with mixed crews of Australians and Britons who trained and flew together. It has a focus on the crew in which the author's father, Roy McNaughton, served as a mid-upper gunner and is referred to as the Trimble crew, the name of the Australian pilot.

Don McNaughton served in the RAAF for four years from 1971, as an aeronautical engineer cadet. Retired, he is Emeritus Professor of Molecular Sciences at Monash University, Melbourne. *Lucky Pommie Bastard* is his first book.

Roy McNaughton and his crew survived 29 bombing missions in No.207 Squadron, Royal Air Force, and No.467 Squadron, RAAF. The description of their mission over Brunswick on 14-15 January 1944 captures the effort required to mount a raid. It describes the routine of the station personnel: briefing and planning staff, aircraft maintenance personnel, armourers, transport drivers, aircrew, the conduct of the mission, and the after-flight debriefing and routine. It captures the tensions, anxiety and hopes of those committed to the operation. To quote Doug Parry, a former World War II RAAF air gunner in Bomber Command: "The best description of a Bomber Command operation I have read". I tend to agree with him.

Regarding Bomber Command operations, the detail provided is incredible. The author has taken a great effort to research the actions and fate of aircrews associated with the Trimble crew. The significant detail and the style of writing demands careful reading and the attention of the reader. That said, I believe the approach provides a compelling story and will capture the reader's interest.

REVIEW BY Bob Treloar

THINKS HE'S A BIRD: From Postal Clerk to Pathfinder Pilot

By **IAN CAMPBELL**
Big Sky Publishing; RRP $32.99

THINKS HE'S A BIRD chronicles the life of Keith Watson, an 18-year-old postal clerk working in the Biloela Post Office, Queensland, who enlisted in the RAAF in August 1941. Through the opportunities of war, he became a Pathfinder pilot in RAF Bomber Command flying Lancaster bombers in the dangerous skies over Germany.

The author has drawn upon five volumes of Keith's diaries when writing *Thinks He's a Bird* and, to quote Air Commodore Tim Alsop, Commander Air Combat Group, RAAF, in his foreword: "…the story is less about what Keith does in the war, although there is plenty of that, and more about how he deals with everything his young mind must confront".

Keith's journey to the Pathfinder Force commenced with flying training in the Empire Air Training Scheme in Narromine, NSW, then to Canada where he graduated top of his class and met the woman he would marry after the war.

The narrative of Keith's operational activities, blended with his relationships with the English families, provides an insight into an often-overlooked aspect of living abroad during wartime.

Ian Campbell has an easy style which enables him to eloquently convey the tension and excitement of flying operations over wartime Europe, providing the many details needed to adequately describe a bombing raid.

The mix of Keith's operational and personal lives provides a story that is captivating and provides more than the usual account of a veteran's operational experiences contained in many biographies. I commend the book to readers who share an interest in military aviation history.

Visit us at the Avalon Airshow 2023,
POD 32 and the Defence NSW Stand.

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