WINGS

SPRING 2023
VOLUME 75 NO.3

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MANAGING EDITOR'S MESSAGE

***WINGS* HAS AGAIN** presented an entertaining variety of topics in the Spring 2023 edition. As with all our editions, we attempt to expose some of the technology currently under development in Australia and the Aussie companies at the leading edge of that effort. In this edition, the focus is on sovereign space capabilities and digital technology.

The cover story introduces an entrepreneurial enterprise to modernise a legacy amphibian to fill a void in existing travel and communications capabilities, particularly in states without the terrain for conventional airports.

The X-Planes feature deals with lifting bodies and the exploration of atmospheric re-entry conditions and early hypersonic flight. Early sub-orbital concepts evolved, to a large extent, from research conducted by German scientists during WWII, and subsequently migrated to the US at wars end.

We conclude the snapshot of Ron Greens' experience as a test pilot working with the US to introduce the F-111 into service. Ron carried the responsibility to demonstrate the dump and burn routine that became a favourite airshow spectacle in Australia.

Once again we hope you enjoy this edition of *Wings*.

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
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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READERS' LETTERS

RAAF CONNECTIONS

I SERVED IN THE RAAF as an Engineering Officer and retired, after over 40 years' service, as a Wing Commander.

Recently, I was passed a copy of *Wings* Volume 75 No.2 and read the obituary for Associate Professor (GPCAPT) Norton Duckmanton OAM, RFD. I noted that during the war he served with 93 Squadron as a navigator flying Bristol Beaufighters in Borneo. My father, WOFF Graeme McLeod, served as a pilot with Norton at 93 Squadron in Borneo. Norton was crewed with WOFF Morton, while my father's navigator was FSGT Paige. The article mentioned he was recalled from a mission on 14 August 1945. On that day, my father participated on a rocket and cannon strike on barracks in the Trobol area. He was not recalled and came under light A/A fire and sustained a bullet hole in his Beaufighter's fin.

In late October 1945, six Beaufighters from 93 Squadron escorted 457 Squadron Spitfires back to Australia from Labuan to Oakey. Both my father and Norton were part of the Beaufighter aircrew on the escort mission. The 93 Squadron aircraft were then tasked to take their Beaufighters to Wagga, NSW to 5 Aircraft Depot. However, during take-off from Oakey, my father's aircraft suffered an engine failure and he completed a wheels-up landing at the end of the strip. Luckily no one on board was injured although the port wing separated from the aircraft fuselage.

Unfortunately, I never met up with Norton Duckmanton during my RAAF service and, as my father was killed in a road accident in 1953, our family did not link up with the 93SQN Association.

My mother, Eileen McLeod, served in the WAAAF during WWII, where she met my father during their service in Geraldton, WA.

As another coincidence, *Wings* also included an obituary on GPCAPT Ron Green. We both served together as PLT OFFs at ARDU at Laverton in 1972 when GPCAPT Green was the WGCDR in charge of the Test Flight.

Wings provides relatable articles to ex-RAAF members as well as keeping us current with present RAAF activities. In my case it has provided me with a link to my parent's past service.

Ken McLeod, Winmalee, NSW

ABOVE Eileen McLeod performing maintenance on an aircraft at Richmond. She is sitting on top of the engine nacelle.

JET POWER

LOCAL LEAD-FOOTS, benzine bogans and assorted hoons were recently seen driving past doing double takes and salivating. They had spotted a couple of jet fighter engines which had been delivered to the Aviation Heritage Museum at Bull Creek, Western Australia. They were about to be fitted to the airframes of its recent warbird acquisitions being prepared for exhibition in coming months.

Those massive power plants based on a Rolls Royce RB-119 design are each capable of delivering 16,000lbs of thrust and providing the potential crowning jewel of drag car modifications at Perth's Motorplex. The museum's curator cautions anyone with evil intent on his new acquisitions to be mindful that if they are used in any Earth-bound apparatus at Kwinana, special care should be taken when opening the taps as you might find yourself returning to earth 33km away in Mandurah.

Daryl Binning, Bull Creek, WA

ON THE COVER
A Grumman Albatross amphibian employed by the US Coat Guard. Photo: Bill Crump/Alamy.

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AIR FORCE ASSOCIATION

PRESIDENT'S DESK

MY THOUGHTS GO TO THE FAMILIES OF Captain Daniel Lyon, Lieutenant Maxwell Nugent, Warrant Officer Class 2 Joseph Laycock, and Corporal Alexander Naggs who lost their lives when their MRH-90 Taipan helicopter crashed into the waters off Hamilton Island in North Queensland. I also appreciate the emotional impact the tragedy has had on members of the 6th Aviation Regiment, the lost aviators' home unit. Loss of comrades in any circumstances is a heartfelt experience.

The tragedy bought home the need to recognise compensation and support for loss of life and injury caused through service regardless of whether it had occurred in peacetime or warlike operations is essential. That was emphasised by Defence Minister Richard Marles in a press interview he gave shortly following the accident. It is also a position the Association took in responding to the invitation to provide input to the government's proposed Legislative Reform Pathway. I appreciate there are elements in the veteran community who would not agree and argue that death or injury in warlike circumstances is a 'higher contribution'. However, a life lost is a life lost regardless and I am certain the lost comrade's family would suffer the same degree of agony regardless of the situation.

The Air Force Association's newly formed National Board of Directors will sit face-to-face for the first time in September when, among other things, veterans' and families' needs will be considered as Association support initiatives. Homelessness remains a high priority. Disturbingly, it's a plight that is little understood by the general community as many think vagrancy when they think of homelessness. Yet, there are many veterans and families who, for a variety of reasons, find themselves in difficult housing situations, especially when the rental market is at its worst with extremely high rent and scarcity of suitable housing. How can we as a veteran support organisation assist? Let me know.

Stay well, stay safe

Carl Schiller
National President

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JOIN THE AIR FORCE ASSOCIATION

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 65 for the contact details.

EDITED BY Bob Treloar

REVIEW REJECTS B-21 RAIDER

ABOVE The B-21 Raider was unveiled to the public in December 2022. Photo: US Air Force.

THE DEFENCE STRATEGIC REVIEW rejected acquisition of the B-21 Raider after a detailed discussion with the US. The review emphasised the need for a significant shift towards long-range deterrence using missiles, submarines and cyber tools to keep potential adversaries at a safe distance.

The Australian Government will upgrade the F-35A Joint Strike Fighter and F/A-18F to Block 4 configuration to enable those platforms to employ the Joint Strike Missile and the Long-Range Anti-Ship Missile.

The RAAF intends to prioritise collaborative development with the US of the MQ-28A Ghost Bat autonomous air vehicle. The Ghost Bat, which was publicly displayed at the Avalon Airshow this year, is designed to operate as a loyal wingman in an integrated system of crewed and uncrewed aircraft, providing a platform that can be replaced at a lower cost than crewed platforms.

Source: Airforce Technology

NO.9 SQUADRON REFORMED

NO.9 SQUADRON WAS REFORMED on 11 June 2023 as an element of No.92 Wing Surveillance and Response Group to operate the Northrop Grumman MQ-4C Triton remotely piloted aircraft system. 9SQN will be headquartered at RAAF Edinburgh, SA and most Triton operations will be conducted from RAAF Base Tindal, NT.

No.9 Squadron has a proud history, serving during World War II and the Vietnam War. Initially formed in 1939, from No.5 Fleet Cooperation Squadron, it flew Walrus aircraft from Royal Australian Navy cruisers and saw active service in the Mediterranean and the Indian and Pacific Oceans, receiving 12 battle honours. It was disbanded in 1944.

Reformed on 11 June 1962 as a helicopter squadron, No.9 Squadron was based at RAAF Base Fairbairn until its deployment to South Vietnam from May 1966 until 1971. It was again disbanded in 1989.

Delivery of the first Triton is scheduled for 2024.

ABOVE RAAF MQ-4C Triton. Photo: Naval News.

C-130J Hercules purchase

A pair of C-130Js.

THE PURCHASE 20 C-130J HERCULES aircraft for the RAAF for $9.8 billion was confirmed in July. The aircraft will replace the 12 Hercules aircraft currently operated by No.37 Squadron at RAAF Richmond, NSW. The first aircraft delivery is expected in late 2027.

The ADF operates the C-130J for personnel movement and logistic and humanitarian support. The aircraft is regularly used in search and rescue, disaster relief and medical evacuation.

Source: ADM

Wedgetail to SUPPORT UKRAINE

THE RAAF WILL DEPLOY an E-7A Wedgetail with 100 crew and support personnel to Germany in October for six months as part of Operation Kudu. The Wedgetail mission is to contribute to the protection of the vital international support flowing to Ukraine. The government has stated that the aircraft will operate outside of Ukrainian, Belarusian and Russian airspace, and ADF personnel or assets will not enter Ukraine.

Source: Australian Defence Magazine

2SQN E-7A Wedgetail.

USN & RAAF exercise off Hawaii

IN APRIL, the US Navy (USN) and the RAAF conducted a bilateral air defence exercise in the Hawaiian Islands operating area as an element of the Carl Vinson Carrier Strike Group integrated training program.

Australian forces included P-8A Poseidon and E-7 Wedgetail aircraft while the USN contributed E-2D Advanced Hawkeye, F/A-18 Super Hornet and F-35C Lightning II air defence assets. USS *Princeton* served as the air defence command post.

Source: DVIDS

ABOVE Lt. Sarah Childress introduces the US E-2D Advanced Hawkeye to Flight Lieutenant Blair Sterling assigned to No.2 Squadron RAAF on the flight deck of USS *Carl Vinson*. Photo: Seaman Joshua Sapien.

Sister squadrons' F-35 interchangeability

Allies discuss F-35 interoperability. Photo: Sgt. Joshua Brittenham.

THE US MARINE CORPS' (USMC) Marine Fighter Attack Squadron (VMFA) 314, Marine Aircraft Group 11 and 3rd Marine Aircraft Wing joined RAAF No.3 Squadron for an integrated training program at RAAF Williamtown, NSW in July.

The program comprised a series of events that included tactical flying training, flight line operations and maintenance of each squadron's respective joint strike fighter variant, USMC F-35B Lightning II and RAAF F-35A Lightning II. Crews also conducted pre-load inspections and AIM-120 advanced medium-range air-to-air missiles and Captive Air Training Missile load and download procedures.

The ability of the sister squadrons to successfully execute a multitude of combined operations across logistics, ordnance, maintenance and flight operations shows the deep-rooted military ties between the two nations.

Source: DVIDS

RAAF & Indonesia surveillance training

IN MAY, RAAF No.11 Squadron and Indonesian Airforce (TNI-AU) No.5 Squadron, took part in Exercise Albatross AUSINDO, one of three annual training exercises conducted with the TNI-AU. The exercise focused on airborne and ground training with RAAF P-8A Poseidon and TNI-AU Boeing 737 maritime patrol aircraft.

It has been 11 years since the exercise was conducted in Australia. It was previously conducted annually in Indonesia.

A TNI-AU Boeing 737 maritime patrol aircraft takes off at RAAF Base Darwin as part of AUSINDO 23. Photo: SGT Pete Gammie.

Marine Corps OSPREYS IN DARWIN

TEN MARINE CORPS MV-22B OSPREYS from Medium Tiltrotor Squadron 363 deployed to Darwin from Hawaii in April as part of a 2,500-strong rotational force, an annual seven-month activity. The deployment was the 12th rotational contingent to deploy to Australia since 2012. The annual rotation enables deployed units to practise expeditionary operations, geographically distributed communications, non-combatant evacuation, embassy reinforcement, humanitarian assistance/disaster relief and rapid projection of combat power.

The Marines also participated in the biennial Talisman Sabre exercise in July which involved 30,000 foreign and Australian personnel.

Source: Stars and Stripes

LEFT MV-22B Osprey tiltrotor aircraft from Marine Corps Base Hawaii take off from Darwin. Photo: Ryan Hageali/U.S. Marine Corps.

Final Classic Hornet delivered

TWO YEARS AFTER the final F/A-18 A/B was retired from RAAF service, Boeing Defence Australia announced that preparation of the final Hornet aircraft to go on museum display was complete.

The RAAF replaced the Classic Hornet with the F-35A Lightning II, some 60 of which have been delivered. The Classic nickname was given to the F/A-18 A/B Hornets to avoid confusion with the larger, younger and more advanced F/A-18F Super Hornets, introduced into service in 2009.

Boeing has refurbished eight Hornets for Australian museums. The refurbishment process involved the removal of software, toxic materials and lubricants, and any potentially technologically sensitive equipment. Rather than be returned to pristine condition, the airframes were prepared to reflect their in-service condition.

Hornet A21-22, a veteran of operations Falconer and Okra, was presented to the Australian War memorial in 2020 with appropriate mission and squadron markings.

The final aircraft delivered to a museum, Australia's first Hornet – A21-101, was unveiled at the Aviation Heritage Museum of Western Australia in April this year.

Source: Riotact

Hornet A21-22 is reassembled at the Australian War Memorial's Mitchell Annex after delivery in 2020. Photo: ADF.

Change of COMMAND

AIR MARSHAL DARREN GOLDIE passed the role of Air Commander Australia to Air Vice Marshal Glen Braz at a hand-over ceremony at RAAF Base Glenbrook, NSW in June. Air Marshal Goldie assumed the inaugural role of National Cyber Security Coordinator. The Deputy Air Commander Australia, Air Commodore Harvey Reynolds, was appointed Deputy Chief of Air Force to take up the role in August. Senior Enlisted Adviser to Air Commander Australia Warrant Officer Raylee Scott handed over to Warrant Officer Stephen Weaver in July.

ABOVE AM Goldie, left, and AVM Braz. Photo: Defence.

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Dambusters squadron debuts over Alaska

F-35B LIGHTNING II FIGHTERS of RAF 617 'Dambusters' Squadron were tested in high-paced warfighting scenarios on their debut in Exercise Northern Edge, the largest US training exercise of the year. More than 200 aircraft and 10,000 personnel took part in the biennial exercise at Eielson Air Force Base (AFB), Alaska.

F-35 aircraft from No.75 Squadron RAAF and the RAF participated in the exercise – the first time for overseas air forces.

The exercise marked the largest gathering of fifth-generation fighters to date providing a complexity and scale not possible in Europe. The opportunity to employ the Lightning's full suite of capabilities and train pilots in realistic and challenging scenarios was invaluable.

Source: Forces Net

ABOVE An RAF F-35B landing at Eielson AFB during Exercise Northern Edge. Photo: RAF.

B-2 Stealth Bombers BACK IN THE AIR

THE US B-2 SPIRIT aircraft fleet resumed full flying operations in May.

The stealth aircraft fleet was grounded last December after a B-2 was forced to make an emergency landing at Whiteman AFB. The aircraft experienced an in-flight malfunction during routine operations and was damaged on the runway after an emergency landing. It was not immediately clear what caused the accident.

It was the second emergency involving B-2 aircraft at Whiteman AFB in 15 months. An aircraft's left main landing gear collapsed on landing in September 2021, forcing it to skid off the runway.

The B-2 is one element of America's nuclear triad, which includes bomber aircraft, silo-based intercontinental ballistic missiles and nuclear-armed ballistic missile submarines.

Source: Business Insider

ABOVE The B-2 Spirit approaches the boom of KC-10A Extender from McGuire AFB, New Jersey during a Capstone orientation flight. Photo: USAF/Staff Sgt. Scott H. Spitzer.

Apaches bound for Townsville

The Army will receive 29 AH-64E Apache attack helicopters from Boeing in 2025. Photo: ADF.

THE AUSTRALIAN ARMY'S 29 AH-64E Apache attack helicopters that will replace the Airbus Helicopters Tiger will be based in Townsville. Army's 1st Aviation Regiment will relocate from Darwin to Townsville in 2025. To accommodate the Apache and its crews, $692.4 million will be spent to renovate and build new facilities at RAAF Base Townsville. The geographic consolidation of industrial support to ADF helicopters should reduce sustainment costs. Boeing Australia will provide maintenance support to both the Apache and Chinook helicopter fleets in Townsville.

The Tiger is to be withdrawn from service in 2028.

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Commemorating the Dambusters' 80TH ANNIVERSARY

ON WEDNESDAY 17 MAY, Air Force Association, South Australia (AFA-SA) and RAAF Edinburgh co-hosted the Dambusters Raid 80th Anniversary Commemorative Service at the Air Force Memorial, Torrens Parade Ground, Adelaide. The service not only marked the Dambusters anniversary, but also acknowledged the Australian contribution to the operation including the three South Australian aviators (SQNLDR Dave Shannon DSO and Bar, DFC and Bar, FLTLT Robert Hay DFC and Bar, FLGOFF Freddie Spafford DFC and Bar) and honoured the 53 brave airmen who did not return. Nikki King, daughter of SQNLDR Dave Shannon, Jean Miller, niece of FLGOFF Freddie Spafford, and their families, and centenarian Ray Merrill DFC, a Bomber Command tail gunner, joined in the commemoration.

AIRCDRE Adrian Maso, Senior Air Force Representative South Australia laid a wreath under the 617SQN plaque on the Air Force Memorial on behalf of the RAAF. Justin Hanson MLC, representing SA Minister for Veterans Affairs, Geoff Brock, laid a wreath on behalf of the people of South Australia and Ms King laid a wreath on behalf of the families of South Australia's Dambusters.

AIRCDRE Maso delivered the keynote address reflecting on the importance of the Dambusters Raid and its lessons for the current Air Force and Australia, noting aspects such as operational risk and the need for innovation in war. Members of No.462 Squadron provided the Catafalque Party and members of 617SQN AAFC based in Adelaide provided guards for a special 617SQN wreath on which attendees placed rosemary and poppies. The wreath was then placed at the SA Dambusters Memorial located on the Pathway of Honour at Torrens Parade Ground.

Attendees then enjoyed lunch at the Combined Ex-Services Mess where members of 462SQN provided short biographical profiles of the three South Australians who flew in the Dambusters Raid.

ABOVE Members of No.617 Squadron AAFC march the wreath to the 617SQN Dambusters Memorial on the Pathway of Honour.

ABOVE Jean Miller and Nikki King with the 617SQN AAFC wreath.

SA HONOURS BOMBER COMMAND AVIATORS

ON SATURDAY 3 JUNE, AFA-SA and RAAF-Edinburgh-based No.462 Squadron co-hosted the 2023 Bomber Command Commemorative Service at the Air Force Memorial, Torrens Parade Ground.

The special service marked the 80th anniversaries of the Battle of the Ruhr and the Formation of No.463 Squadron RAAF. It also acknowledged the remarkable achievements of Bomber Command and honoured the sacrifice of the more than 55,000 bomber crews who lost their lives throughout the campaign.

About 10,000 Australian airmen served with Bomber Command in a number of Australian squadrons, but at least three quarters of them served in RAF and allied squadrons in either RAAF or RAF uniforms. Of those 10,000 Australians, more than one-third paid the ultimate sacrifice. A tragic statistic. A further 650 were killed in training aircraft accidents.

Three Bomber Command veterans attended: centenarian Ray Merrill DFC, who flew Lancasters with 218 SQN (RAF) as a tail gunner; Don Looker who flew with 115 SQN (RAF); and Angas Hughes who flew 32 missions with 467SQN and survived bailing out of a flaming Lancaster.

TOP LEFT An AAFC Cadet recites a reading at the 2023 Bomber Command Commemorative Service.

LEFT From left, Her Excellency The Hon Frances Adamson AC, Governor of South Australia, RAAF Bomber Command veterans Angas Hughes, Don Looker and Ray Merrill DFC, WGCDR Duncan Scott, CO 462SQN and AIRCDRE Adrian Maso, Commander Air Warfare Centre at the service.

VIMY FLAG PRESENTED TO RAAF EDINBURGH

MEMBERS OF AFA-SA visited RAAF Base Edinburgh on Tuesday 20 June for the unveiling of a Vimy Flag the Association has provided for display at the Sergeants Mess on permanent loan.

The 100-year-old Vimy Flag was produced in 1919 for the epic and record-breaking flight from England to Australia in the famous Vickers Vimy G-EAOU by Sir Ross Macpherson Smith, Sir Keith Macpherson Smith, Jim Bennett and Wally Shiers. The Smith brothers and Wally Shiers were South Australian. The Flags were personally signed by each of the four intrepid airmen and are important heritage artifacts.

The intent is for the Vimy Flag on display at RAAF Edinburgh to record and promote the remarkable story of the Vickers Vimy flight and its courageous crew to inspire young RAAF aviators to be similarly visionary achievers and courageous in their service for our nation.

The flag was unveiled during the Sergeants Mess morning tea interlude and AFA-SA State Secretary, Dr Warwick Raymont, gave a short speech outlining the background of the Vimy Flag while Acting President, Lawrence Ng, spoke about the role of AFA-SA.

ABOVE Lawrence Ng, left, and Dr Warwick Raymont with the Vimy Flag.

Changes at NSW Division

THE AFA NSW DIVISION held a well-attended annual general meeting over two days in mid-June. Following extended discussion, members resolved that the division would transfer to a company limited by guarantee (CLG) structure to make the Association less reliant on volunteers. The reorganisation will allow the appointment of business-savvy external directors to progress the division into a more commercial entity.

Becoming a CLG will entail significant changes to our way of business and may impact division business dealings with state branches, which will require further member feedback and discussion prior to progressing to registration as a CLG.

Some time ago, the Division Council identified that the initiatives being set in place could not be exercised if solely reliant on volunteers and consequently instituted a separate but allied foundation, the Ad Astra Foundation Ltd. The foundation has been registered with the Australian Charities and Not-for-profits Commission and has been granted deductible gift recipient (DGR) status, fringe-benefits and other tax concessions. As a not-for-profit and DGR entity, the foundation expects to fund its initiatives through grants and philanthropy.

Foundation directors will be largely independent from the Association and include past and contemporary senior Air Force Officers and SNCOs, and business leaders. The foundation will address the Royal Commission into Defence and Veteran Suicide Interim Report and the Productivity Commission Inquiry Report which identified ADF and ex-service organisations (ESO) as bodies suited to attend to future veteran support. A business entity overseen by a CEO and support staff will be established to implement foundation initiatives.

PROGRAM IN ADVANCED PLANNING

Veteran and Families Homeless Recovery Program. The foundation will proactively help reduce veteran homelessness by providing veterans' living centres and crisis accommodation. A program to provide access to immediate trained support for disturbed veterans and those involved in domestic violence events and to co-ordinate ongoing support and training for independent living is being developed.

PROGRAMS IN EXISTENCE

Companionship dogs. Ad Astra Foundation Ltd has sponsored two companionship dogs in partnership with Defence Force Welfare Association NSW through Defence Community Dogs (DCD). DCD trains Assistance Dogs to serve veterans who need physical and emotional support to deal with injuries and illnesses including post-traumatic stress disorder.

Crisis centre. The foundation is leading a collaboration with Department of Veterans' Affairs NSW, NSW Premiers Department, RSL NSW, other ESOs, Veteran Support Centres, Defence and relevant Commonwealth agencies in developing a single national contact point for ADF veterans and their families.

Transition support. The foundation has commenced a transition support program to complement existing Defence Transition services. It provides a national network of ex-service personnel working in varied civilian jobs and enterprises to help veterans transition to civilian employment.

Welfare support. The foundation will give financial and personal support sought by any veteran or their dependants in need.

Social engagement. The foundation is currently developing a framework for veteran and family health and wellbeing through regular, structured social activities. To promote camaraderie, mateship and engagement with active service veterans, the foundation has engaged Invictus Australia (formerly Veteran Sport Australia) to develop an ongoing list of social activities.

CADETS

AFA NSW will continue to support No.3 Wing Australian Air Force Cadets Band as well as the NSW Australian Air League.

HISTORICAL AIRCRAFT RESTORATION SOCIETY

AFA NSW is the major sponsor of the two Caribou aircraft on the HARS register.

PODCASTS

The Division Ad Astra Projects Manager, Peter Ring, implemented a program to record a series of podcasts to capture snapshots of past and present RAAF veterans' lives and experiences while serving. The objective is to provide a store of impressions and reflections on service life to inspire and educate. A total of 88 podcasts have been captured and posted on the AFA NSW website over the past two-plus years.

Listen here: *raafansw.org.au/podcasts*.

LEFT Invictus Games 2023 Team Australia will compete at the sixth Invictus Games in Düsseldorf, Germany, from 9-16 September 2023. Photo: FSGT Ricky Fuller.

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EDITED BY John Kindler

Upgrade for KOONIBBA TEST RANGE

A test launch from Koonibba Range.

SOUTHERN LAUNCH WILL upgrade the Koonibba rocket range, near Ceduna, South Australia to a permanent suborbital launch facility after its co-owner, the Koonibba Community Aboriginal Corporation, received a $4.5 million grant from the federal government.

The rocket range is Australia's first licensed space launch facility. It allows companies to launch and recover rocket and payload test articles for evaluation and further test before subsequent placement of qualified equipment in orbit.

The facility is separate from Southern Launches' more traditional Whalers Way complex at the tip of the Eyre Peninsula, SA, which specialises in orbital launches over the sea.

Southern Launch hopes the upgrade work will begin later in 2023, with launches by the end of the year and into 2024. However, plans are still awaiting sign-off from the local council.

The Koonibba Community Aboriginal Corporation will also use a portion of the government funds to develop an observatory on Koonibba lands from which launches can be viewed.

Source: spaceconnectonline.com.au

NEW F-35 FLEET SOLUTIONS

F-35 Lighting II landing after a flight demonstration at the Australian International Airshow 2023. Photo: LAC Ryan Howell.

A NEW MAINTENANCE SOLUTION FOR THE RAAF F-35 FLEET has been unveiled by Lockheed Martin and the Belgium-headquartered ILIAS Solutions. Data is integrated from the Autonomic Logistics Information System (ALIS holistic fleet management) and the ILIAS management system to provide RAAF maintainers with detailed insights into past, current and future state of fleet readiness.

Using the solution, it is possible for the RAAF to perform sovereign fleet data analysis, improve aircraft availability and improve the use of ALIS in maintenance execution.

The F-35 program manager for Australia, Rob Weitzman, said the RAAF implementation will serve as the benchmark to introduce the technology to other F-35 fleets and will also be expanded to support C-130J fleets.

Source: Defence Connect

Hypersonix DART AE.

Launch partner for 3D-PRINTED SPACEPLANE

BRISBANE-BASED HYPERSONIX LAUNCH SYSTEMS, which has been selected to provide vehicles for the US Defense Innovation Unit (DIU) HyCAT1 program, has teamed with launch provider Rocket Lab USA.

Hypersonix will use Rocket Lab's Hypersonic Accelerator Suborbital Test Electron rocket to take its mostly 3D-printed DART AE vehicle to its initial operating speed, from which it will collect flight data to measure its ability to fly non-ballistic flight patterns, its dynamic acceleration, its range performance (1,000km) and its engine cycle flexibility.

HyCAT1 sought a hypersonic platform that could provide high-cadence, long-endurance tests of the vehicle and its components, detection and track sensors, and communications, navigation, guidance and control systems. DIU required the selected vehicle to operate in a "representative environment", maintaining speeds up to Mach 5 with a manoeuvrable and non-ballistic flight profile, and to fly for at least three minutes with near-constant flight conditions, repeatable at short intervals. Hypersonix' DART AE is capable of non-ballistic flight patterns up to at least Mach 7 following a Mach 5 launch, exceeding the HyCAT1 requirements.

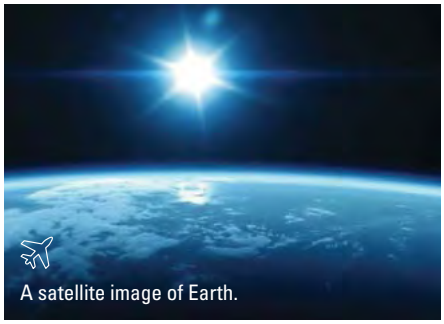
Meanwhile, Hypersonix has taken delivery of a demonstrator version of the engine that will power its in-development hypersonic spaceplanes. The Spartan scramjet is manufactured from special composites designed to tolerate the extreme heating and cooling experienced when travelling at multiple times the speed of sound.

While hypersonic technology (flying at least five times the speed of sound) is nothing new, countries are racing to develop the next generation of missiles that are so manoeuvrable in mid-air they can't be intercepted.

Hypersonic technology may one day create aircraft that can travel into space, creating an alternative to traditional vertical rocket launch techniques. Hypersonix believes the Spartan will help make that goal a reality.

Source: spaceconnectonline.com.au

Fleet Space signs with Defence Space Command


A satellite image of Earth.

FLEET SPACE TECHNOLOGIES has agreed a $6.4 million contract with Defence Space Command for the use of its commercial Centauri satellite cluster to develop and demonstrate a low earth orbit (LEO) satellite communications system for tactical communications and data relay in denied environments. Dubbed ASCEND2LEO, the program seeks to identify how commercial space capabilities can support Australia's national security objectives. Currently, the satellites are used by the mining industry.

The program is a collaboration between the Defence Science and Technology Group, Fleet Space Technologies, the University of South Australia, Rice Satcom and SmartSat CRC. SmartSat worked with Fleet to develop a proposal to repurpose technology used for mineral exploration and technology SmartSat developed to build more resilient search and rescue infrastructure into a demonstration of tactical voice communications.

Source: spaceconnectonline.com.au

Black Sky produces rocket propellant

QUEENSLAND ROCKET MANUFACTURER BLACK SKY AEROSPACE has successfully produced ammonium perchlorate, a key chemical for rocket fuel. Black Sky believes it's the first in Australia to produce the explosive agent, which is used as a component of fireworks, flash powders, explosives and smokeless jet propulsion systems.

When ignited, oxygen from ammonium perchlorate combines with aluminium to produce aluminium oxide, aluminium chloride, water vapour, nitrogen gas and significant amounts of energy. That energy and heat causes the water vapor and nitrogen to expand rapidly, which can be funnelled through a nozzle to create thrust. Ammonium perchlorate constitutes about 70 percent of most rocket fuel.

The successful result coincided with the government announcing $2.5 billion in funding to accelerate local missile production over a two-year timeframe.

Source: spaceconnectonline.com.au


ABOVE Black Sky rocket launch from a propriety POD system.

Gilmour Space
UNVEILS ERIS ROCKET

GILMOUR SPACE TECHNOLOGIES formally unveiled the Eris rocket at its Gold Coast factory in May, with the attendance of Prime Minister Anthony Albanese. Eris will be Australia's first orbital rocket, and the Gilmour mission will be the first orbital launch attempt from a commercial Australian launch site.

The company aims to launch the three-stage Eris rocket from its Bowen Orbital Spaceport in Northern Queensland later this year. The first and second stages will be powered by a large hybrid rocket engine. The third stage will be powered by a new 3D-printed liquid rocket engine.

The rocket stands at 25m, has a fairing diameter of up to 1.5m, and is planned to deliver a 305kg payload to low-Earth equatorial orbit at an altitude of 500km.

Only 11 nations have launched their own rockets into orbit, and Gilmour Space's efforts will help to build a significant dual-use capability for Australia.

Source: Australian Defence Magazine

ABOVE Adam Gilmour, right, explains the Eris rocket to PM Anthony Albanese.

COUNTER-DRONE CAPABILITY

ELECTRO OPTIC SYSTEMS (EOS) has launched its Australian-made counter-drone capability, the Slinger.

The Slinger incorporates a radar, a 30mm cannon with specifically designed ammunition, and EOS' proprietary stabilisation and pointing technology for counter-drone operations. It can reportedly track and discriminately engage moving drones at a range of more than 800m, with unique ammunition making it suitable for use in built-up environments.

EOS says the Slinger has been designed and developed in Australia specifically for export markets, with a focus on addressing contemporary and emerging threats based on lessons learned in recent conflicts, such as the Ukraine.

Source: Australian Defence Magazine

A drone in the sights.

Neumann's electric propulsion
SYSTEM SENT INTO SPACE

AN ELECTRIC PROPULSION SYSTEM created by Adelaide-based Neumann Space was sent into space for the first time in June. The launch, on board a SpaceX Falcon 9 rocket from Vandenberg Space Force Base, California, was the first in a series of in-orbit demonstrations planned for 2023 and 2024.

Neumann claims its electric technology is simpler than traditional chemical propulsion methods and allows potential for spacecraft to be effectively refuelled and deorbited more easily.

In April, Neumann, in a collaboration with a US Space Force-funded project, saw Colorado-based CisLunar acquire the Neumann Drive.

The company also announced it would partner with European microsatellite manufacturer Space Inventor to test its electric propulsion system in orbit. The Neumann Drive will be integrated as an in-orbit demonstration onboard a Space Inventor 6U EDISON Satellite arranged for launch in the latter half of 2024.

Source: Space Connect

ABOVE Neumann Electric Thruster.

Raytheon tests air defence system

ABOVE Defence personnel testing the SRGBAD System at the Woomera Test Range.

RAYTHEON AUSTRALIA HAS successfully demonstrated the LAND 19 Phase 7B Short Range Ground Based Air Defence (SRGBAD) System ability to detect, track, guide and engage representative targets at the Woomera Test Range in South Australia. The series of tests confirmed the system's accuracy and suitability for Australia's defence requirements.

Flight trial lead Henri Westell said the trial was a mammoth task. The scope of the task was to understand the capabilities to be demonstrated, the mission systems required to exercise those capabilities, the people and expertise needed to prosecute the task, and the assets or facilities needed to support those people through a safe, effective demonstration.

Source: Defence Connect

CARBONIX EXPANDS IN THE US

AUSTRALIAN DRONE MANUFACTURER CARBONIX has announced its expansion in the US market via an operating partnership with New Hampshire-based ArgenTech Solutions. The two companies have signed a master service agreement that will see ArgenTech Solutions provide flight operations, maintenance and pilot training services while employing Carbonix Uncrewed Aerial Systems.

The partnership will enable Carbonix vertical take-off and landing aircraft to be operated and supported by ArgenTech Solutions across various commercial, NGO and government missions in the US and the wider Americas.

ArgenTech Solutions' entry into the commercial market leverages its experience as an unmanned aerial vehicle subcontractor to Boeing-Insitu, where staff are embedded with the troops flying missions for the US Department of Defence, NATO and foreign military customers.

Carbonix recently became one of just a few drone companies to receive Beyond Visual Line of Sight (BVLoS) approval in Greater Sydney, which has paved the way for it to continue BVLoS testing and mission development with sophisticated payloads including survey sensors, light detection and ranging scanners and photogrammetry cameras.

$52m for Queensland space facilities

THE FEDERAL GOVERNMENT has approved a $52 million grant to help establish three new space facilities in Queensland, in a project led by Gilmour Space Technologies.

The investment will support a $156 million manufacturing network, including a facility for building commercial rockets and satellites. It will also help facilitate the creation of an orbital spaceport in North Queensland and a common test and manufacturing facility, enabling member organisations to advance their space research and technology development at a lower cost.

The Australian Space Manufacturing Network will be co-funded by the Queensland Government, Gilmour Space and its partners. Gilmour is seeking a location for the hub on the Gold Coast, aiming for operations to begin in 2024.

Source: Defence Connect, Space Connect

$3.4bn defence tech overhaul

THE FEDERAL GOVERNMENT has announced $3.4 billion to be spent over the next decade to develop hypersonics, directed energy, autonomous and other technology for the ADF. The funding and newly established Advanced Strategic Capabilities Accelerator (ASCA) represent an additional $591 million above current planned spending on defence innovation.

The Defence Strategic Review, unveiled in April, identified the creation and acquisition of disruptive new technologies as one of six priority areas for immediate action.

The ASCA will replace the Defence Innovation Hub and Next Generation Technologies Fund. It has 18 months to develop, test and refine an operating model. Hypersonics, directed energy, trusted autonomy, quantum technology, information warfare, and long-range fires have all been listed as priorities for the ASCA program.

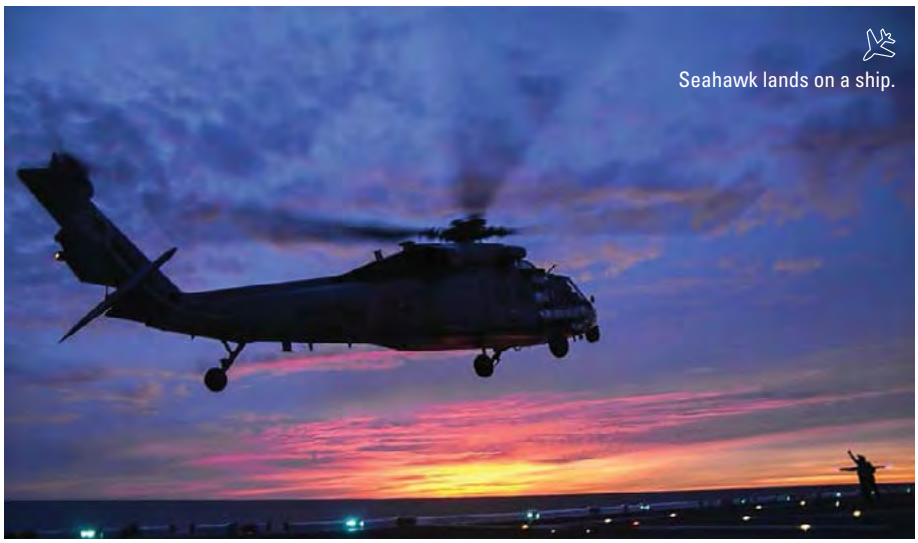
Source: Defence Connect

Head of GWEO ENTERPRISE APPOINTED

AIR VICE-MARSHAL LEON PHILLIPS HAS BEEN APPOINTED CHIEF of the Guided Weapons and Explosive Ordnance (GWEO) enterprise and promoted to Air Marshal. He was previously Head Aerospace Systems and has over 36 years' experience in the RAAF, predominantly delivering complex aerospace projects and managing their in-service support.

The GWEO enterprise is expected to accelerate the establishment of a local long-range guided weapons and munitions manufacturing industry in Australia. The government plans to commit $4.1 billion to acquire more long-range strike systems and manufacture longer-range munitions in response to the recommendations of the Defence Strategic Review. Of that, $2.5 billion will be invested in GWEO.

Source: Australian Defence Magazine



Seahawk lands on a ship.

Aussie maintenance FOR US SEAHAWKS

AUSTRALIAN DEFENCE INDUSTRY has successfully completed the first-ever deep-level maintenance of a US Navy MH-60R Seahawk "Romeo" helicopter at Nowra, NSW.

More than 200 personnel at Nowra support the world-class Australian capability, delivering maintenance, logistics, warehousing and technical support for the Royal Australian Navy (RAN) MH-60R.

The RAN's own fleet of MH-60R helicopters will expand to 36 aircraft from mid-2025 through Project SEA 9100.

Source: Defence Connect

SOUTHPAN SATELLITE DISH

CONSTRUCTION HAS BEGUN on the first dedicated SouthPAN satellite dish at Uralla, NSW. SouthPAN is a Satellite-Based Augmentation System (SBAS) that uses a combination of reference stations, telecommunications infrastructure, computing centres, signal generators, and satellites to improve the accuracy of GPS signals to as little as 10cm resolution. The new uplink processing centre at Uralla will consist of a ground control centre and two radio frequency uplinks. Lockheed Martin won a $1.18 billion contract late last year to help oversee the project and will build the SBAS ground segment.

SouthPAN uses distributed ground stations to monitor signals broadcast by Global Navigation Satellite System satellites and then compares each station's known location with position data from the satellites. The service has been live since 2022, but will only formally broadcast from 2027, with more critical "safety of life" services coming on-line in 2028.

Australia and New Zealand signed a $190 million deal with Inmarsat to allow SouthPAN to be broadcast from one of the firm's upcoming I-8 satellites from 2027.

Inmarsat I-8 satellite.

SKYKRAFT AIR TRAFFIC MANAGEMENT

ABOVE Skykraft air traffic management satellite.

AUSTRALIAN SPACE SERVICES COMPANY Skykraft has launched another prototype air traffic management satellite stack in its second launch for 2023.

Launched on board a SpaceX Falcon 9 rocket from Vandenburg Space Force Base, California, the prototype is part of a program designed to track aircraft from space and provide global communication between pilots and air traffic control, irrespective of a plane's location.

Skykraft says its air traffic management technology will improve safety, reduce fuel costs and contribute "significantly" to a reduction in environmental impacts from air transport.

Its air traffic management constellation will grow consistently to provide redundant global coverage, with an average of more than seven satellites within range of an aircraft at any time, anywhere in the world. The first five satellites in the planned 200-strong constellation launched in January.

Source: Space Connect

Airflite life-support CONTRACT

PERTH AIRCRAFT MAINTENANCE AND AVIATION services company Airflite has been awarded a $16 million contract to manage the complete life cycle of all ADF aeronautical life support equipment (ALSE). The contract covers design, development, production, operation, maintenance and disposal of all ALSE in ADF use.

The company is expected to establish a new facility in Moorabbin, Victoria while leveraging additional support from its facility in Perth.

Approximately 80 percent of ADF ALSE is shared across multiple aircraft platforms. It includes helmets and oxygen masks, inflatable life rafts and vests, load carriage and restraint harnesses, flares, radios and signalling devices for post evacuation survival and night vision devices.

ABOVE Airflite managing director Homer Constantinides and Officer Commanding Surveillance and Response Systems Program Office (SRSPO) Group Captain Alison MacCarthy sign the ALSE contract surrounded by members of SRSPO. Photo: CPL Brenton Kwaterski.

NEW REMOTE WEAPON SYSTEM PRODUCTION LINE

DEFENCE, SPACE AND COMMUNICATIONS COMPANY Electro Optic Systems (EOS) has opened its new R150 Remote Weapon System (RWS) production line at its manufacturing facility in Canberra.

The R150 stabilised remote weapon system can be mounted on protected vehicles and be fitted with weapons up to and including a 12.7mm machine gun. It allows soldiers to engage targets while remaining secure within the vehicle.

An initial batch of 14 R150 gimbals will be provided to the US to be delivered to Ukraine as part of the United States' military assistance package.

Larger EOS RWS, such as those used by the Australian Defence Force, have already been provided to Ukraine, integrated with the Australian Bushmaster protected mobility vehicles. The R150 and the larger RWS have a common user interface, enabling operators to switch seamlessly between the two systems without requiring additional training.

Source: Defence Connect

ABOVE Matt Jones and Guy Shadbolt cut the ribbon for the EOS R150 production line opening. Photo: EOS.

Defence industry workforce survey

THE INAUGURAL DEFENCE CONNECT AUSTRALIAN DEFENCE Industry Report provides a detailed view of the job search, employee sentiments and attraction factors for the defence industry workforce.

The survey received 1,435 responses and a useable sample of 870 active defence industry participants, with 57 percent of responses coming from Australia's small-to-medium sized businesses.

The survey found 59 percent of respondents were satisfied with their current organisation, with just 1 percent indicating they were planning to leave the defence industry. Nearly a quarter of respondents said they were "passively searching for a new role".

USAF looking for Raptor replacement

THE UNITED STATES AIR FORCE (USAF) has officially released a classified solicitation to industry for an engineering and manufacturing development contract for the next generation air dominance (NGAD) platform with the intent to award a contract in 2024.

The NGAD acquisition strategy is expected to invigorate and broaden the industrial base to deliver rapid and innovative warfighting capabilities. Secretary of the Air Force, Frank Kendall said: "The NGAD platform is a vital element of the air dominance family of systems which represents a generational leap in technology over the F-22, which it will replace."

NGAD will include attributes such as enhanced lethality and the ability to survive, persist, interoperate and adapt in the air domain, all within highly contested operational environments. It will enable counter-air missions to strike airborne and ground-based threats to achieve air superiority.

Source: Defence Connect

ABOVE F-22 Raptor positioned for refuelling.

Toll Aviation

Integrated rotary and uncrewed operations and training for Defence.

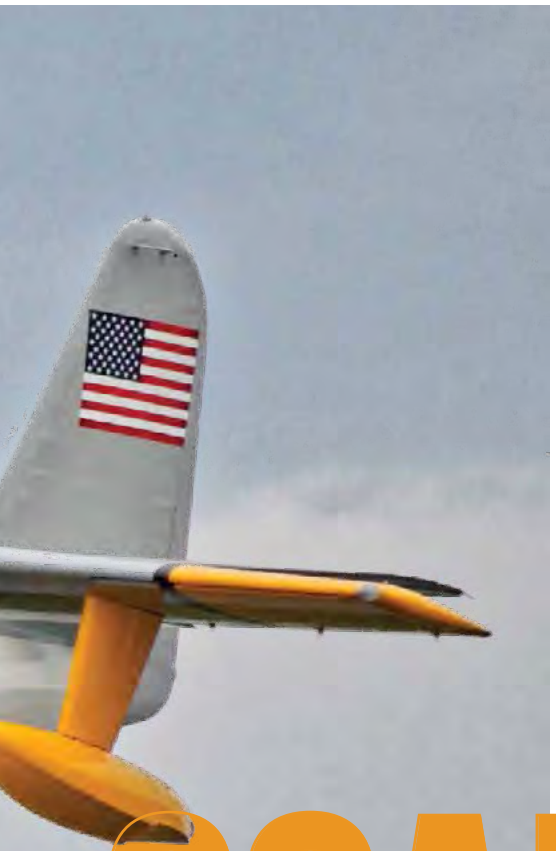
Advanced Aerial Solutions | UAV Training Australia | Toll Aviation

www.uavtrainingaustralia.com.au
government.defence@tollgroup.com

TOLL

THE ALBATROSS

A PROVEN PERFORMER UPDATED WITH MODERN TECHNOLOGY, THE NEW ALBATROSS AMPHIBIAN WILL OFFER UNRIVALLED VERSATILITY AND RANGE WRITES **CHRISTOPHER REES.**



SOARS AGAIN

AN EXPANDING MARKET and the vision to resurrect the iconic Albatross amphibian have placed Amphibian Aircraft Industries (AAI) on a course to be the world leader in the manufacture and development of amphibian aircraft.

Vietnamese-born, Sydney-based entrepreneur Khoa Hoang leveraged his experience restoring helicopters to follow his passion for an amphibian to meet future travel needs. Khoa recognised a gap in the market provided the incentive to develop a mid-range, higher-passenger and payload capable amphibian to satisfy an evolving market.

But why did air travel fall out of love with amphibians? Like many other big city waterways, Sydney Harbour was a busy airport in the 1930s, with amphibians such as the Short Empire flying boat a regular visitor. However, one of the legacies of World War II was an abundance of military airfields, often located close to towns and cities. Flying boats could not serve inland cities as fast as iconic planes such as the Lockheed Constellation and Boeing 377 Stratocruiser. The onset of jet-powered airliners in the 1960s further reduced flying times, and speed won the day.

Fast forward to 2022, and world population demographics have changed. Communities have been established in more remote locations. Tourism also drives the continuing demand for access to out-of-the way places that don't have the geography or resources for a conventional airport. As demonstrated during WWII, amphibian aircraft also add another string to the search and rescue bow. According to *Fortune Business Insights*, the need for amphibians is projected to grow from US$159.2 million in 2020 to $358.1 million in 2028 at a compound annual growth rate of 11.71 percent in 2021-2028.

Access to the many islands, especially in Southeast Asia, is often only possible by an extended boat trip or helicopter. The cost of building a suitable runway capable of accommodating larger passenger aircraft with cargo on many islands is prohibitive. Speed has become an essential feature of modern travel especially in the case of a medical emergency.

HISTORY

The Albatross, manufactured between 1949 and 1961, was developed from the smaller Grumman Mallard. The aircraft was made to satisfy a military requirement to serve with the US Air Force (USAF), US Navy and US Coast Guard. The aircraft supplied to the largest user, the USAF, was designated SU-16, later HU-16.

In addition to the amphibian's primary search and rescue function, the USAF also ordered 36 anti-submarine warfare variants which included a magnetic anomaly detector in the rear fuselage able to locate submerged submarines.

Such was the adaptability of the aircraft, Albatrosses were subject to many variants and were sold to several export markets, including West Germany, Argentina, Chile, Spain and Canada. Many are still flying.

Four hundred and sixty-six aircraft were built in two primary wing configurations, the original 80-foot wingspan classified as the A model and the 96-feet 8-inches span B model. The last 21 Albatross deliveries were all B versions, and 243 of the A model were converted to the extended-wing configuration. The increased span delivered a higher aspect ratio wing that created the same lift with less drag, and thus less engine thrust leading to a reduction in the take-off and landing distances.

The Albatross, while equally at home on land and water, could also be ordered with the facility operate from snow or ice. That application required a strengthened hull and the introduction of a large extended ski fitted to the underside of the fuselage. Outrigger skis located outboard of the wing

US Navy Grumman HU-16. Photo: Dylan Agbagni.

LEFT
Render of the new AAI Albatross.

tip floats maintained the required lateral support and balance for the aircraft. Those versions were called Triphibians.

AAI CEO Dan Webster says the Albatross is a highly versatile aircraft. "While passenger/cargo is likely to represent the greatest demand, the aircraft can be fitted out with medical treatment facilities allowing the Albatross to fly to remote locations and be used as a treatment centre while on the water," he says.

Khoa's vision to resurrect the Albatross has not been without its challenges; the Type Certificates from the US Federal Aviation Administration for the G-111 passenger version and HU16 military variant were obtained in May 2016. Since then, Hoang's plans to design and build new versions of the aircraft in Australia took several years to develop before work could begin.

His resilience was rewarded in December 2022 when a research and development facility was opened at Darwin airport with financial backing from the Northern Territory Government and the Paspaley Innovation Investment Fund. Since then, other investors have expressed an interest, recognising the potential worldwide demand for a capable amphibian.

The option of starting from scratch and designing a flying boat would have been a billion-dollar project with all the inherent problems of controlling cost and qualification tests to gain Civil Aviation Safety Authority certification. The decision to take an existing aircraft, albeit 60 years old, and restore it would enable the team at AAI to adapt a proven design and introduce advanced technology in the updated prototype.

On the retirement of the Albatross in the 1980s, Chalk International Airlines had 13 aircraft converted from military to civilian use, designated G-111. Several were operated briefly by Chalk, with a number placed in storage or operated by private concerns. The aircraft G-111 (A22SO) owned by AAI was shipped to Darwin from Avalon, Victoria, where it had been in storage for several years.

Restoration will involve reassembling the main components as close as possible to the original, including installation of fully restored Wright reciprocating piston engines. The restored version will provide the baseline for a new updated prototype Albatross designated G-111T.

G-111T PROTOTYPE

The design parameters for amphibians introduce additional challenges compared to aircraft that operate from prepared runways, and the resultant amphibian is invariably heavier and slower once in the air. The designer must work to minimise the hydrodynamic drag to minimise the incremental thrust required just to affect an effective take-off from a water surface.

Landing on an uneven water surface subjects the "keel" to strong impact forces that must be accounted for in the structural design. The keel must also be designed to displace the water in a pattern that prevents ingestion by the engines. A high-wing configuration, commonly used on amphibians, allows the engines to be located away from the water spray, which is generally controlled by spray suppressors and spray strips incorporated in the hull design. Those spray-control features deflect the water sideways and away from the fuselage, helping to reduce drag on both take-off and landing.

AAI aims to keep the new design as simple as possible, maintaining the key features of the original model. The requirement for a rugged aircraft will mean retaining an aluminium-alloy skin construction rather than the introduction of composites. AAI is collaborating with the Japanese Industrial Conglomerate ShinMaywa, which will bring more than 60 years of experience in designing and manufacturing amphibious aircraft to the project. In addition to ShinMaywa, AAI is working with several key suppliers including Dassault and Pratt and Whitney to develop advanced solutions for the G-111T prototype.

The prototype will include the highly acclaimed Pratt and Whitney turboprop PTA6A-67F engines replacing the original Wright R1820-76 cyclone piston engine radials. A brand-new, contemporary digital avionics system will be incorporated for maintainability and compliance with current air space management regulations. Completing the restored Albatross is planned for later in 2023 and the first modernised G-111T prototype is expected to fly in 2024.

On completion of the prototype, G-111T variants will be developed to include the following:

- Combi Passenger/Cargo – 28 passengers plus three crew with 4.5 tonnes of useable cargo capacity for water operations, as the G-111T.

ABOVE & ABOVE LEFT The original mid-century Albatross, VH-NMO, now owned by AAI as it works to secure its STC.

LEFT The Albatross arrives in Darwin.

- Aeromedevac – Fitted with basic patient monitoring systems for 12 stretcher cases.
- Aeromedical – Higher-end monitoring and treatment facilities for up to four to six patients.
- Search and rescue – equipped with mission systems and tailored sensors for missions up to 12 hours extendable with external fuel tanks to 20 hours.

The ability of the Albatross to land in heavy swell seas and strong winds renders the platform unique in the amphibious aircraft field. Humanitarian operations can be continued when other smaller aircraft cannot contribute. It also has the potential to be used in water-drop firefighting operations with its ability to land on water.

FUTURE DEVELOPMENTS

AAI's current complement of seven employees will be expanded to about 300 personnel as production increases to 12 aircraft per year. Work to secure investment in factory manufacturing systems, including tooling, assembly processes and test facilities to meet the expected demand, is in progress.

The initial plan to produce the prototype with 28 seats is only the start. Designs are already in train for a stretched version of up to 44 seats. In addition, the drive to net zero emissions by 2050 will involve considerable engine development with options for electric versions and other technologies, including hybrid and hydrogen-fuel-cell versions.

Introducing aircraft manufacturing to Darwin will open the potential for aviation product development, providing ongoing employment and upskilling opportunities for the local workforce. The Darwin facility will be a composite manufacturing/service hub; crews will be trained, customers will take delivery of their aircraft and after-sales service will be provided.

Webster sums up the immediate objective: "Now our priority is to get the restoration of G-111 completed and flying while, in the background, work on the design for the prototype continues. We already have orders in place, plus expressions of interest. It is encouraging to see the support and confidence in AAI to deliver a world-beating aircraft."

Connecting you from land, sea and space

Vocus is Australia's leading specialist fibre and technology solutions provider, connecting wholesale, enterprise and government customers nationally through our extensive network.

This includes 25,000kms of fibre on land, under sea, and now from space with Vocus Satellite - Starlink. It's a solution that's changing the game for secure high-speed connectivity.

VOCUS

How Vocus can boost mission critical capability with high bandwidth solutions

It's important for defence organisations not to compromise when it comes to mission-critical communications. Critical defence systems demand a secure fibre network with the security, capacity and performance needed to meet the most rigorous requirements.

Vocus is a wholly Australian-owned company with a long history of delivering fibre and network solutions for the Department of Defence, through our acquisition of Nextgen Networks in 2016. As a legislated owner and operator of critical infrastructure, we also partner with major defence industry prime system integrators.

Vocus owns and operates an extensive and purpose-built optical fibre network throughout Australia and the Asia Pacific region, serving the needs of enterprise and government organisations. Through our current five-year, $1b investment strategy, we continue to grow the reach, capacity and security credentials of our network, as well as capitalise on new technologies and enrich our digital capability.

If you simply cannot afford for your communications to fail, Vocus provides industry-leading network solutions with the levels of security and reliability you need.

Vocus enables defence missions through:

1. A high-capacity and secure national fibre network

A high-capacity fibre network enables communications with little to no lag or latency, while robust security and availability make sure information reaches the right person at the right time.

Vocus operates Australia's second-largest privately owned long-haul fibre network. This includes Nextgen Networks' mission-critical transport network, which was acquired when Vocus bought the Nextgen Networks business.

Our national network infrastructure is purpose-built to support enterprise and government organisations, and its footprint is aligned with key defence sites around the country. Our network offers up to 40 Tbps internode capacity via wavelength services for point-to-point and highly secure multipoint services with up to 100 Gbps in its MPLS virtual LAN solution. We also continue to expand and upgrade our network so it remains amongst the most resilient and secure across Australia.

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Low-earth orbit (LEO) satellite systems offer speed, latency, and bandwidth comparable to fixed line and fixed wireless technologies, and provide a generational leap in regional and remote connectivity. With our LEO satellite solutions, Vocus offers fast installation and activation of communications infrastructure supporting remote sites such as airfields, construction projects and test ranges.

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3. An Australian heritage and ownership

With headquarters in Melbourne, Vocus is owned by a consortium of Macquarie Infrastructure and Real Assets, and Aware Super – two highly regarded Australian infrastructure investors.

4. A strong track record in supporting the Commonwealth

Vocus is a trusted partner to the Commonwealth Government, having delivered a significant number of contracts for agencies such as the Bureau of Meteorology, Australian Tax Office, and Department of Foreign Affairs and Trade. As a supplier to the Department of Defence through the Defence Industry Security Program, we play a key role supporting data transport, satellite ground communications, and maritime services, among a range of other capabilities.

5. An innovative approach

Vocus' strong record of delivering defence network solutions is backed by our world-class team of innovators, experts and service professionals. Forward-thinking and creative, we challenge the conventional in order to deliver the exceptional. We customise every solution to provide our defence customers the flexibility and adaptability they need to meet the challenges of today and tomorrow.

For more on how we're helping Australia go forward, go further and go faster, visit vocus.com.au

BIG AMBITIONS IN SPACE

WORDS
Dr Gregor Ferguson

AS SPACE BECOMES INCREASINGLY IMPORTANT TO DEFENCE – AND CONGESTED, DEFENCE IS WORKING TO ENHANCE SPACE DOMAIN AWARENESS WITH A SUITE OF TERRESTRIAL AND SPACE-BASED SENSORS TO HELP ENSURE SATELLITES CAN BE LAUNCHED AND ACHIEVE ORBIT SAFELY.

DEFENCE IS INCREASINGLY DEPENDENT on space-enabled capabilities for communications, surveillance and navigation, and has big ambitions in space. Defence Space Command, established under the RAAF last January and now under the ADF's Joint Capabilities Group, is working to deliver on a Defence Space Strategy released early last year.

The 2020 Force Structure Plan (FSP) listed seven space-related projects worth up to $20 billion over the next 20 years. The Defence Strategic Review (DSR) released on 24 April validated the importance of those projects and the basic imperatives facing the ADF in the 21st century.

2020 FSP SPACE PROJECTS

- Joint Project (JP) 9120 Satellite Communications, 2020-2030, $4.6-6.9bn
- Satellite Communications Assurance, 2028-2038, $1.7-2.5bn
- Terrestrial Operations in Contested Space, 2027-2038, $1.4-2bn
- JP9360 Space Situational Awareness, 2020-2033, $1.3-2bn
- DEF799 Satellite Imagery Capability (Access), 2020-2031, 0.4-0.5bn
- Sovereign Satellite Imagery Capability, 2020-2035, $3.2-4.8bn
- Additional Sovereign Satellites (imagery), 2031-2040, $1.2-1.8bn

As well as JP9102 (covered in the Autumn edition of *Wings*), JP9360 and Defence Project (DP) 799 are active and expected to introduce significant capability. JP9360, a consolidation of six separate but related sub-projects, aims to deliver enhanced space domain awareness (SDA), essentially assured access to space whenever Defence needs it, and DP799 will deliver access to commercial satellite imagery.

Placing any sort of satellite into orbit is increasingly risky as a couple of orbital bands, low earth orbit (LEO, out to about 2,000km) and geostationary orbit (GEO, around 35,786km), become congested. The risk of collision, both in orbit and during launch, has grown significantly over the past few years and stated plans by major satellite operators and manufacturers are destined to add tens of thousands of satellites in LEO alone over the coming decade.

Added to that is a growing inventory of decommissioned satellites in LEO, along with clouds of debris resulting

OPPOSITE Space Based Infrared System. Photo: Lockheed Martin.

BELOW Senior Researcher Dr Jason F. Alvino and Defence Space command, Space Control Group Coordinator Squadron Leader Justin Hill preparing the DSTG 50cm SDA Telescope for collecting observations of satellites and debris in orbit around Earth, in preparation for a training exercise. Photo: Peter Hoare/Defence

from previous collisions or from satellites breaking up. An object as small as a flake of paint, travelling at speeds of 10km/s, can disable a structurally fragile satellite. The European Space Agency estimated in 2021 there were more than 130 million objects greater than 1mm in size currently in orbit. In 2022, Inmarsat estimated that, after about 6,300 successful launches over the decades, there were more than 32,000 objects larger than 10cm in size orbiting the earth. And collisions, or deliberate destruction of satellites using anti-satellite weapons, create even more debris.

So SDA matters and a sovereign capability is important. Governments need to know what's happening and need to be able to take action based on their own firm knowledge. To help achieve a sovereign SDA capability, JP9360 will establish a suite of terrestrial and space-based sensors to help ensure satellites can be launched safely and don't conflict with other objects once in orbit – whatever that orbit may be.

It is understood that the original stove-piped approach to JP9360 didn't allow Defence the flexibility and agility to field state-of-the-art capabilities, often at relatively short notice. The private sector is developing new, fit-for-purpose products and services much faster than a traditional defence acquisition system can respond. The DSR acknowledged that dynamic, stating: "Given the speed of technological developments in space, the current capability life-cycle process is too slow. Defence must adopt an approach that emphasises speed of capability acquisition including off-the-shelf (commercial and military) capabilities."

Rapid technology development and Australia's deteriorating strategic circumstances are forcing a more urgent adoption of new capabilities. Russia can already hold every satellite in LEO at risk. China can hold assets in LEO, medium earth orbit (MEO) and GEO at risk. The implication is that Defence will increasingly acquire data as a service, rather than always seeking to own an exclusively Australian sovereign capability, though in some areas the sovereignty of a capability will remain paramount.

That approach is consistent with the first line of effort in Defence's space strategy, which is to "enhance Defence's space capability to assure joint force access in a congested, contested and competitive space environment". Objective 1a of that

ABOVE The C-Band Space Surveillance Radar System at full operational capability. Photo: Sophie Pearse/Defence.

LEFT Space Surveillance Telescope, Exmouth. Photo: Defence.

SENETAS

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line of effort is to develop an operating concept and architecture which is aligned with Defence's allies and international partners, but emphasises sovereignty and key Australian contribution and interests.

Objective 1b acknowledges the challenges facing Australian operators and industry: it is to develop a space program roadmap that identifies quick wins while balancing Australia's space capability needs against the essential requirement of value for money and the need to develop and foster a nascent Australian space industry capability.

JP9360 is now a single program that will be delivered in capability tranches. However, to help understand its scope and intent, it's useful to consider the original six sub-projects:

- AIR3029 Ph.1, the relocation of a former US C-Band Space Surveillance Radar from White Sands Missile Range to RAAF Base Learmont, Exmouth, WA
- AIR3029 Ph.2, the relocation of an ex-USAF Space Surveillance Telescope (SST)
- JP9350 Ph.1, the development of an ADF Space Situational Awareness (SSA now SDA) mission system
- JP9351 Ph.1, the development of a suite of indigenous Australian SDA sensors
- JP9352 Ph.1, the replacement of Defence's C-band space surveillance radar, also at RAAF Base Learmonth
- JP9355 and JP9356 which focus on the delivery of space-based Infrared imagery.

The first two of those sub-projects are already complete. The C-Band radar fills an important gap in the Space Situational Awareness Partnership between Australia and the US and is operated remotely from the JORN control site at RAAF Edinburgh, SA by the RAAFs No.1 Remote Sensor Unit. The C-Band radar is considered obsolescent as it can track only single targets in LEO. It is, however, a very high-fidelity sensor which makes it useful still for imaging spacecraft of interest. Joint Project 9352 Ph.1 was to replace it, but that program may be sidelined entirely by a new US Space Force project, the Deep Space Advanced Radar Capability (DARC).

Project AIR3029 Ph.2 implemented the relocation of a former USAF Space Surveillance Telescope (SST) from the Caribbean to Exmouth and was completed in 2019. The Exmouth installation required construction of a cyclone-proof rotating dome weighing 275 tonnes to house the sensor. The dome rotates with the SST to provide a 360-degree field of view to track space debris and help predict potential collisions.

Northrop Grumman has a US$341 million (AU$508 million) contract to build three radars at strategic sites around the world for the DARC project. The radars will be phased array sensors with steerable beams that can track multiple targets and powerful enough to image the GEO orbit as well as LEO. The first DARC radar is scheduled to be installed "somewhere in the Indo Pacific" by the end of 2025.

No frequency band for DARC has been declared, but the sensor can be operated in all-weather on a 24/7, 365 days a year basis, unlike the SST which is attenuated significantly by atmospheric phenomena and even the time of day.

The suite of indigenous Australian SDA sensors is proving interesting: while a sovereign SDA capability is essential, LEO coverage needs to be global because events happen fast enough in that orbit that a global network of sensors is vital to keep track of them. Thanks to AUKUS Defence has several options for both sovereign and joint surveillance and could select any or all of them.

The first option is a ground-based radar network: US company LeoLabs has built the sixth of a planned 20 S-Band phased array radar, at its own expense, at Collie in WA. The network includes existing radars in North America, Europe and New Zealand, and a seventh is under construction in Argentina. The objective is to detect objects as small as 2cm in size out to more than 1,000km and calculate the orbit of every object that passes through the network field of regard.

In terms of data acquisition and quality, an active radar provides 24/7 functionality and is probably superior out to about 2,000km. But a second option for Australia, optical sensing, can provide greater resolution of smaller objects, especially in GEO. Canberra-based EOS (formerly Electro-Optical Systems) claims to be the

A training event at the Responsive Space Operations Centre in Adelaide. Photo: Peter Hoare/Defence.

only provider of qualified optical SDA data in the southern hemisphere and Australia's leading provider of SDA data and services.

EOS SDA systems are fully interoperable with those of the US's Space Surveillance Network. It has a network of active and passive optical sensors located at seven separate sites in Australia and covering all orbital ranges from LEO to GEO. Its principal sites are at Mt Stromlo, ACT and Exmouth. EOS operates a Conjunction Analysis and Threat Warning service based on its own catalogue of orbital objects as well as evidence from other available data sources, depending on the customer and application.

The third option is to use space-based sensors looking out at both GEO and MEO orbital bands. Space-based SDA surveillance systems aren't affected by weather or light pollution so have unrestricted visibility. Additionally, they can view objects from different angles over short time spans, which may be an important feature of a reactive space capability.

Space-based surveillance is the domain of companies such as Adelaide-based Inovor Technologies whose Hyperion space mission aims to put a constellation of 12U cubesats (space for 12 units of payload) into orbit to observe the MEO and GEO bands. Inovor estimates that about 80 percent of the capital value of in-orbit space assets is located in GEO, so the investment is worthwhile.

Its cubesats will use a computer vision system it has developed in collaboration with the Adelaide-based Australian Institute of Machine Learning. The sensor can detect very faint objects using a proprietary machine learning algorithm.

A fourth option is to use passive radars of the type developed by two more Adelaide-based companies, Daronmont Technologies and Silentium Defence, though Nova Systems and German radar firm Hensoldt are also active in the Australian passive radar market. A passive radar uses ubiquitous radio signals – usually VHF and UHF radio and TV signals – to illuminate and then image targets passively.

Silentium's MAVERICK S deployable passive radar is designed to detect and track objects in LEO. A single radar can act as an independent sensor or gap filler, while a constellation of radars can be networked to provide higher resolution in a specific contingency.

The reality is that Australia needs a combination of all those sensor options for both military and commercial applications. Many of the companies mentioned offer data as a service (DaaS), while others offer a sovereign surveillance capability that needs a ground-based mission system for effective data fusion.

There are three reasons why a government would consider a DaaS provider: the first is cost – private sector providers with a multiplicity of commercial and defence customers can provide most of the capabilities a government might want for itself, but at a significantly lower cost. The second reason is the ability to

relatively quickly change providers if a new technology or commercial arrangement becomes attractive. The third reason is the sheer volume of data an SDA program can generate: LeoLabs, for example, estimates that it generates 200 terabytes of data every day, which presents a significant data-management challenge.

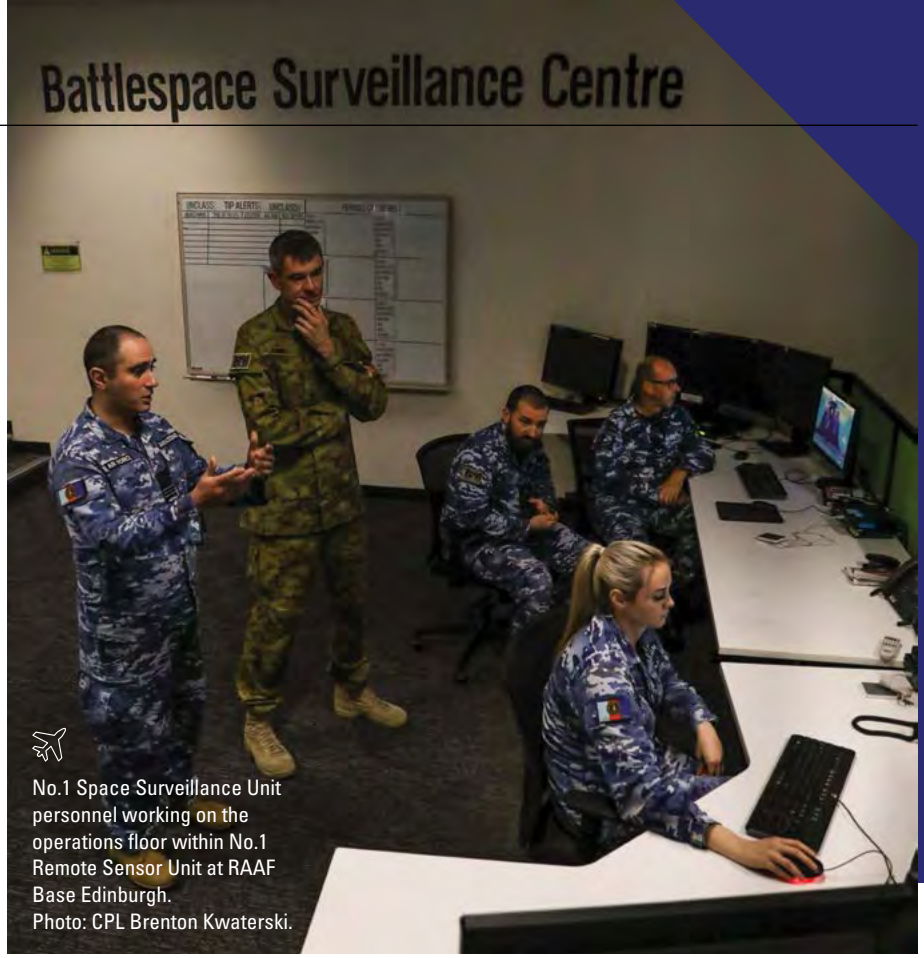
The configuration options in turn shine a spotlight on Defence's need for an SDA mission system, originally planned under JP9350 Ph.1. Defence released a Request for Tender last year for tranche 2 – a DaaS for ground-based and optical SDA systems, and a Request for Information for tranche 3- a command and control (C2) system and big data repository and management system for civil and military SDA products.

Both processes were halted by the DSR, and industry expects those tranches will be re-scoped as a result of the review. But the common view is that the C2 system lies at the heart of a sovereign SDA capability, so the onus is to find the right prime contractors who can pull together data from a disparate set of providers.

All programs were delayed to some extent by the DSR, though Defence Science and Technology Group's (DSTG) Resilient Multi-Mission Space (RMS) STaR Shot continued unabated. Airbus Defence & Space will design and manufacture four satellites, at least two of which will be based on its Arrow 150 satellite bus, to satisfy RMS at an all-new space facility in Adelaide. Those satellites will be placed in LEO over the next eight years. One objective is to deliver position, navigation and timing (both GPS and GPS-denied applications), communications and EO data direct to troops on the ground. The potential impact of RMS on JP9360 or the rest of Defence's space projects is unknown.

Meanwhile, it's worth noting that the US Space Force and its US military antecedents have a long history of working with DSTG on the detection of enemy missiles, both at launch and in flight. Project Dundee, for example, saw the Pentagon working with the then-DSTO on detection of ballistic missile launch plumes using the Jindalee Over-The-Horizon Radar at Alice Springs during the 1990s.

The Pentagon's then-Defense Support Program has evolved into the Space-Based Infrared System, or SBIRS, a constellation of six satellites in a combination of GEO and highly elliptical orbit designed to detect and track hostile missiles at launch and in-flight, provide guidance for missile defence systems and provide IR data to augment battlespace awareness. While the prime contractor is Lockheed Martin, whose LM2100 Combat Bus is the basis for SBIRS; the payload will be manufactured by Northrop Grumman. Both companies have a substantial footprint in Australia. Again, it's not certain whether Defence Space Command will join with the US Space Force in adopting SBIRS for Australian purposes.



No.1 Space Surveillance Unit personnel working on the operations floor within No.1 Remote Sensor Unit at RAAF Base Edinburgh.
Photo: CPL Brenton Kwaterski.

GOING COMMERCIAL

Defence often needs rapid access to commercial satellite imagery and Phase 1 of DEF799 demonstrated its value as a planning and resource-management tool in Operation Bushfire Assist during the 2019-20 bushfires.

DEF799 was expected to provide more opportunities for commercial imagery suppliers to support Defence. However, it is now believed to be linked to a US initiative, possibly a National Reconnaissance Office (NRO) program. Pending the release of further information, it's worth noting that the NRO awarded five-year Electro-Optical Commercial Layer (EOCL) contracts to commercial US space imagery providers BlackSky, Maxar and Planet Labs in May 2022.

The NRO acknowledges that commercial remote sensing offers increased transparency, mission-critical situational awareness, and humanitarian assistance benefits due to its unclassified and shareable nature. The EOCL contracts feature user-friendly license agreements and built-in flexibility that maximises shareability across a diverse customer base.

Earlier in 2022, the NRO also awarded five contracts for commercial Synthetic Aperture Radar data to Airbus US, Capella Space, ICEYE US, PredaSAR (owned by Terran Orbital) and Umbra Space under the agency's Strategic Commercial Enhancements Broad Agency Announcement framework.

It is possible the ADF could join those NRO programs in some way, or it could opt for a sovereign capability based on its own commercial arrangement with global imagery suppliers. The point is, the ADF has options – and many more than may have seemed open to it when the precursor projects to JP9360 and DEF799 were first mooted.

The entire space domain can be seen as one of options: while sovereignty matters in some areas, it isn't important or essential in all cases. So Defence is faced with deciding what matters most, investing to establish a sovereign capability in specific technology, and simply acquiring everything else as a service.

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- ✓ Lower sail in adverse conditions, holding station and for tactical range advantage
- ✓ Use unique 1.8m diam keel winch to carry, lower and recover sensors, modems and thin line arrays to varying depths
- ✓ Carry 300kg partner payload
- ✓ Power 150W partner payload 24/7 with 8 hours sun per day
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- ✓ Advance in all conditions
- ✓ Operate in strong currents e.g. East Australia and Leeuwin
- ✓ Operate in Doldrums with no wind or waves e.g. Timor Sea
- ✓ Navigate near reefs, shoals & islands e.g. Timor Sea and Indian Ocean
- ✓ Situational awareness, detection & classification via radar, 360 degree and PTZ cameras
- ✓ Communicate LIVE via hi and low bandwidth satellite
- ✓ Operate without fossil fuels and associated logistics
- ✓ Transport via RTA trailer & standard SUV
- ✓ Launch + recover from crewed vessels
- ✓ Launch + recover from ports with large tidal ranges e.g. Darwin and Broome
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- ✓ Launch + recover from a standard council boat ramp
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SECURING SECRETS FOR THE FUTURE

ALTHOUGH STILL YEARS AWAY, QUANTUM COMPUTING THREATENS A CATACLYSMIC CYBER EVENT.

EVEN IN THE FACE OF TODAY'S CYBER-THREATS, a 'cataclysmic event' looms. Quantum computing is considered the biggest ever cyber threat. Why, when it is still years away? Because today's conventionally encrypted data will be retrospectively vulnerable to future quantum computing attacks.

It's so serious that the US Government has signed the Quantum Computing Cybersecurity Preparedness Act mandating the migration of federal agencies to quantum-resistant IT and encryption security. Defence and government data demand quantum-resistant encryption protection now because the highest-value data has a life of 20-plus years.

Quantum computing will have a transformative effect on the global economy. Once commercially available, its advantages will span industries, enhancing associated technologies and allowing complex problems to be solved like never before. However, those advances will not come without risk. Quantum computers will change cybersecurity significantly, especially cryptography.

There are three parts to encryption. It begins with a source of randomness (entropy); numbers used to seed keys must not be vulnerable to prediction or bias. In the quantum era, randomness will become even more crucial because quantum computers will be able to ascertain patterns much more quickly than today's computers. Quantum random number generators provide high entropy and a true source of randomness by leveraging principals from quantum physics.

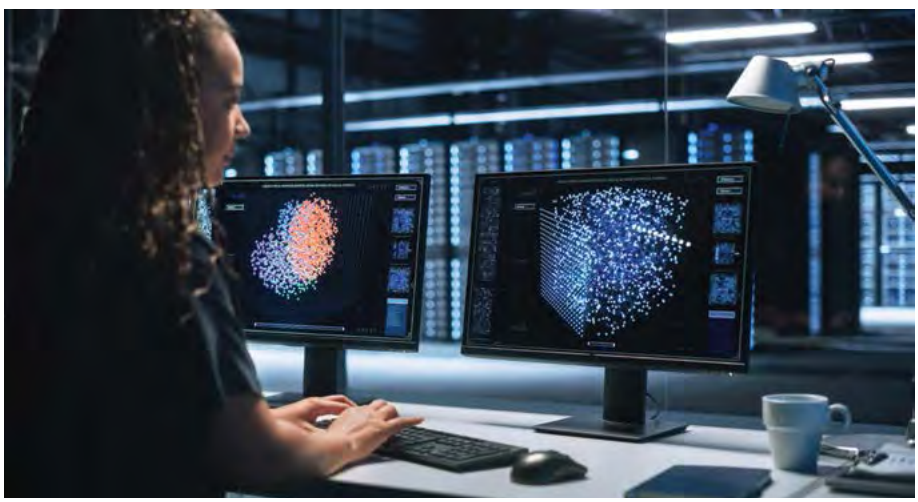
Once keys are generated, they must be distributed in a way that guarantees forward secrecy. Quantum key distribution guarantees forward secrecy, using a quantum principle known as the 'observer effect'. If intercepted and observed in transit, the sender and receiver would be alerted that the key is not safe to use.

Last but not least are the algorithms themselves. While it's established that today's classical algorithms are all vulnerable, quantum-resistant algorithms are designed to remain secure post-quantum. Post-quantum cryptography will use algorithms that are secure against attacks from both quantum and classical computers.

National Institute of Standards and Technology evaluation of finalist candidates for the Post-Quantum Cryptography Standardization project is expected to be completed in 2025. It intends that new public-key cryptography standards will specify one or more additional unclassified, publicly disclosed digital signature, public-key encryption, and key-establishment algorithms capable of protecting sensitive information well into the foreseeable future (after quantum computing arrives) are made available worldwide.

Defence, its supply chains and government organisations should encrypt all sensitive/targeted data – from data at rest and in use, to data in transit across networks, secrets and IP. Today, organisations must ensure the encryption technologies they use are fit-for-purpose and enable quantum-resistant encryption, to avoid future cataclysmic data breaches.

Simon Galbally, CMO Senetas



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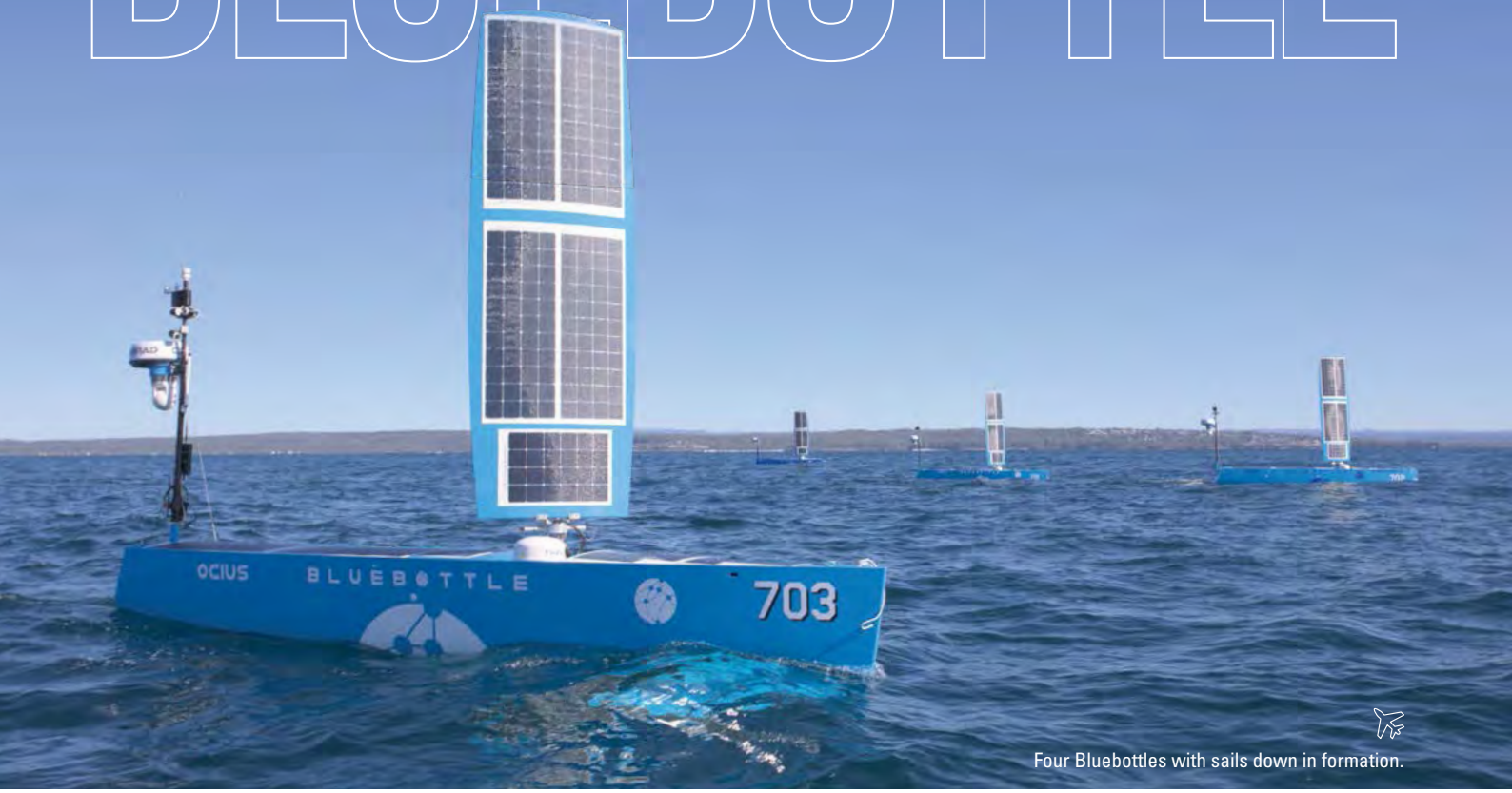
A FRIENDLY BLUEBOTTLE



Four Bluebottles with sails down in formation.

AN AUSTRALIAN-DESIGNED AND BUILT UNCREWED OCEANOGRAPHY VESSEL IS BEING ENGAGED IN MULTIPLE TASKS, FROM UNDERSEA MAPPING TO SURVEILLANCE OF ILLEGAL FOREIGN FISHING VEHICLES.

AUSTRALIA HAS A VAST MARINE JURISDICTION, the third largest in the world, with an exclusive economic zone (EEZ) covering 8.2 million square kilometres. Recognising the expense and resources required to monitor that massive area using crewed systems and satellites, it was inevitable that Australia would employ autonomous systems.

One of those solutions is the Bluebottle uncrewed surface vessel (USV) from Ocius Technology. Designed and built in Australia for Australian conditions, the 7m long single-hull vessel has proven to be a highly efficient uncrewed oceanography vessel for multiple ocean monitoring purposes. Powered by three forms of untethered energy – solar, wind and waves – it can roam freely in our EEZ, with Australian Maritime Safety Authority (AMSA) approval, while carrying up to 300kg of surveillance payload, powered continuously and sustainably with 150W of energy from environmental sources. Typical missions last 30-40 days and are only limited by biofouling.

"We started in 2000 building solar and wind-powered hybrid electric ferries and in 2010 during the GFC, we had an enquiry from the USA asking if we could build a platform 'that could go to sea forever'," explains Ocius Technology founder and CEO Robert Dane.

"We thought we could and started building a 10 foot (3m) prototype called Nemo in 2013. We got the attention

of Navy and since 2015 we have been working under three different Australian Federal Government innovation contracts, producing demonstrable prototypes and optimising capabilities accumulating over seven years to about $10 million investment."

Those contracts, developed in close partnership with the Royal Australian Navy (RAN), finished in March 2022 but were extended to continue work with Border Force and Army. In November 2022, the RAN ordered five Bluebottles and they have now been delivered on time and budget. Ocius is currently under contract to operate the craft off the Australian east coast.

Ocius worked with Cobham Air to provide intel on illegal foreign fishing vessel (FFVs) movements. Bluebottles would locate the FFVs on radar, approach to a distance and clandestinely track the intruders with a zoom camera, and Border Force would be informed. Of course, as soon as the Border Force vessel came over the horizon, the fishers would attempt to flee but the Bluebottle surveillance was able to direct the Border Force straight to them. The surveillance products then provided a chain of evidence to support prosecution.

The company has also performed a one-month trial for the Australian Marine Parks (AMP) off Perth, WA, demonstrating the Bluebottle's utility at policing Marine Sanctuary regulations. Missions saw Bluebottles 'stinging' illegal fishers by recording the illegal activity with hi-res zoom photos, hull number identification, geographic location, time and date. AMP has awarded Ocius a second contract to patrol another area off the east coast.

Ocius has just completed a trial of bathymetric seabed mapping and sub-bottom profiling of two active volcanoes about 1,290km south of Tokyo and 1,290km north of Guam. The company experienced two cyclones in the two-month trial and struggled in the high seas and overcast conditions. The exercise demonstrated the need for more power for the large sensors and propulsion to keep the 'lines' very tight. Ocius is therefore building a new Bluebottle called Bathy which remains 7m in length but will have a 5kW genset in the payload bay and 400 litres of diesel in the keel to deliver the power required for bathymetry and hydrography work.

ABOVE Operation Resolute.

BLUEBOTTLE ORIGINS

Named after the Australian jellyfish which uses its body as a sail, the Bluebottle was born from Robert's 25-year background of sailing small boats and inspired by a solar boat race.

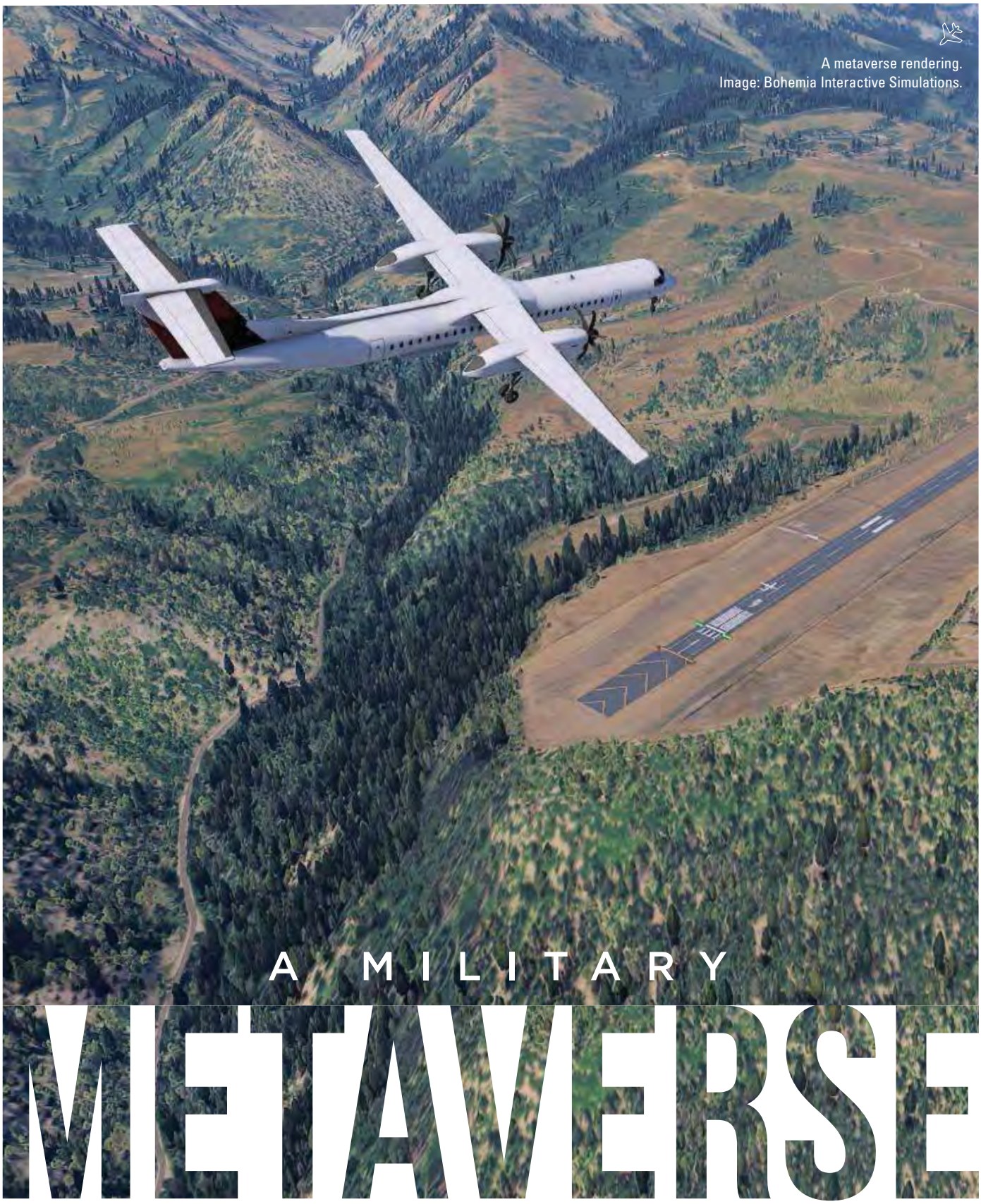
"In 1996, I saw the Advanced Technology Boat Race in Canberra, where the solar boats were like solar cars, with panels flat on the deck, and I thought how could we design a boat that could use solar as well as wind and also be seaworthy?" Dane says.

"That thought really stuck in my head, and I asked the judges if I could enter a boat with solar panels on large Malibu surfboards, angled to the sun and wind and they said they'd like to see that. So, with a bunch of friends, we entered a boat designed just like that, and we beat the next solar boat in a 60km race by 30km."

A Bluebottle USV on a trailer looks like a normal 7m sailboat but has several unusual features. First it has a solar sail – a rigid sail that folds into the deck. Second, the rudder is at the bow because it has a flipper on it to harness wave energy from the pitching of the boat. Finally, the Bluebottle sits on the trailer on its relatively large keel which is able to house a patented keel winch used to deploy and retrieve subsurface sensors if required for a specific mission.

"In the last 15 months, four Bluebottles have clocked over 30,000nm unescorted roaming in the EEZ. Over that time, they have lost two solar sails, one rudder, several flippers and power to the propeller a few times, but because of redundancy and power from alternative sources – solar, wind or waves, they've been able to stay safe and 99 percent of the time recover to base. On only four occasions, Ocius has been required to tow a Bluebottle home but through good design, good management and a bit of good luck, a Bluebottle has not yet been lost."

Bluebottle has been designed to be launched and recovered by two people from a standard boat ramp, due largely to the fact Ocius didn't have a lot of money in 2015 and it saved the company a fortune over the years in many trials and operations. For the customer, it means the Bluebottle not only doesn't need crew, food or fuel, it doesn't require a support boat or a crane to launch.



A metaverse rendering.
Image: Bohemia Interactive Simulations.

A MILITARY METAVERSE

THE MILITARY'S USE OF SIMULATION HAS EVOLVED TO INCORPORATE ADVANCED TECHNOLOGIES AND INNOVATIVE APPROACHES, BUT CORRELATING ACCURATE AND UP-TO-THE-MINUTE TERRAIN DATA IS A CHALLENGE.

A pilot flies the No. 76 Squadron Hawk 127 Simulator during a trial of eye tracking technology. Photo: CPL Brett Sherriff.

IMAGINE A SCENARIO WHERE ADF PERSONNEL are immersed in a conflict alongside allied forces. The view from an E-7 Wedgetail aircraft provides a complex picture of the battlespace. The allied ground forces are now deployed, and the enemy's air capabilities have been momentarily neutralised by the combined air defence of the naval task force and allied air assets. The ability to support allied ground forces with intelligence, surveillance, combat support and logistics while coordinating with their integral air defence becomes critical for the campaign's success.

Friendly forces have meticulously prepared for the campaign, actively engaging in experimentation and collaboration with allied partners to develop doctrine and effective tactics, techniques and procedures. They have dedicated themselves to extensive practice in simulators, simulations and live training, honing their proficiency in the likely operational terrain. Furthermore, they have undertaken comprehensive preparations through wargaming, simulating key engagements, and actively rehearsing on the computer-generated terrain where the battle will unfold.

In the above scenario, the immersive and realistic terrain environments provided by simulation platforms enable ADF personnel to gain a deep understanding of the operational environments they may encounter during real-world operations by accurately representing terrain features such as elevation, vegetation and structures.

The influence of terrain extends far beyond visual aesthetics. Terrain significantly affects military tactics, strategies and decision-making. Different terrains present unique challenges and opportunities, influencing mobility, cover and concealment, line of sight and communication. By simulating diverse terrains, military simulations allow personnel to practice adapting their tactics and making informed decisions based on the specific characteristics of the physical environment. That type of training enhances the readiness and preparedness of the armed forces by ensuring personnel are equipped to navigate and overcome the complexities posed by different terrains.

Interoperability is essential in joint operations, where collaboration between different branches of the armed forces and allied nations is common. Likewise, the interoperability of the simulations used by different nations, branches and services. Terrain correlation therefore becomes critical when different simulations from various vendors are connected or used together. Correlating terrain data by aligning and synchronising it across simulations ensures all participants share a common understanding of the virtual environment, enabling seamless interoperability, effective communication and coordinated actions.

MILITARY METAVERSE

Over the years, the military's use of simulation has evolved to incorporate advanced technologies and innovative approaches. A recent op-ed by Jennifer McArdle and Caitlin Dohrman on warontherocks.com envisaged the concept of a 'military metaverse', a persistently simulated environment. A metaverse could have many useful applications, from training to mission planning and rehearsal for real-world operations. "Under the hood" of such a military metaverse would be a mix of simulation technologies to provide the user with a seamless experience, for whatever purpose the metaverse may be applied. The military metaverse concept is a step-change from today's approach of integrating different simulation products through standard interoperability protocols and instead running containerised technology "on the cloud" using a modern and open web architecture.

Since the 1980s, different military programs have worked to combine "models, simulations, people, and real equipment into a common representation of the world", according to a technical evaluation report presented at the NATO Modelling and Simulation Group Conference in 2001. Most recently, the US Army established the Synthetic Training Environment (STE) Cross-Functional Team to create a "common synthetic environment", which shares many of the concepts of a military metaverse. The team's goal is

to converge live, virtual and constructive training through "common standards, common data, common terrain, and an open architecture". A so-called one-world terrain underpins the STE, allowing training anywhere in the world at any time.

Whatever form future military metaverses take, terrain data will be a key factor driving their success. High-fidelity terrain data will deliver a 1:1 digital twin of Earth, suitable for training in multi-domain operations (MDO), mission planning, mission rehearsal and more. However, today's stove-piped and slow terrain development processes will not satisfy that dynamic need. To meet the needs for some training and mission rehearsal tasks, terrain source data (e.g. 3D data from an on-demand drone or satellite flyover) must be imported, enhanced, stored and streamed to applications that need it, with updates made in hours, not weeks or months.

Flying Officer Amanda Kent, a No. 453 Squadron Air Traffic Controller trains in the air traffic control simulator at RAAF Base Richmond. Photo: CPL David Said.

TERRAIN GENERATION

Creating terrain for simulation is one of the more difficult and expensive components of a high-fidelity training system. Traditionally, terrain databases consist of a hundred-plus data formats with dramatically different levels of fidelity depending on the target applications. A flight simulator might need terrain that is low fidelity (e.g. a simple satellite textural overlay), while a tank gunnery trainer might need every tree and bush rendered in high fidelity. Updating terrain data can take months, and terrain databases rarely correlate perfectly (look exactly the same), causing "fair fight" issues in a connected/interoperable environment. There are a number of key challenges to deliver a useful solution.

Defence organisations have used commercial-off-the-shelf (COTS) terrain and geospatial data since the 1990s. Pulling from multiple data sources results in a more realistic representation of real-world terrain. By importing high-resolution satellite imagery, road and building positions, forestry data, surface definitions (grass, sand etc.) and seasonal data, simulations can render a more accurate digital twin – a simulated environment that better represents the real world. Obviously, all source data needs to be precisely geo-referenced, and that is especially important when custom 3D models are placed in/on the terrain.

Today's leading militaries, including the ADF, have a strong focus on MDO, which can span vast distances and incorporate land, sea, air and space forces. The US Space Force stated its priorities include moving "toward a more resilient on-orbit posture" at the same time that conventional forces have focused training on traditional combined arms operations. To support the full range of multi-domain training, terrain databases need to provide an accurate representation of the Earth from space down to blades of grass and the ocean floor. Acquiring the appropriate source data to build such a high-fidelity digital twin of Earth is a challenge. Updating terrain with new source data is also important.

Currently, modern military forces use many different simulations and often connect them with command and control systems for combined arms training. The US Army, for example, has an entire program dedicated to providing "the framework for integrating the Army's live, virtual and constructive systems into an integrated training environment". Simulations ingest terrain data in various formats and for integrated training to be successful, each simulation needs terrain data that is correlated with all of the other simulations. For example, if a Joint Terminal Attack Control (JTAC) simulator is connected to a flight simulator, then both simulators must provide their operators with exactly the same "out of the window" view.

A number of products exist to build correlated terrain from source data, for example TerraTools, but elements may not look exactly the same depending on the rendering engine (e.g. Unreal vs. Unity). Generating correlated terrain that looks exactly the same across multiple rendering engines can be much more expensive and time-consuming and may even require custom modifications to the simulations to support all the necessary terrain features (such as caves, dense urban areas or deep snow cover). Terrain is typically built to the lowest acceptable fidelity to achieve correlation while minimising processing complexity – noting that many military simulations cannot handle real-world fidelity (e.g. high tree density or megacities).

GAME-LIKE 3D TERRAIN

Procedural generation of the terrain is a technique used to add real-world complexity/fidelity to a game world that is based on relatively low-fidelity source data. For example, trees, bushes and grasses that populate a forest may be procedurally generated if the area to be simulated is known to be forested, so the environment looks "real" in the simulation. Many modern computer games and game engines support procedural generation. Popular entertainment titles like Kerbal Space Program, Star Citizen and Elite Dangerous use procedural generation to populate entire planets with features like trees and rocks.

While procedural generation technology has existed for over two decades, it hasn't been leveraged by military forces for terrain simulation, primarily because it is engine specific. That means the procedural

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generation typically happens at run-time, just before the scene is rendered, breaking correlation with simulations that don't support exactly the same procedural generation. That divergence greatly exacerbates the issues with building terrain for multiple runtimes described above. Open standards for terrain – for example, Open Geospatial Consortium recommended against procedural generation for that reason. That results in low-fidelity terrains, possibly suitable for flight and high-level aggregate constructive simulation, but not suitable for ground-based training.

Almost all of us have a smartphone and are familiar with apps like Google Maps that stream terrain from a cloud-based server to our phones. Distributing terrain across military organisations is rarely that simple. Terrain files that are typically many gigabytes in size are either copied across the network or distributed on SSDs and, in some cases, DVDs. Despite the obvious cost in terms of time, there is also an administration challenge with update coherence; users must manually delete old files and copy in new ones, perhaps on hundreds or thousands of PCs. The problem is compounded by the number of different simulations supported. Updating terrain across a typical battle simulation centre can be daunting.

While the military has successfully integrated different simulations for many years, support for dynamic terrain correlation has never been fully achieved. Obviously, military actions affect the terrain in many ways, from vehicles making tracks to craters from artillery to the destruction of homes and infrastructure. Ideally, those changes would be represented in the same way in all connected simulations. The operator in the JTAC simulator would observe the same effect on the target as the pilot in the flight simulator, even though they might be using different rendering engines to visualise the scene. That will be even more important for the military metaverse when all connected technologies must access terrain that represents a single "source of truth". Dynamic terrain modifications need to be stored centrally and affect all aspects, from physical simulation (e.g. vehicles driving over rubble) to artificial intelligence (e.g. fleeing civilians unable to use a destroyed bridge) to the visual scene (e.g. destroyed buildings).

Thanks largely to innovations in cloud computing, AI procedural generation, and data collection (e.g. photogrammetry), those terrain challenges are rapidly being solved by leading industry players. That capability is critical for military metaverses. For example, for the US Army STE to succeed, high-fidelity terrain must be available on-demand to the connected applications that need it.

Good source data is now readily available from providers like MAXAR and LuxCarta. Less than a decade ago, only satellite (or aerial) imagery was available to texture terrain for simulation. Today, MAXAR can provide 3D data for any location on the planet, LuxCarta can automatically extract data from imagery to feed into procedural generation algorithms, and OpenStreetMap provides the majority of the world's roads and building footprints, from which the smallest villages to the largest megacities can be generated to support simulated training.

Founded in 2020, blackshark.ai provides a 3D digital twin of Earth by extracting information from satellite imagery and fully automatically reconstructing detected attributes in photorealistic 3D. A scalable AI builds the core of the blackshark.ai platform, detecting features globally with incredible accuracy and speed. A patented approach to 3D reconstruction can store petabytes of data and render it in infinite detail in real time, allowing for powerful visualisation and simulation applications for government, geospatial intelligence, humanitarian relief, planetary management, autonomous driving and flying, insurance, smart cities and more.

New platforms like Mantle ETM from Bohemia Interactive Simulations are solving terrain correlation and dynamic terrain problems by moving procedural generation (for example, from blackshark.ai) onto the cloud and streaming 3D content directly to supported applications. Mantle ETM is a custom-built platform based on proven COTS components and expert design/development services for creating simulated terrain for visualisation, training, mission rehearsal and terrain analysis. A version of the cloud-enabled Mantle ETM platform is already used within the US Army's STE, working with many different terrain data input formats, including 3D data from One World Terrain.

Cloud computing will, of course, enable the military metaverse, and at a recent panel on the future of the STE, Brig Gen. Jeth Rey, Director of the Network Cross-Functional Team in US Army Futures Command, made his team's priorities clear. "We are looking to move from a network-centric to a data-centric environment to support the STE," he said. "We will have to have cloud capability, AI, and machine learning."

The importance of understanding terrain for military operations cannot be understated and therefore being able to appropriately represent terrain in simulations is critical. The road to the military metaverse goes through the interconnectivity of systems and data, in particular terrain data, where a cloud-capable enterprise terrain management system will be required to achieve the future needs of coalition and joint military activities.

A JTAC student confirms target coordinates during a live fire serial at the Delamere Air Weapons Range, NT. Photo: CPL Nicci Freeman.


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MATHS KEEPS FLEETS FLYING

DSTG SCIENTISTS HAVE DEVELOPED SOFTWARE TOOL TO KEEP RAAF FLEETS OPERATING SAFELY, WHILE MINIMISING COSTS AND MAXIMISING FLEET AVAILABILITY.

A MATHEMATICAL TOOL DEVELOPED BY DEFENCE SCIENTISTS can be used by aircraft fleet managers, including the RAAF, to consider the suitability of extending airframe inspection intervals. Longer times between inspections introduces cost savings and leads to increased aircraft availability.

The team behind the FracRisk tool, DSTG scientists Dr Ribelito Torregosa and Dr Weiping Hu, received a Vice Chief of Defence Force (VCDF) Capability Award earlier this year for their achievement. FracRisk was one of only six VCDF Capability Award winners chosen from a field of 170 across Defence this year. It was a proud moment for the developers, who have been toiling away on FracRisk for more than a decade.

According to Dr Torregosa, there is a numerical value specified in the safety standards for the acceptable risk of catastrophic fatigue-related failure of aeronautical components.

"What FracRisk does is prove that even if we do inspections less frequently, the risk of catastrophic failure is still lower than the standard demands," he asserts.

"Back in 2010, there was a new requirement from Defence's airworthiness authority (DGTA, now DASA) to develop an in-country capability to conduct probabilistic risk analysis to predict the likelihood of an aircraft incurring fatigue-related structural damage."

Dr Torregosa has a background in earthquake and structural engineering, fields heavily reliant on probabilistic risk analysis (like fatigue-related failures, earthquakes don't happen that often).

He and Dr Hu first took a look at Defence's C-130H Hercules fleet. "Initially we were considering using commercial software," Dr Torregosa says. "But we realised we couldn't use the standard software so I proposed that we develop software from scratch. Having in-house software would have benefits; we'd be able to update the software much more easily, for example."

Dr Torregosa's mathematical algorithms in FracRisk combine several types of data including in-service findings and theoretical calculations. The pair was able to use FracRisk to process Hercules aircraft data and arrive at the same analytical results as the manufacturer, Lockheed Martin. After being independently verified and validated, and undergoing several upgrades, the FracRisk tool was transitioned to the industry last year. It is available as freeware to registered users from DSTG's public website, dstg.defence.gov.au.

The Fracrisk success means Australian Defence scientists now have a sovereign capacity to respond rapidly to urgent requests. "The development of FracRisk also now opens more opportunities in DSTG," says Dr Torregosa. "Because we own the program, when we have an idea for an upgrade, we can easily implement it without delay. Winning the VCDF award is the most exciting thing because this is an award covering the whole of Defence. It's definitely my proudest Defence achievement."

ABOVE Vice Chief of the Defence Force Vice Admiral David Johnston AC, RAN presents Dr Torregosa and Dr Hu with a VCTD Force Capability Award. Photo: Lauren Larking.

TOP Historical image of paratroopers exiting a RAAF C-130H Hercules over Australian bushland.

DELIVERING FOR DEFENCE

RAPIDLY EMERGING AS A CENTRE-OF-GRAVITY FOR SPACE ACTIVITY, SOUTH AUSTRALIA'S DEFENCE SECTOR IS IDEALLY PLACED TO MEET THE OPERATIONAL NEEDS OF DEFENCE PROJECTS.

ABOVE The Jindalee Operational Radar Network.

SOUTH AUSTRALIA IS FAST BECOMING the ADF's operational hub for information warfare, with leading capabilities in intelligence, surveillance, reconnaissance, cyber and electronic warfare operated and supported from the Edinburgh Defence Precinct (EDP).

The EDP hosts the state's largest Defence presence, encompassing RAAF Base Edinburgh, the Defence Science and Technology Group's largest Australian operations, a network of defence industry and the Woomera Range Complex,a critical test and evaluation range for next-generation systems.

Over the past decade, the precinct has become a key centre for the ADF's aerospace and information warfare programs, with the establishment of the Air Warfare Centre, Jindalee Operational Radar Network, space capabilities, 92 Wing and 1 Remote Sensor Unit. Electronic Warfare capability has also been bolstered, with the opening of the Pitt-Johnston Electromagnetic Warfare Research Centre.

Strengthening the nation's surveillance capabilities, RAAF Base Edinburgh will also be home to Australia's new MQ-4C Triton and the MC-55A Peregrine, with the first delivery of the latter due this year. Construction is also due to start soon on a purpose-built Defence 737 deep-maintenance and modification facility adjacent to the base, that will provide the critical infrastructure necessary for the onshore maintenance and upgrade of both the P-8A Poseidon and the E-7A Wedgetail fleets.

Defence SA Chief Executive Richard Price says South Australia continues to prove itself as a leading force in delivering sovereign defence capability. "South Australia is a hub of Defence activity, and we are recognised as having some of the country's most important defence precincts supported by world-class infrastructure," he says. "Our defence sector is robust, determined, forward-thinking and globally competitive. Combined with our innovative research community, cutting-edge technology and a highly skilled workforce, South Australia is in the prime position to support and deliver ADF projects."

According to Price, the state's lead role in the delivery of the nuclear-powered submarine program and advanced technologies under Pillar II of the trilateral AUKUS partnership, will further cement SA's standing as the Defence state.

"South Australia's shipbuilding expertise is second to none, and our role in the nuclear-powered submarine build places us at the centre of the most transformative industrial endeavour in Australia's history," he says. "However, our state's strengths and opportunities are much broader than naval shipbuilding, with our high-quality research depth and industry expertise in advanced capabilities including information warfare, quantum sensing and passive-radar technologies, creating opportunities right now that will continue for generations to come.

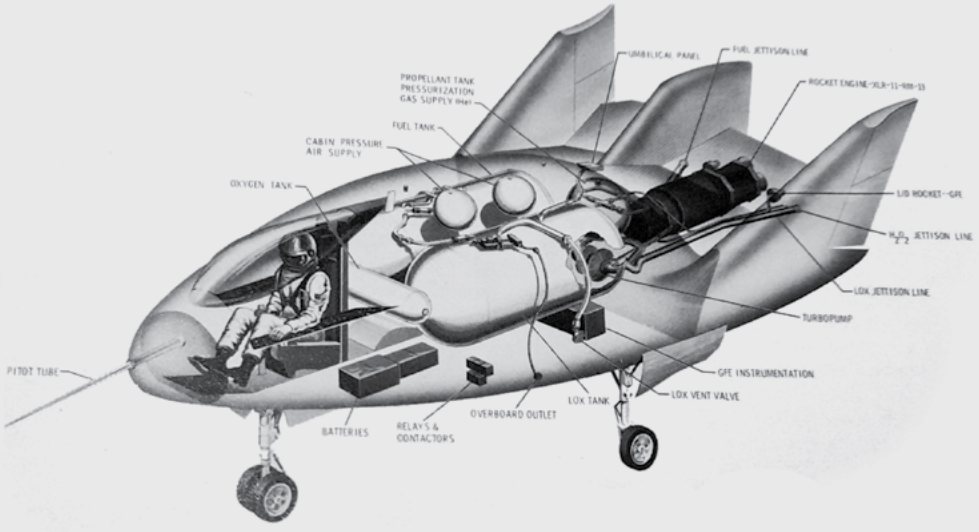
"In South Australia, we are working hard to deliver for Defence. We are committed to growing the skills and capabilities of our defence industry, to support the success of our national Defence agenda and ensure we are building Australia's sovereign capabilities now and into the future."

Learn more at defencesa.com

ORBITAL BOMBERS & LIFTING BODIES

THE X-20 TO X-38 EXPERIMENTAL AIRCRAFT INCLUDED WINGLESS 'LIFTING BODY' DESIGNS THAT CONTRIBUTED TO THE SPACE SHUTTLE PROGRAM.

WORDS Michael Nelmes



A NUMBER OF AMERICAN HIGH-PERFORMANCE AIR AND SPACE DESIGNS were at least partly inspired by World War II concepts from Nazi Germany.

Northrop's 'tailless' swept-wing X-4 used a semi 'flying wing' design which built upon not only Jack Northrop's earlier designs, but also German work in the 1920s and 1930s by Alexander Lippisch and the Horten brothers. Its more immediate inspiration, Britain's DH.108 jet, bore striking similarity to the wartime Messerschmitt Me 163 rocket fighter. Results from the X-4 flight test program influenced a number of future designs.

The X-5 with its variable-geometry or 'swing' wings was based on the wartime Messerschmitt P.1101 prototype. That innovation saw fruition in the 1960s with the F-111, and later with the F-14 Tomcat fighter, B-1 Lancer bomber, Europe's Tornado multirole fighter and, most prolifically of all, in the USSR with numerous MiG, Sukhoi and Tupolev attack/bomber designs.

America's space program was kick-started by German wartime scientists

Lifting-body family: X-24A, M2-F3 and HL-10 at NASA Flight Research Center, Edwards AFB. Photo: NASA.

ABOVE Artist's concept of the X-20 Dyna-Soar separating from its Titan launch rocket. Image: USAF.

BELOW LEFT The X-24A's internals were dominated by fuel and liquid oxygen tanks for the XLR-11 rocket engine. Image: NASA.

who had worked on Nazi rocket projects such as the V-2 and Me 163 and who were 'imported' to the USA after the war through Project Paperclip. Another German wartime idea, from the fertile minds of Dr Eugen Sänger and his future wife, Dr Irene Bredt, seemed like pure science fiction at the time, but laid the groundwork for America's postwar 'lifting body' aerospace planes.

NAZI ANTIPODAL BOMBER

Sänger and Bredt's *Antipodenfergleiter* (antipodal long-range glider), codenamed *Silbervogel* (silver bird), was a design proposal submitted for Germany's *Amerikabomber* project. With a length of 28m and a 90t fuel load, it was to be launched from a rocket sled riding a 3km rail. Entering a rocket-powered 30-degree climb, the bomber was to reach a speed of 6km per second – more than half the Earth's escape velocity. Its rocket fuel expended, it would skip, like a pebble on water, on the atmosphere after descending from 145km altitude. Using that technique, it was expected to travel 24,000km to the other side of the world – the antipodes, and along the way bomb a target such as New York before atmospheric re-entry and landing in Japanese-held Pacific territory for reuse.

Fantastic as the scheme was, considering the level of technology of the era, the craft's weapons payload would not have justified the effort and resources expended. Even if its bomb could be guided to a target, its efficiency would have been inferior to that of the V-2 rocket. Itself a 'space bomb' of sorts, the V-2 could reach an altitude of 175km and guide a one-tonne warhead towards a target at hypersonic speed, though not accurately.

Sänger and Bredt's antipodal bomber proposal was captured by US forces at war's end and sparked some interest in America when it re-surfaced a few years later. The rail launch technique (used at a smaller scale in 1944-45 for launching V-1 flying bombs) did at least appear in science fiction on the silver screen. In the 1951 film *When Worlds Collide*, for example, it was used to launch the huge 'space ark' rocket which saved mankind from destruction.

BOEING X-20 DYNA-SOAR

Among the German rocket scientists brought to America under Project Paperclip were Krafft Ehricke and Dr Walter Dornberger. Ehricke had published work on space flight to Mars, and Dornberger was the wartime major-general who had co-ordinated the V-2 program – and, famously, the man to whom Hitler apologised for dismissing his military rocketry proposals.

Working for Bell Aircraft Corporation in New York in 1952, Dornberger and Ehricke submitted a design for a glide-bomber. Less ambitious than Sänger and Bredt's proposal, it would be launched by two-stage rocket to an altitude of 100,000ft, reach Mach 4 and traverse about 5,000km.

Although official reaction to the space bomber concept was lukewarm, the USAF Air Research & Development Command (ARDC) at Edwards Air Force Base, California saw the idea's potential for reconnaissance. In 1954, ARDC began backing research into hypersonic sub-orbital vehicles and three years later instituted a program called Dyna-Soar (for dynamic soaring). The program's aim was to develop a manned hypersonic test vehicle to investigate the flight regime beyond that of the X-15 which was then in development. The goal of the three-step Dyna-Soar program would be an orbital vehicle, the X-20, for military reconnaissance with bombardment as an additional option.

Proposals were sought from industry. Lockheed, Republic and North American devised plans for an orbital 'satelloid'. Douglas, McDonnell, Convair, Martin, Bell, Northrop and Boeing proposed a maneuverable manned glider boosted to 300,000ft altitude and a speed of 28,000kph. The glider could reach the other side of the globe while sub-orbital and, as an aerodynamic design, return to land conventionally for re-use.

The National Advisory Committee for Aeronautics (NACA) agreed to provide technical advice to the air force. By November 1958, when an agreement was signed, NACA had become the National Aeronautics & Space Administration (NASA). The Dyna-Soar development phase called for air-drop tests from a B-52 mothership (designated NB-52B) to begin in 1962. Early tests were to include acceleration to supersonic speed using a Thiokol solid fuel rocket. Manned sub-orbital launch tests were to follow, and finally the first manned global flight would be made in 1963. An offensive weapons system was to be operational by 1967.

The X-20 was planned to be launched on top of a Titan IIIC rocket, reach 320,000ft nine minutes after launch, and enter a 24,000km trajectory. It would deliver a half-tonne weapons payload from space, re-enter the atmosphere and, 105 minutes after launch, touch down with a landing speed of 280kph.

Designed to withstand the temperatures and forces associated with atmospheric re-entry, the X-20 was to be constructed of exotic materials. The primary metal was a nickel alloy called René 41 (also used for the shingles covering the Mercury space capsule). The underside heat shield and wing leading edges would be of molybdenum, and the nose cone of graphite with zirconia rods. The gap between the outer heat shell and the internal shell was to be water-filled to dissipate heat by evaporation. Heat exposed surfaces would be covered in a ceramic material, later used for heat tiles on NASA's space shuttle.

Attitude control in space was to be accomplished with nose and tail-mounted thrusters and, following re-entry, hydraulically actuated elevons would control roll and pitch. The pilot's control stick, a small side-mounted joystick for high-g situations, was adopted later on the F-16 fighter and some modern airliners. The windshield windows, resembling those used on the space shuttle, were covered with an alloy heat shield which would be jettisoned after re-entry.

The X-20 project progressed far enough for five USAF pilots and one from NASA to be selected to fly it. However, after a full-scale mockup had been built, funding constraints and delays moved the scheduled date for its first piloted launch back by three years, to 1966, and the program was finally cancelled before the partly built X-20 had flown. Nevertheless, its legacy lived on, notably in the space shuttle program and in Boeing's later X-40 Space Maneuver Vehicle and X-37 Orbital Test Vehicle for US Space Force. To quote Jay Miller in his book *The X-Planes*: *In particular, fundamental re-entry heating dynamics technology generated by the X-20 materials research program served as the single most important data base available in the US at the time Rockwell International initialed work leading up to the space shuttle… In total, few vehicles have contributed more to the science of high-Mach flight, and even fewer have done so without ever having reached the actual hardware stage.*

NASA M2-F1 LIFTING BODY

The true 'lifting body' concept was developed in the late 1950s by Dr Alfred J. Eggers Jr, assistant R&D director for Ames Aeronautical Laboratory (later NASA Ames Research Center) at Moffett Field, California. By slightly modifying the shape of a spacecraft's symmetrical nose cone, he found, aerodynamic lift could be produced.

The idea was further developed by aerospace engineer R. Dale Reed at NASA's Flight Research Center (FRC, later Dryden FRC), Edwards AFB. Reed adopted the idea to create a spacecraft crew capsule that could land conventionally like an aircraft, after atmospheric re-entry, and be reused, unlike the crew capsules of the Mercury, Gemini and Apollo space programs, which fell to Earth before deploying parachutes for a splashdown in the ocean.

The form of a lifting body can be thought of as opposite that of a flying wing. While a flying wing has little or no fuselage, a lifting body is all fuselage and no wings, but with vertical stabilisers. Lift is generated by the broad fuselage shape during its glide through the atmosphere.

In 1962, Dryden FRC began a program to build a lightweight, unpowered lifting body to flight test the wingless concept at low speeds. The resulting M2-F1 (M and F for manned flight), dubbed the 'flying bathtub', made its first tentative flight tests the next year over Rogers Dry Lake. It was tethered by rope and towed at up to 200kph (110kts) by a Pontiac convertible car; the same 'auto-tow' method often favoured for launching recreational gliders of the era. After several hundred ground tows, a NASA R4D (C-47) tow plane was used. Seventy-seven of those flight tests,

TOP The X-24B (former X-24A) displayed beside the SV-5J. Behind them is the North American XB-70 Mach-3 bomber. Photo: Michael Nelmes.

MIDDLE One of two Martin Marietta jet-propelled testbeds for the X-24, in the National Museum of the US Air Force in Dayton, Ohio. Designated SV-5J but never flown, it is painted up as the X-24A. Photo: Michael Nelmes.

ABOVE The NASA/Northrop M2-F3 displayed in the National Air and Space Museum, Washington DC. Photo: Michael Nelmes.

made by 10 pilots including Chuck Yeager, proved the aerodynamic and handling qualities of the lifting body.

NORTHROP M2-F2

Following studies conducted at its Ames and Langley research centres, NASA then designed successors to the lightweight M2-F1: a pair of heavyweight lifting bodies. Designated M2-F2 and HL-10 (HL for horizontal landing), those vehicles were built by Northrop which had earlier submitted a proposal for the Dyna-Soar program.

The M2-F2, flown during 1966-67, was the first of five heavyweight lifting bodies developed and flown by FRC. Although it was fitted with an XLR-11 rocket motor, its 16 flights were all glides from the B-52 mothership.

In 1973 the M2-F2 was seen in spectacular fashion on millions of television sets in America and around the world, though most viewers would not have known what it was. It was the subject of a 1967 archival crash-landing film shown in the opening sequence for TV's *Six Million Dollar Man* series, starring Lee Majors as USAF Colonel Steve Austin. The M2-F2 is shown tumbling numerous times after gliding in to land. According to the show's premise, Austin survived the crash and was rebuilt as a bionic man. Its real pilot, NASA test pilot Bruce Peterson, was seriously injured but survived, although he disliked his terrifying accident being on public replay every week.

Surprisingly, the M2-F2 was not completely destroyed and was rebuilt as the M2-F3 – now with a third, central fin for better lateral stability. It flew 26 more times between 1970 and 1972, achieving an altitude of 71,500ft and speed of Mach 1.6.

MARTIN MARIETTA X-23

In 1962, the USAF Flight Dynamics Laboratory joined NASA in its interest in lifting-body research and initiated a three-phase program called Spacecraft Technology and Advanced Re-entry Test (START). Phase One: ASSET (aerothermodynamic/elastic structural systems environmental tests). Phase Two: PRIME (precision re-entry including maneuvering re-entry). Phase Three: PILOT (piloted low-speed tests).

The Martin Marietta corporation had for several years been following Dr Eggers' lifting body research. The USAF contracted the firm to produce four examples of a small (2m long) Phase Two PRIME vehicle: the SV-5D, soon renamed X-23A.

During 1966-67, three successful 30-minute space journeys were made, launched by Atlas rocket from Vandenburg AFB. Using telemetry data and examination of the recovered vehicles, each flight explored the high-speed characteristics of maneuverable re-entry vehicles.

Among other things, the X-23A tested materials to withstand the heat of atmospheric re-entry, an ablative resin underside shield and a carbon phenolic nosecone. With ablative shielding, the outer layer is heated to a gas which carries the heat away by convection. In 1959, the Project Mercury space capsule was successfully tested with an ablative shield of fiberglass bonded with a modified phenolic resin. The X-15 flown that year had a titanium internal structure and Inconel-X (nickel-chromium alloy) skin, also designed for re-entry temperatures. For the reusable space shuttle, in the 1970s, reinforced carbon tiles (for temperatures greater than 1,260°C) and silica ceramic tiles (for lower temperatures) were developed.

The X-23A was guided via both on-board inertial and ground-based navigation systems. Following each flight, it was recovered mid-air by C-130 aircraft, or after parachuting into the ocean. The program was a major step

X-24 STATISTICS

	X-24A	X-24B
FUSELAGE LENGTH	7.47M	11.43M
GROSS WEIGHT	5,194KG	6,260KG
POWERPLANT	Thiokol XLR-11-RM-13 rocket engine of 3,846kg thrust. Hydrogen peroxide auxiliary thrusters.	Modified XLR-11-RM-13 of 4,445kg thrust. Hydrogen peroxide auxiliary thrusters.
TEST FLIGHT PERIOD	1969-71	1973-75
NUMBER OF FLIGHTS	28	36
MAXIMUM SPEED	MACH 1.6	MACH 1.76
MAXIMUM ALTITUDE	71,400FT	74,130FT

BELOW The X-33 was to be a test vehicle for Lockheed Martin's VentureStar concept. Image: NASA.

BELOW Concept illustration of the X-38 docking with the International Space Station. Image: NASA.

TOP X-38 V-131 displayed at the Evergreen Aviation & Space Museum at McMinnville, Oregon USA. Photo: Michael Nelmes.

ABOVE Present-day view of NASA's Neil A. Armstrong (formerly Dryden) Flight Research Center at Edwards AFB.

ABOVE LEFT X-38 V-132, the second of two X-38s built for atmospheric flights, after release from its NB-52B mothership in 2001. Photo: NASA.

forward in hypersonic re-entry space vehicle design, furthering several research fields: maneuverability both in space and in the atmosphere, heat dissipation using water-to-steam cooling (earlier intended for the X-20), and ablative heat shields.

MARTIN MARIETTA X-24

Martin Marietta's next development, the X-24A, was a manned, rocket-powered vehicle to explore the lifting-body design's low-speed flight characteristics and controllability. It did not venture into space and, as it did not undergo atmospheric re-entry, aluminium sufficed for its structural material. Like the X-15, it was air launched from the underwing pylon of NASA's NB-52B mothership. Control was via a hydraulically operated system of 10 control surfaces, the pilot receiving 'artificial feel' feedback to the control stick and rudder pedals. The craft was flown and landed at Edwards AFB during 1969-71, before being radically altered with the addition of a long nose and flattened undersides and renamed the X-24B. A planned X-23C hypersonic craft did not eventuate.

1990s LIFTING BODIES

NASA's X-33 program of the 1990s called for a single-stage-to-orbit reusable launch vehicle (SSTO RLV) and, eventually, a commercial passenger space-liner for intercontinental travel. Submissions were received from McDonnell Douglas, Rockwell and Skunk Works at Lockheed Martin (Lockheed Martin was the result of a 1995 merger of Martin Marietta and Lockheed).

In 1996, Lockheed Martin's design was accepted for an uncrewed technology demonstrator for the company's sub-orbital VentureStar passenger space-liner proposal. Like the X-15, the X-33 would rely on metallic thermal protection. The 21m craft was to lift off vertically and reach Mach 13, powered by a pair of 1,800kN 'aerospike' rocket engines which, unlike standard rocket engines, would maintain efficiency at a range of altitudes. But in 2001, after being 85 percent built, the X-33 and VentureStar were cancelled, five years before operational debut was planned.

NASA's X-38, similar in design but larger than the X-24A, was developed concurrently with the X-33 in the late 1990s. Unlike the X-33, however, it was completed and test-flown from the NB-52B mothership. The X-38, a joint NASA/European project, was to serve as an emergency crew return vehicle (CRV) for the International Space Station (ISS), and thus had to accommodate a complement of seven. Two prototypes were built and flown atmospherically, while the orbital prototype was only 90 percent completed before program cancellation in 2002. Nowadays, the Russian Soyuz crew transfer vehicle and the US SpaceX Crew Dragon spacecraft, which first delivered astronauts to the ISS in 2020, are available for ISS emergencies.

Other reusable spaceplane concepts with lifting-body properties have included the Rockwell X-30 (cancelled in 1993), while others, such as the Boeing X-48 UAV with a 6.4m span and flown in 2007, featured either blended wing body or flying wings designs.

Scan the QR code for a 15-minute 1962 US Air Force film about the X-20.

Scan the QR code for a 15-minute 1970s NASA/USAF film about lifting bodies.

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RIGHT Beaufort conducting reconnaissance and anti-submarine patrols.

THE MISSING CREW OF BEAUFORT A9-56

WORDS
Michael Musumeci

MORE THAN 80 YEARS SINCE IT DISAPPEARED WITHOUT TRACE, THE FATE OF BEAUFORT A9-560 AND ITS CREW REMAINS A MYSTERY.

THIS YEAR MARKS 81 YEARS since the still-unexplained disappearance of RAAF Beaufort A9-56 and her crew. The tragic loss may have been buried in the archives but it continues to bring back the sad loss of a brother, uncle, relative, with many still wondering what happened to the crew of A9-56.

At 8.30am on 12 June 1942, Beaufort A9-56 departed Mareeba airfield to carry out an anti-submarine patrol of the east coast off Cooktown, Far North Queensland. That was the last time the aircraft was ever seen and no further radio transmissions were heard.

The crew consisted of Sgt John R. Pittman 407971, Pilot, Sgt Charles D. Hucker 400674 Navigator, Sgt Horace E. Shying 405942 Wireless/Gunner,

and Sgt Edward K. Jones 407679 Wireless/Gunner, all attached to No.100 Squadron RAAF. The squadron had arrived in Mareeba the previous month and was operating out of the little outback town hidden behind the Great Dividing Range; a strategic location.

No.100 Squadron was raised in early 1942 from the remnants of a British unit that had been destroyed in Malaya. It flew Bristol Beauforts from bases in Queensland and New Guinea, and was equipped to conduct torpedo and level bombing operations.

Tasked from Townsville, the Beaufort A9-56 crew were to carry out an anti-submarine patrol over the convoy area east of Cooktown.

When the aircraft became overdue, it was presumed that the Catalina aircraft tasked to relieve it had failed to locate the convoy, or that A9-56 had remained longer in the area to complete a search pattern. That would have caused A9-56 to refuel at Cooktown before returning to Mareeba.

After waiting some time for an arrival signal from Cooktown, an unsuccessful attempt was made to raise the aircraft by wireless transmission. A signal was also sent to Cooktown asking whether Beaufort A9-56 had landed there. A negative reply was received but there was insufficient time for a search in the remaining daylight hours of 12 June.

A further signal was sent to Coen, Cape York enquiring if the aircraft had landed there, although it was considered unlikely it would have been so far north. A response confirmed it had neither landed nor been sighted in that area.

SEARCH FOR A9-56

From dawn the following day, seven aircraft searched the area in which A9-56 could have been operating. No sight of any debris, oil slicks or anything that could be associated with an aircraft was found. Beaufort A9-56 had simply disappeared.

A further search of the coast and inner reef was carried out on 14 June by two aircraft. Again nothing was found. The crew of the Catalina that was to relieve Beaufort A9-56 reported they had not sighted the convoy and had no contact with A9-56.

Weather reports from other aircraft operating in the vicinity were favourable. Visibility was 12-15 miles with isolated showers. Owing to restrictions in the use of wireless transmission, it was not possible to ascertain whether Sgt Pittman had made contact with the convoy. It was therefore not possible to advance any definite reason for the aircraft's disappearance.

Officially, all crew members were presumed to have lost their lives as a result of air operations on 12 June 1942. No trace of the aircraft or crew has ever been found.

All members of the crew are respectfully remembered and honoured in the Sydney Memorial in Rookwood, Sydney. They are also remembered in the Roll of Honour, Commemorative Area, Australian War Memorial, Canberra.

THE CREW

John Roland Pittman was born on 3 June 1921 in Adelaide to Ronald Ernest and Annie Vera Pittman of Hart, SA. He attended the Hart Public School from 1933 to 1934 and Balaklava High School from 1935 to 1937.

In August 1938, John completed a correspondence course in accountancy through Blennerhassett's Institute of Accountancy. On 16 March 1939, he was successful in a permanent appointment to the public service, as a clerk with the Engineering and Water Supply Department in Adelaide. He was a member of the RAAF Reserve for several months awaiting the call to commence his air crew training. In February 1941, aged 19, John enlisted at No.5 Recruiting Centre, Perth. Upon enlistment he was approved and appointed to 5 Initial Training School (ITS) in Pearce and mustered as Air Crew V.

John commenced his military service at the ITS, learning fundamentals such as mathematics, navigation and aerodynamics. On 16 March 1942, he mustered as Air Crew V (P) and then, on 26 April 1941, Air Crew 11 (P) , attaining the rank of Leading Aircraftman. On 1 May 1941, he was posted to 9 Elementary Flight Training School in Cunderdin, WA. John was provided initial pilot training under the Empire Air Training Scheme. The school provided 50 hours of basic flying instruction on a simple trainer aircraft over an eight-week period.

John successfully completed No.13 Aircrew II (P) Flying Course and was awarded his Flying Badge on 18 September 1941. He was admitted into hospital from 22-28 October 1941 and remained in Geraldton until 13 November 1941, when he mustered as a (T) Sgt, Airman Pilot.

At the end of November 1941, John was posted to No.4 Embarkation Depot in Adelaide where he was kitted and given his final medical examinations.

He was to be posted to England, but that was cancelled in December 1941. With Japan driving towards Australia, he was sent to No.2 Embarkation Depot at Bradfield Park. Posted to Nhill, Victoria with No.1 Operational Training Unit on 5 January 1942, John completed No.2 Hudson Conversion Course.

In early February 1942, he posted to 7 Squadron at Laverton, Vic until late March, commencing duties within No.100 Squadron, Richmond, and then posting to Mareeba in late May 1942. He was 21 when he tragically lost his life.

Charles Douglas Hucker was born on 22 March 1919 to William and Mary Munro Hucker in Ararat, Vic. The family, including brothers Robert, Allan, Jock and sisters Mavis and Gladys, resided in Lake Bolac, Vic.

Charles attended the Ballarat College from 1933 to 1935. Prior to enlistment, he was working as a wheat farmer and enjoyed playing golf, tennis and football.

His brother Jock, interviewed in 2015, reminisced: "He was very keen and interested in photography and tried to teach himself to tap dance. I can still remember him attaching aluminium plates to his shoes as he danced through the house… He was also very keen on flying and always wanted to be in the RAAF."

On 12 October 1940, aged 21, Charles enlisted with the RAAF at the No.1 Recruiting Centre, Melbourne. He was appointed to No 1 ITS Somers, Vic and, by June 1941, had mustered as an Air Observer.

On 12 October 1940, Charles attained the rank of Aircraftman. He was promoted to Leading Aircraftman (LAC) on 7 December 1940, and then to Sergeant on 27 June 1941. He served in Singapore with No.36 Squadron from late September 1941, No.100 Squadron at Richmond in December 1941, 1 Service Flying Training School in late January 1942 and again with No.100 Squadron at Richmond from late February 1942. In early May 1942, Sgt Hucker was transferred to his final posting at Mareeba with No.100 Squadron.

A stain glassed memorial of Sgt Hucker is displayed at Scots Church and in the cemetery at Lake Bolac. He was 23 when he tragically lost his life.

Horace Edward Shying was born on 13 December 1916 in Randwick, Sydney to Horace Edward and Charlotte Yeomans Shying of Strathfield, NSW. Horace had a brother, Harry, and sister, Norma. The family lived in Homebush. Horace completed his schooling at Annandale Public School from 1926 to 1930 and attended Leichhardt Junior Secondary School from 1930 to 1931. He then completed a course in window dressing at a Darlinghurst technical college from 1932 to 1934.

FROM TOP Sgt John Roland Pittman, Sgt Charles Douglas Hucker, Sgt Horace Evans Shying and Sgt Edward Kennion Jones.

ABOVE The official tribute to the crew of Beaufort A9-56.

BELOW SQNLDR Andrew Chadwick and Jock Hucker unveil the plaque dedicated to the crew of Beaufort A9-56 at Mareeba airport, 79 years to the day after the aircraft disappeared.

Horace was employed as a window dresser with Winns Ltd, Sydney for six years, then as a salesman and window dresser with Fosseys Pty Ltd, Sydney for 18 months. While in NSW, he enlisted within the Militia Forces and was attached to the 2nd Armoured Regiment, Ashfield as a driver until discharge on 17 February 1941. He then moved to Melbourne and worked as a stockkeeper for O'Gilpins Ltd for five months and then as a manager for Drews Pty Ltd. He moved to Queensland and worked for Penney's Chain Stores in Brisbane as a salesman prior to enlistment.

On 22 June 1941, he enlisted with the RAAF in Annerley, Brisbane and was posted to No.3 ITS at Sandgate. He was promoted to LAC and posted to No.2 Wireless Air Gunners School in Parkes, NSW attaining the rank of Sgt (T) in April 1942.

On 9 March 1942, he posted to No.1 Bombing and Gunnery School at Evans Head, NSW and then to No.100 Squadron. He was 25 when he tragically lost his life.

Edward 'Ken' Kennion Jones was born on 12 June 1921 in Clare, SA to Rev Albert Edward and Gladys Annie Coombs Jones. He had one sister, Kathleen Thora Norman. Tragically they lost their mother on 27 June 1921.

Prior to enlistment, Edward worked in the office of the Engineering and Water Supply Department, Adelaide.

He enlisted with the RAAF on 10 December 1940 in Adelaide. On 9 January 1941 he commenced training at No.1 Wireless Air Gunner School in Ballarat, completing the course at the end of June 1941. He was then posted to No.1 Bombing and Air Gunnery School at Evans Head and, on completion of that course, was posted to No.100 Squadron. He tragically lost his life on his 21st birthday.

MEMORIAL SERVICE

On Saturday 12 June 2021, an official memorial service was conducted at the Mareeba Airport Memorial Park to honour the crew of Beaufort A9-56 which disappeared after take-off from the airfield.

Family of the late Sgt Charles Hucker travelled from around the country to attend the service. Jock Hucker, Charles' 96-year-old brother, paid tribute to Sgt Hucker and the crew of A9-56.

RAAF Squadron Leader Andrew Chadwick and Jock Hucker officially unveiled the plaque as the Last Post was played. A solemn service was conducted, the plaque was blessed by Noel Wason from Mareeba and wreaths were laid. Master of Ceremony Michael Musumeci paid tribute to the crew and described the events surrounding the disappearance of the aircraft.

The plaque was funded with contributions by the Mareeba Military Muster, crewmember families and the Vietnam Veterans Motorcycle Club. The Mareeba Shire Council and Marcello Pendenza assisted with the construction of the memorial and its installation.

The plaque was placed within the confines of the Mareeba Airport as a beacon of remembrance to the crew who have no graves. It is a poignant reminder of the sacrifices made during WWII.

This article is dedicated to Jock Hucker who sadly passed away on 19 March 2023, aged 98.

THE FASTEST GO-KART IN THE WEST

EMPIRE TEST PILOT SCHOOL GRADUATE **GPCAPT RON GREEN** WAS INTEGRAL TO THE INTRODUCTION OF THE F-111 INTO RAAF SERVICE.

THE OFFICIAL ACCEPTANCE of the first F-111C aircraft took place at General Dynamics Fort Worth, Texas on 4 September 1968. Leading the assembled VIPs was the Australian Minister for Defence, who, during his acceptance on behalf of the Australian Government, somewhat unfortunately announced that from that moment on, the Australian aircraft would be known as the "F one-double-one."

Guests were seated in front of F-111C A8-125, with no visitor aware it was really A8-131 with a temporary false tail number. F-111Cs 125, 126 and 127 were all in the flight test department, with 126 complete and ready for handover, and the other two in the final stages of acceptance testing.

The assembled guests were also unaware that on the previous day, the wing carry-through box assembly undergoing static fatigue tests had experienced a catastrophic failure. It is still not known whether any US Air Force (USAF) personnel were aware of that on 4 September, or whether the contractor had managed to conceal the failure.

The RAAF flight test team of myself and Harry Walton proceeded to the flight line on the following morning, signed for A8-126 from the resident Engineer Officer, then WGCDR Tony Dietz, and moved to the aircraft. It was fitted with 600-gallon tanks at stations 2 and 7 (the Pacific Ferry configuration) since the intention was to conduct a range-proving test program at Edwards Air Force Base (AFB). At that point, no ferry-range tests had been done to determine the range increment produced by our extended wing aircraft (F-111B wings).

Our flight to Edwards was uneventful and, on arrival at the F-111 Joint Test Force (JTF) facility, we placed the aircraft into the hangar for a detailed inspection planned for the following day.

Immediately after arrival and shut down,

I received an urgent message to call the project office in Washington. The very agitated project manager's first words were: "You are not to fly that aircraft again without my personal authorisation". When he calmed down, he explained about the wing carry-through box failure, the resultant possible cancellation of the entire project, and the legal implications of Australia having just accepted aircraft 126.

After two weeks, Washington finally gave approval for a taxi test once each week until a decision was made on the future of the aircraft. That approval was given after concern was passed to Washington over the deterioration of seals in the hydraulic systems due to lack of pressure, accumulator pressures dropping and other symptoms due to lack of use.

Hence, every Friday afternoon saw 126 started and taxied to the threshold of runway 04. When there was a gap in the traffic, air traffic control (ATC) would give approval to enter and line up, then fast taxi "when ready". The aircraft was then lined up, the engines run up to full military power, parameters noted, power increased to minimum A/B then maximum A/B, again noting engine parameters. At that point, brakes were released and the aircraft was allowed to accelerate. The nose was rotated to take off attitude and the throttles were then reduced to idle and the aircraft was allowed to roll to the end of the runway, then taxi back to the JTF line. The RAAF contingent quickly became known as the owners of the fastest go-kart on the West Coast of the USA.

By mid-December, word was received that a government-to-government agreement had been reached and 126 was to be returned to the Fort Worth facility, but that could not be done immediately.

During its grounded period, the RAAF team had received a constant flow of kits for approved engineering change proposals (ECPs) for installation on 126. Installation had been delayed due to uncertainty over the aircraft's future ownership, but once that question was resolved, incorporation of the modification kits proceeded rapidly. The extent of the modifications required a full functional check flight (FCF) and Washington eventually passed down approval for one FCF and one ferry tank flight to Fort Worth. The FCF lasted nearly six hours and a great deal of range performance data was gathered. The subsequent flight to Fort Worth was uneventful, except for the illumination of a translating cowl caution light on final approach to the contractor airfield, Carswell AFB. A8-126 then remained with the rest of the F-111C fleet until its second delivery in 1973.

FLIGHT SIMULATOR

Following the return of 126, I was sent to the Link organisation at Binghamton, New York to conduct acceptance tests on the F-111C simulator; number five off the production line from Link, with the same software as the first four F-111A simulators.

The simulator showed atypical pitch characteristics, developing severe pitch up on take-off, stall and crash and a severe pitch down excursion on final approach for landing, where it dived into the ground short of the runway. Link executives were less than complimentary about my flying ability and eventually arranged for a demonstration by two USAF non-flight rated sergeants (SNCOs) who flew the simulator smoothly and accurately.

OPPOSITE A8-126 during a handling display. Photo: LAC Dan Pinhorn.

RIGHT GPCPT Ron Green.

BELOW The first A8 F-111 aircraft, A8-125 to A8-130, arrive at RAAF Amberley, Qld, 1 June 1973.

Notwithstanding that demonstration, and after two days of frustration, I advised Link management that I intended to recommend that the RAAF F-111 simulator be rejected. That was on a Thursday evening. The next morning, Washington directed me to remain in Binghamton for the weekend, with the situation to be reviewed on Monday.

On Sunday afternoon, Link management invited me to fly the simulator after they had "fine-tuned a few software settings". The pitch problem was gone; the simulator behaviour appeared to represent the aircraft accurately and was adequate for acceptance. No further explanation of the errant behaviour was offered. However, I met one of the SNCOs some months later at Nellis AFB and he revealed that a polarity error in the ground effect equations had been discovered by the Link engineers working that weekend. The other four simulators were also corrected.

AUTO THROTTLE

With the F-111C project on hold, I remained with the F-111 JTF until June 1970. During that period, USAF weapons carriage and release test flying on the F-111A continued, and the Category II program for the FB-111 moved into full operation. The latter program provided much of the missing data we had planned to acquire with our instrumentation proposal, particularly concerning the aeroelastic characteristics of the long wing.

A proposal, that emerged from the F-111 System Program Office (SPO) after much analysis of early losses in Vietnam while conducting Combat Lancer Operational Test and Evaluation (OT&E) operations, focused on the self-adaptive characteristics of the flight control system when used with auto terrain following radar (auto TFR). Several of the routes from Takhli in Thailand to the target areas in North Vietnam covered reasonably level ground initially and then travelled over rising terrain. The SPO reasoned that in the absence of external visual reference on a dark night, distraction caused by increasing electronic threats could demand crew attention to the point where they might miss a reducing airspeed situation as the aircraft followed rising terrain without increasing thrust. There would be few or no aircraft behaviour cues because of the smooth flight control system response. If speed decay continued, the angle of attack (alpha) could reach the stall and cause the aircraft to depart. From only 200 feet above ground level (AGL) and at night, recovery would be unlikely.

Since the relationship between the rate of rise of terrain and the rate of speed loss for various weights and configurations was not known, a program was drawn up to provide speed-loss data by flying an aircraft against known rising terrain, with store loads typical of the Vietnam operation.

I was appointed lead pilot for that program and preparatory flights were carried out to determine the safe alpha limit for recovery. It was found acceptable to initiate recovery at two degrees less than the stall value. A series of flights was then flown against the slopes of Mt Whitney (4,418m) in California's Sierra Nevada mountains, beginning at the Utah-Nevada border. That route provided adequate opportunity to stabilise the power setting on the flat TFR leg at 200 feet AGL and 450-480 KIAS before reaching the rising ground of the Sierra Nevadas.

Six data flights were flown and instrumentation records of aircraft response were flown to the contractor facility each night. That data was used to design an auto throttle proposal for TFR system.

The F-111 was flown by the RAAF from 1973 to December 2010. Sadly, Ron Green passed away in March 2023.

DUMP & BURN FLIGHT TESTS

There was concern about fuel dumping at high all-up-weights following the loss of one engine, a situation that could require operation of the remaining engine in afterburner. The concept of dumping fuel into the atmosphere and then lighting the afterburner was seen to closely parallel fuel/air explosive weapons then under development and might thus constitute a potential aircraft disaster. There was no way to simulate that situation, so empirical flight tests had to be carried out.

Ron recalled the decision was not greeted with unbridled enthusiasm at the FTC. He was nominated as the pilot for the test program. The test plan called for the aircraft to track visually along a black line on the lakebed at 1,000 feet AGL and dump fuel at an incremental set of speeds and engage the afterburner with the dump in progress. Initial test point was at 350 knots. Optical and photographic observation stations were located on the lakebed and two chase aircraft with photographers and high-speed cine cameras were allocated. Emergency and medical facilities were strategically positioned along the track.

On the morning of the test, tension was obvious. Not only among the test team but also the throng of spectators gathered at the western edge of the lakebed. Two practice runs were made to ensure all communications links and photographic systems were operational, followed by a live pass. Fuel dump was commenced over a checkpoint, and left engine minimum afterburner lit at a second checkpoint 1,000 feet down track.

The rest is history. A chase pilot described flying alongside the fireball as "impressive", with the flame front about 20-30 feet behind the dump nozzle. At subsequent test points covering a range of airspeeds and angles of attack, the closest the flame front moved to the A/B nozzles was 16 feet.

Dump and burn displays later became features of F-111 public events throughout Australia.

Spectacular dump and burn to enthral the crowd.

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BEWARE OF PIGEONHOLES

WHILE COMMON AND SOMETIMES REASONABLE, PIGEONHOLING CAN BE RESTRICTIVE AND EVEN DANGEROUS. PERSPECTIVE BY **PETER RING**.

AS WE PROGRESS THROUGH LIFE, we are regularly pigeonholed. We even pigeonhole ourselves.

During my life, I have been a farmhand, a petrol puller, an Air Force pilot, a civilian helicopter pilot, a survival instructor, a youth worker, a culture change consultant, a sheep farmer, a roustabout, a wool classer, a real estate agent, a husband/dad/grandfather/great grandfather and a pain in the arse (suggested by my wife, and I am) and other qualifications I suspect I do not even know about.

My early pigeonholes matched my status at the time; the kid who served petrol, the young bloke who carted hay. Not so bad, but then when I wanted to join the Air Force and become a pilot, I was told by my friends "but you are only a labourer". That threw me for six. That pigeonhole put severe doubts in my head about my capabilities and my head nearly won the confidence battle.

Group behaviour convinces many of us to conform to the pigeonhole we are assigned. Right now, I could be in the grumpy old farts pigeonhole and that may be the case for a number of my acquaintances. I hesitate to even try to name other derogative pigeonholes each of us may be assigned. All I know is that most constrain and taint us in our future explorations of opportunities, careers and life.

In my young life, I did not feel game enough to have an opinion unless it was one I had to have to do my job. Never about life or the world around me. Keep your head down was my motto; I had been conditioned to do that for my whole childhood and adolescence. I was in a very deep pigeonhole of "say nothing", my opinion was not welcome.

When I reached the ripe old age of 26 and was assigned to a Fighter Combat Instructors Course, I clearly needed to speak up. And I did, just so I would survive and pass the course. That left me in a new state which I really enjoyed, and I swore I was not going back to the old me. I was levered out of my "say nothing" pigeonhole.

While many pigeonholes relate to our functions and are useful to a degree, others are reactive ones that bear no relation to reason. We are just pigeonholed by social attitude: young, childish, boofhead, grumpy, uneducated, untidy, no common sense, foreigner, angry. Such categories could have an element of truth, but they can be destructive. We all seek and deserve reason and encouragement not arbitrary pigeonholes.

Being pigeonholed limits our head space to what we think, or others think, is achievable or acceptable for us. That locks us up and many chances to be who we might dare to be are packed into "maybe tomorrows".

We too often do not let our un-pigeonholed self out for a run because often with that release some of our different side emerges and we do not want people thinking we are "off in the rough". But everybody is already somebody else's antithesis.

Sometimes you need a cohort curious enough to explore life to get together. And then, maybe the cohort will realise how much they/we are the same, how much we are different and what common traits are revealed. It is very easy to patronise when you contemplate life because we all have lived, and we all have learned some pretty deep lessons. I may have learned different lessons to you, or the same, but whatever the case I like to see what commonalities I have with others.
I find that I share with many others some deep stuff, maybe even some deep fears which I think then reduces my isolation as a person.

> It is only with the heart that one can see rightly what is essential is invisible to the eye.
>
> **Antoine de Saint-Exupéry, *The Little Prince***

Lately, there has been a lot of press about people making lots of noise and being authoritarian about many subjective issues. They appear to want to rule and pigeonhole big segments of our society as ignorant, unknowing and sometimes even racist. I think that they might be CAOS agents. CAOS stands for groups that want

to Crush All Our Spirits. They jibber jabber so much about a need to change society to their ideal that people start to give in to their strident opinions just to quell the incessant interference.

CAOS believes the weakness we all have is a failure to sustain our beliefs and spirit in the face of strident noise. Their aim is to supress our spirit of fun and irreverence, courage and boldness, determination and grit, ethics and vision, support and encouragement, friendship and humanness and then enforce their way.

To enhance their agenda, sensationalist reporting by much of the media appears to ignore the need for accuracy and depth. That to me is an aspect of media and news that is ever deteriorating. Many current affairs programs now focus on somewhat trivial issues hoping to grab the headlines with sensationalist reports. Social media is rampant with falsehoods, exaggerations, and just straight cow dust. Many family-time TV shows are now more often what is called reality TV. Those shows appear to want to reduce life to the lowest common denominator with amplification of the worst of our human behavior. Movies that graphically dramatise the unchecked violence in the world are rife. Even our weather reports describe events using sensationalist words. It is not that those features of our social engagement are right or wrong, just that we allow them to distort the world mostly without challenge.

> Television is the first truly democratic culture – the first culture available to everybody and entirely governed by what the people want. The most terrifying thing is what people do want.
>
> **Clive Barnes**

Inside many of us is a person trying to understand the day-to-day degradation of our necessary-to-a-good-life community standards. Where is it all leading when our lives are besieged with little logic, falsehoods, alarmist claims, din and sensationalism.

What will happen to our society if we all succumb to the pigeonhole CAOS want to consign us to and we stop valuing our own experience and wisdom. Frequently, our social acceptance becomes more important than our natural, individual selves and it overrides our real honesty, integrity and forthright living. CAOS wins again.

In my life, I found there were depths to me that were uncovered each time I was confronted with some sort of moment. I found a new aspect of my entity, each time I was outside my comfort zone. Eventually, you start to be bold enough to believe in yourself and your own wisdom because after all, that wisdom came through your experience of good and tough times.

So, beware of CAOS agents, they are everywhere, brainwashing people and supressing individuality.

Ask yourself the following questions.

- How do I remain conscious and deliberate about what I do with so many societal pressures?
- Do I need to liberate myself more?
- Most of the time am I acting with honesty and forthrightness or with an introverted, time-developed social survival ethic?
- Is the only thing in this world that you really control yourself, and do you totally control yourself?

We need to reflect at length on our participation in life. Life may be too complex to do anything about. The external influences and exposure may sometimes overwhelm which is exactly what CAOS wants.

Do not let your reasoned, conservative reactions or genetic responses discourage your own decisions. Step outside your assigned pigeonhole and be your strong, capable self and then get out there and value your wisdom, deny the corrosive CAOS influence.

CEREMONIAL PARADE

ON SUNDAY 28 MAY, cadets and officers from the NSW Group of the Australian Air League (AAL) participated in the group's annual Ceremonial Parade, marching through the streets of Sydney from Martin Place to Metcalfe Park, Pyrmont.

The parade has been a regular fixture on the Air League's calendar since 1936 when cadets first marched through Sydney to Government House where the Minister for Defence, Sir Robert Parkhill, handed over the League's flag. This year's parade saw just over 300 members on parade representing 18 squadrons across NSW and the ACT.

The first stop for the parade was the cenotaph at Martin Place where a wreath was placed by the NSW Group Cadets of the Year, Sqn. Sgt Lara Wilbow from Doyalson Squadron and Sgt Jonathan Nolan of Marrickville Squadron, accompanied by the Last Post and Rouse.

At the completion of the wreath laying service, the parade made its way through the streets of Sydney and Darling Harbour to Metcalfe Park, Pyrmont where it was met by the Reviewing Officer, the Hon. Matt Kean MP, Member for Hornsby and Shadow Minister for Health. Other dignitaries and guests included Ron Glew OAM, President of the Air Force Association NSW and Grace Walker, NSW State Chair of Women in Aviation Australian Chapter.

Following the Reviewing Officer's address, awards and trophies were presented to members and squadrons for competitions on the march and activities throughout the year.

There were also a number of presentations to student pilots present at the parade, including 13 Student Pilot Epaulettes to cadets who had completed 10 hours of flying training, and four flying scholarships from the Canterbury RAAF Association and the NSW Group towards flying training at the Air League's Air Activities Centre, Camden NSW. Those were to: Cadet Zach White, Moorebank Squadron; Leading Cadet Mahnoor Syed, Edmondson Park Squadron; Corporal Toby Ong, Canterbury Squadron; and Leading Cadet Joel Blanning, Sutherland Shire Squadron. The 2023 Flying Encouragement Award was made to Senior Cadet Ben Hunt of Taree Squadron.

ABOVE The wreath laying service at the cenotaph, Martin Place.

BELOW LEFT Ron Glew OAM, President of the Air Force Association NSW presenting Flying Scholarships to successful applicants.

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

WORDS Flight Lieutenant (AAFC) Paul A Rosenzweig OAM

DIAMONDS IN THE LISMORE SKY

AMBERLEY FLIGHT OF THE AUSTRALIA AIR FORCE CADET'S (AAFC) Elementary Flying Training School (EFTS) took its Diamond DA40 NG Star aircraft to Lismore, NSW in May to conduct Cadet Aviation Experience (CAE) flights for 47 Air Force Cadets and two staff of No.3 Wing (NSW). It was supported on the Sunday by an aircraft from Richmond Flight EFTS.

EFTS's mission is delivering flying pathways to Cadets through powered flying experiences and training. Those opportunities include CAE flights, Pilot Experience Flights and Cadet Flying Training.

Pilot Officer (AAFC) Rob Moore, Commanding Officer of No.326 (City of Lismore) Squadron congratulated the EFTS staff for making the two days appear seamless.

"Very well run and big smiles all around," he said. "The weekend was a huge success for our Cadets, staff and parents. Our squadron can't thank the staff of EFTS enough for the effort they put in to making it happen".

Powered flying programs are conducted for the AAFC by EFTS through its three hubs, Amberley Flight (Queensland), Richmond Flight (NSW) and Point Cook Flight (Victoria).

Two CAE flight participants show their appreciation to EFTS Amberley Flight.

POWERED PILOT

CADET UNDER OFFICER JESSE ISAAC OF NO.604 SQUADRON at Hampstead Barracks, SA has had a couple of big years.

It started with a Pilot Experience flight in a DG1000S glider with the AAFC's Balaklava Glider Training Flight. Then, after some privately funded powered flying training, he flew his first solo flight in a Cessna 172-S at Parafield Airfield, which entitled him to receive and wear the AAFC First Solo Flight badge on his AAFC uniform.

Following further training and passing a CASA theory exam in December 2021, CUO Isaac did his flight test and gained his recreational pilot's license.

CUO Isaac's achievement was recognised by the Commanding Officer of the AAFC's Elementary Flying Training School (EFTS), Wing Commander Mark Dorward, who approved the award of the Cadet Pilot's Badge. The badge was presented to CUO Isaac on behalf of Aviation Operations Wing by the Flight Commander of Balaklava Flight, Flight Lieutenant (AAFC) Ian Wright.

CUO Isaac has been counting his ongoing AAFC glider training towards the Skills section of the Duke of Edinburgh's International Award. He has received the Bronze and Silver Awards, and is now a Gold Award participant. CUO Isaac spoke about his impressions of flying.

On first flying a glider: "When I saw the cadets before me take-off, I was a little nervous, but when I sat in the glider with an instructor, all of that fear disappeared. When the winch kicked in, we accelerated very quickly and climbed at about a 45-degree angle. I will never forget that feeling of getting pushed back into your seat."

On powered flying: "Powered flying felt quite a bit different, and it was exciting to be able to explore while up in the air, while having an engine and not having to worry about finding thermals. Leading up to my solo flight, I did a lot of flying within Parafield's circuit area in order to improve my take-offs, approaches and landings. I also trained in stalling, glide and flapless approaches, as well as what to do if I had an engine failure after take-off."

On flying solo: "After only 9.3 hours of flying with an instructor, I was ready to take to the skies by myself. I will never forget the moment of getting taxi clearance from air traffic control and taxiing the aircraft all alone. In those moments, I was so nervous. But as soon as I was given clearance for take-off, all my nerves settled and my training kicked in.

"I still always get a thrill when I advance the throttles and move down the runway, but I will never forget that moment on my first solo."

LEFT CUO Isaac, centre, with FLTLT(AAFC) Ian Wright, right, and FLTLT(AAFC) Paul Rosenzweig OAM, Deputy Flight Commander. Photo: CIV Samira Khan.

ELEANORE TIBBLE PILGRIMAGE

LATE LAST YEAR, three Air Force Cadets were selected as the 2022 recipients of the Cadet Sergeant Eleanore Tibble Pilgrimage: Jesse Isaac (604 Squadron), Charlie Smith (215 Squadron) and Madeline Wilson (418 Squadron).

The pilgrimage was established in 2005 to allow a Cadet to accompany Australia's Federation Guard on an Anzac Day activity, but COVID-19 travel restrictions limited recent awardees to domestic activities only. For 2023, AAFC Headquarters planned a return to international activities, including visits to various military and civilian establishments in New Zealand or Australia to provide a unique cadet experience.

Cadet Flight-Sergeant Wilson undertook a visit to East Sale at the end of last year. Jesse Isaac and Charlie Smith, promoted to Cadet Under Officer earlier this year, were scheduled to undertake a visit to New Zealand for Anzac Day.

Both have secondary appointments with the AAFC's Aviation Operations Wing (AOW): CUO Isaac holds the Cadet Pilot's Badge (for powered flying) and supports gliding training, while CUO Smith holds the AAFC First Solo Badge (gliding) and is an Aviation Ground Support Officer with Amberley Flight, Elementary Flying Training School.

They began their pilgrimage on 21 April with a rare opportunity, a VIP visit to the Australian War Memorial's Annex in Mitchell. Highlights included seeing the 'G For George' Lancaster Bomber, the most intact V2 rocket mounted on its trailer, the Meillerwagen, F-18 Classic Hornets and helicopters.

They were then formally presented with their awards by Chief of Air Force, Air Marshal Robert Chipman AM CSC.

In the afternoon, the pair visited the Australian War Memorial's main halls.

CUOs Isaac and Smith then travelled to NZ to attend and participate in various Anzac Day events, beginning with the Dawn Service March at Upper Hutt.

At the National Commemorative Service at Pukeahu National War Memorial Park in Wellington, CUO Isaac had the privilege of placing a floral tribute at the Tomb of the Unknown Warrior on behalf of the Australian Defence Force Cadets, together with Cadet Staff-Sergeant Esmae Collett of the Wellington City Cadet Unit (New Zealand Army Cadets).

In the afternoon, CUO Isaac and CUO Smith participated in the Atatürk Memorial Service in Strathmore, Wellington, and CUO Smith placed a tribute with CDTSSGT Collett and the son of the Turkish Ambassador to New Zealand.

CUO Isaac said: "The pilgrimage was a powerful and moving experience. I would like to thank the Australian Defence Force, the New Zealand Defence Force and their

Cadets, the Australian Air Force Cadets, and Ms Tibble's family for the opportunity to travel abroad in honour of Cadet Sergeant Eleanore Tibble."

CUO Smith reflected: "The pilgrimage blew all expectations Jesse and I had out of the water, it was truly a once-in-a-lifetime opportunity."

BELOW CUO Smith, left, and CUO Isaac in front of the V2 ballistic guided missile in the Australian War Memorial Annex.

POWERED FLYING OPPORTUNITIES

THE OFFICER COMMANDING OF THE AAFC'S AVIATION OPERATIONS WING (AOW) recently announced the names of Cadets who will undertake powered flying training in 2023.

The Cadets of Nos.2, 3 and 4 Wing currently receive inspirational aviation experiences through the AAFC Powered Aircraft Capability (PAC) which is provided via 12 leased Diamond DA40 aircraft operated by the Elementary Flying Training School (EFTS) flights at RAAF bases Amberley, Richmond and Point Cook.

Selections for the EFTS PAC program were as follows: 2 Wing region (12 Cadets); 3 Wing region (eight Cadets); 4 Wing region (10 Cadets).

The Powered Service Provider (PSP) program provides an alternative but similar experience for Cadets in other states who do not have access to the established EFTS flights. Powered flying training will be provided by an Air Force approved PSP – civil aviation providers and flying schools.

Selections for the PSP program were as follows: 1 Wing region (four Cadets); 5 Wing region (two Cadets); 6 Wing region (five Cadets); 7 Wing region (five Cadets) and 8 Wing region (two Cadets).

Numbers are subject to variation due to aircraft and instructor availability.

Scan the QR code for more information, and to download the AAFC Powered Flying brochure.

WING COMMANDER JAMES ALFRED TREADWELL AFC OAM

19 July 1931 – 8 June 2023

JIM TREADWELL ENTERED THE RAAF as a Trainee Signaller on 1 October 1951. After completing air gunnery training on Lincoln aircraft, in December 1952, he was awarded a Signaller's Brevet graduating "Proficient with Special Distinction". He was posted to No.11 Squadron at Pearce as a Sergeant Signaller on P2V-5 Neptune Maritime Reconnaissance aircraft.

Jim applied for pilot training but was unsuccessful. Always the determined man, Jim sold the small car he had driven across the Nullarbor and paid to learn to fly at the West Australian Aero Club, eventually obtaining a Commercial Pilots license with an instructor's rating.

After being offered a job at the Aero Club, he resigned from the RAAF. His resignation was rejected and in April 1955 he was selected for pilot training. Winning the Goble Trophy, he graduated from No.21 Pilots Course "Proficient with Special Distinction" in March 1956.

On completion of Fighter course on Vampire aircraft, he was posted to No.75 Squadron flying Meteors. In 1957 he was posted to No.77 Squadron, RAAF Williamtown to complete the third Avon Sabre conversion course at Williamtown. In September 1958 he was posted to No.3 Squadron on the Sabre ferry to Butterworth where he served in Nos 3 and 77 Squadrons during the Malayan Emergency.

In October 1958, he married Elizabeth who produced five beautiful children. Over the period of Jim's RAAF service, Elizabeth provided solid support during protracted periods of service separation. She passed away early 2021.

On return from Malaya in 1960, Jim was posted to No.2 Aircraft Depot, RAAF Richmond flight testing Mk 35 Vampire aircraft constructed by De Havilland at Bankstown. He then qualified as an Advanced Navigator in 1961 on No.16 Advanced Navigation Course at RAAF East Sale. From Sale he was posted to No.1 Applied Training School, RAAF Pearce as a Navigation Instructor. In addition to instructional duties, he shared the SAR callout duties with Bull Pratt as Navigator of the Dakota based at Pearce. Returning to Malaya in 1963 during Confrontation as the No.78 Wing Navigation Officer, Jim flew with No.3 Squadron. He completed a tour in 79 Squadron at Ubon, Thailand before returning to Australia in 1965 on posting to No.76 Squadron.

Completing RAF College of Air Warfare in 1965, Jim graduated as a General Duties Weapons Officer. He returned to No.81 Wing, RAAF Williamtown and completed Mirage operational conversion.

In 1968, he was posted to No.76 Squadron, later taking command of the Squadron. In June 1969, he was posted to No.77 Squadron as Commanding Officer and established the Mirage Photo Reconnaissance capability. He completed No.26 Staff College Course in 1972 and was posted to the Directorate of Aircraft Requirements.

Jim resigned in 1977 to become a farmer. However, he re-entered the service in 1981, at the RAAF's request, to form No.26 Active Reserve Squadron.

A larger than life, respectfully irreverent larrikin, Jim was recognised by his peers as a sociable, competent and determined fighter pilot. Jim was awarded the Air Force Cross in 1972 and, in 2007, the Medal of the Order of Australia for services to Veterans and their Families.

Jimmy the Tread. Sadly missed, always remembered.

LAST FLIGHT SUBMISSIONS

If you would like a tribute to a past RAAF member included in *Wings*' Last Flight, please email your words and at least one photograph (the best quality possible) to managing.editor@wingsmagazine.org. While we cannot guarantee all submissions will be published, we will do our best.

SERGEANT FELIX SAINSBURY OAM

14 May 1920 – 12 April 2023

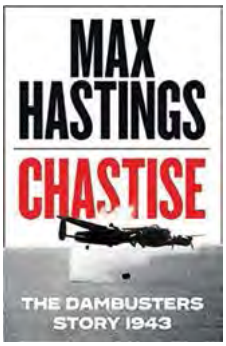
FELIX SAINSBURY WAS WORKING for Sydney Atkinson Motors in Perth when the war broke out. He joined the Militia before transferring to the Air Force on 28 October 1940. Trained as an armament fitter and, after learning about servicing and fitting guns, arming bombs and loading them onto aircraft, bomb disposal and air gunnery, he was posted to No.3 Squadron. He embarked for the Middle East from Fremantle in July 1941.

He initially served in Syria and then for the next two years in North Africa while No.3 Squadron fought above the sands of the northern deserts. While in North Africa, contrary to regulations, he kept a series of diaries and photographs and the diaries are now with the Australian War Memorial, Canberra. He later collated his recollections *Ground Crew: A Middle East Diary*, recording the hardships and the close calls when under attack by German and Italian aircraft, and the humour which saw them through times of hardship. The following excerpt from his book is illustrative of the hardships of war in the desert.

On January 11, 1942, he wrote: *Often a pilot went out on a dawn operation and did not return. It is not long before his empty place in the tent is filled by somebody else. Later, somewhere out in the trackless desert wasteland, a wandering Arab will find the tangled wreck of an aircraft and the remains of its pilot. Others are still waiting to be found and others will never be found. The drifting sand has covered them... This must be the loneliest, (most) unforgiving place on this Earth in which to finish your life.*

In July 1943, Felix returned to WA and was posted to No.4 Service Flying Training School at Geraldton, where he passed on his armament skills to others. After the war he returned to his old job, married Muriel McLeod and had three children.

In 2021, Felix was awarded the Medal of the Order of Australia for long standing service to the yachting community and to the Air Force Association. He was President of the West Australian Branch of No.3 Squadron Association for 25 years and, at 102, was the last surviving World War II member of the Squadron. A No.3 Squadron F-35 aircraft honoured Felix with fast and slow passes over his funeral on 3 May in Fremantle.



REVIEW BY Bob Treloar

CHASTISE: The Dambusters Story 1943

By **MAX HASTINGS,**
Harpers Collins Publishers;
RRP $38.00

ON A CLEAR MOONLIT NIGHT on 16 May 1943, 19 Lancaster heavy bombers of No.617 Squadron RAF took to the skies on a mission to destroy the dams above the Ruhr Valley, the heartland of Nazi Germany's industrial might supporting the German war effort. The success of the mission has become legend, although the results achieved were not as significant as the RAF planners had anticipated.

In *Chastise*, Max Hastings examines the raid in the context of the wider activity of Bomber Command and the overall conduct of the war in 1943 and gives the reader cause to consider the brutal decisions made by wartime leaders in a circumstance of total war.

The attack required the delivery of weapons from very low level by specially trained aircrew. While the Squadron was led by very experienced aircrew, half of the aircrew were transferred from a neighbouring squadron, some of whom had flown very few sorties in Bomber Command.

Of the 19 bombers that launched for the mission, only 11 would return – a 42 percent loss rate – 56 aircrew, all but two, killed. Thirteen Australians took part in the raid and eight survived the war. With the destruction of the dams, between 1,300 and 1,500 died in the flooding of the valley below, of whom about half were prisoners or foreign workers, many were women.

Chastise provides a comprehensive review of the operation and confronts the shortcomings of the planning processes of RAF higher command. Throughout the book, he emphasises the human dimension while providing an overview of the activity. His description of the raid and the challenges that confronted the aircraft crews will engage the reader.

REVIEW BY Bob Treloar

FIGHTER COMMAND'S AIR WAR 1941

By **NORMAN FRANKS**
Pen and Sword Books;
RRP $55.00

THE BATTLE OF BRITAIN had been fought and won in the latter half of 1940. The following year provided the opportunity for Fighter Command to take the war to the Luftwaffe in the skies over France. When Germany invaded Russia, the offensive was stepped up to draw Luftwaffe squadrons from the Russian front.

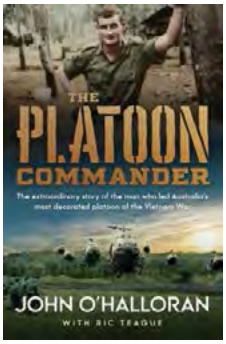
However, in doing so, the roles of the two Battle of Britain adversaries were reversed and although the RAF believed that they were inflicting significant losses on the Luftwaffe, any RAF losses over France meant the loss of valuable trained air crew.

Norman Franks presents the results of a detailed research of the war diaries of both forces. Identification of the squadrons involved in the day to day fighting and the claims of their pilots provide an illuminating insight into not only the results of the battle, but the mind sets of the commanders.

Over 100 Circus operations by the RAF conducted in 1941 are reported in a clinical and easy to absorb manner. A circus was generally conducted by four wings of fighter aircraft, each wing fielding two or three squadrons, and a small formation of bomber aircraft to strike selected targets within France. The intent was to cause the Luftwaffe to rise and fight.

Although in diarist format, the descriptions of each Circus contain individual pilot comments. What is interesting is the extent to which kill claims by both sides were inflated. The tactics employed by both sides are examined and show how each fighter force quickly adapted to changing conditions tempered by experiences gained in air combat.

An excellent reference for the serious students of air warfare in World War II.



REVIEW BY Bob Treloar

THE PLATOON COMMANDER

By **JOHN O'HALLORAN**
WITH RIC TEAGUE
Hachette; RRP $26.94

THE STORY OF A YOUNG Tamworth man who was conscripted into the Australian Army in the first call up, and for whom conscription offered an opportunity to widen his horizons while providing an adventure.

John O'Halloran, selected for officer training early during recruit training, willingly traded basic infantry training for the 22-week officer training school at Scheyville, western Sydney. On graduation he was posted to 6 RAR to command 5 Platoon in B Company. His description of training for jungle warfare reflects the challenges, hardships and the blending of personalities into a fighting team.

The lead-up actions prior to the Battle of Long Tan are well recounted. O'Halloran's platoon provided the initial support to the beleaguered D Company and his description of the battle and the actions of the men engaged in the fighting is guaranteed to capture the reader's attention. With graphic detail and a willingness not to pull any punches, O'Halloran provides a vivid description of the fighting. He also provides brutal comment concerning leadership.

His appraisal of questionable acts by some soldiers in Vietnam is disturbing.

5 Platoon became the spearhead of the Australian attack against a battalion-sized enemy dug in and prepared during Operation Bribie (Battle of Ap My An) six months later. Of the eight Australians killed, six were from O'Halloran's platoon. His description of the battle is chilling.

The Platoon Commander is well written and provides an excellent account of O'Halloran's life experiences and fighting in Vietnam, and it provides a different perspective of the Battle of Long Tan. He provides an excellent commentary on the skirmishes fought by his soldiers during their tour of duty.

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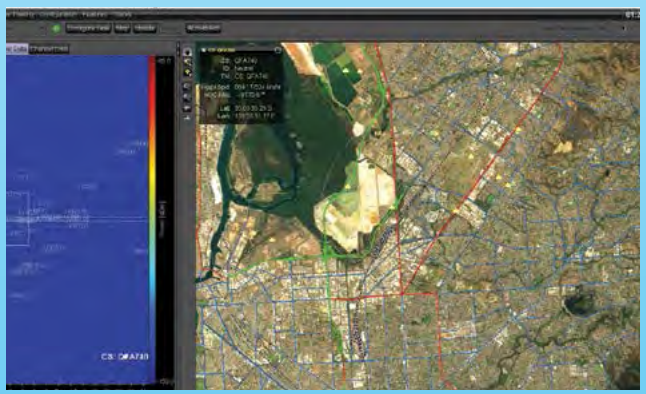

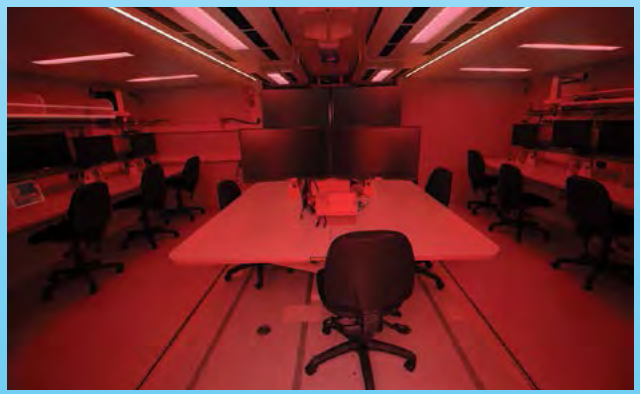

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