THE CANBERRA IN THE RAF

ROYAL AIR FORCE HISTORICAL SOCIETY

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As was pointed out both before and during the event, several aspects of the Canberra's career had been covered on previous occasions. Your Editor had the options of simply referring members to those papers or, at the risk of being accused of recycling (again) and a degree of repetition, reproducing them to create a more comprehensive volume. He opted to do the latter.

ABBREVIATIONS

A&AEE	Aircraft and Armament Experimental Establishment
ACAS	Assistant Chief of the Air Staff
AEA	Atomic Energy Authority
AFB	(US) Air Force Base
AFVG	Anglo-French Variable Geometry (aircraft)
API	Air Position Indicator
BAWA	Bristol Aerospace Welfare Association
C4ISTAR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CENTO	Central Treaty Organisation
COMINT	Communications intelligence
CSE	Central Signals Establishment
DS	Directing Staff
ECM	Electronic Counter Measures
EE	English Electric
ELINT	Electronic intelligence
ETPS	Empire Test Pilots School
FAC	Forward Air Control(ler)
FEAF	Far East Air Force
FRA	First Run Attack
FRADU	Fleet Requirements and Air Direction Unit
GCHQ	Government Communications Headquarters
GPI	Ground Position Indicator
JARIC	Joint Air Reconnaissance Intelligence Centre
LABS	Low Altitude Bombing System
MEAF	Middle East Air Force
MRCA	Multi-Role Combat Aircraft
NAS	Naval Air Squadron
NDB	Non-Directional Beacon
NEAF	Near East Air Force
OCU	Operational Conversion Unit
RPF	Radio Proving Flights
SBAC	Society of British Aircraft Constructors
SEATO	South East Asia Treaty Organisation
SLAR	Side-looking Airborne Radar
TRU	Technical Research Unit
TWU	Tactical Weapons Unit
UKVG	United Kingdom Variable Geometry (aircraft)

THE CANBERRA IN THE RAF

BAWA, FILTON, 8 APRIL 2008

WELCOME ADDRESS BY THE SOCIETY'S CHAIRMAN

Air Vice-Marshal Nigel Baldwin

Ladies and gentlemen – good morning. It is a pleasure to see so many of you here – well over 100. Several of you, I know, are not members of the Society but are here because of the encouragement of friends. If you like what you see, please don't hesitate to join us properly!

Before I introduce our Chairman for the day, I want to pause for a moment: many of you know that one of the founder members of our Society, Air Commodore Henry Probert, died suddenly last Christmas Day. To say that we were his favourite Society or organisation would not be an exaggeration. Henry probably knew more about RAF history than anyone else and he was, amongst his other many achievements, the highly regarded biographer of Bomber Command's Sir Arthur Harris. We miss Henry already. Perhaps we might pause for a few moments to respect his memory.

Pause

This is the fourth time we have been able to take advantage of the Bristol Aerospace Welfare Association's splendid facility here in Filton; I would like to thank Jim Bishop, the Chairman of BAWA, for allowing us to set up another day here. Coming here gives several members, who find travelling to north London difficult, the chance to attend one of our seminars so that is very good for us.

I would also like to thank BAE Systems, Cobham plc, and Rolls-Royce for making a financial contribution to help offset some of the costs of mounting the day; their combined generosity means that we will be able to produce a hardback publication on the Canberra to complement those in which we recorded our previous events here at BAWA when we studied TSR2, the Tornado and the Harrier.

Our Chairman for today is Air Chief Marshal Sir Michael Knight. Once a young Canberra pilot, he retired from the RAF nearly twenty years ago when, in his last post, he was the UK's Military Representative to NATO. He then immediately rejoined as a flying

officer in the RAFVR to spend eight years flying ATC and CCF cadets and was also the Honorary Air Commodore of No 7630 (VR) Sqn of the RAuxAF. Amongst a plethora of distinctive appointments, he has been Chairman of Cobham plc, the Page Group, Cranfield Aerospace Ltd, and President of the Royal International Air Tattoo and of the Air League. Determined to have sleepless nights, he was, until very recently, the very active Chairman of the Vulcan to the Sky Trust trying to get XH558 back into the air. Being an ex-President of the RAF Rugby Union and of Combined Services RFC, he will have no difficulty keeping today's speakers up to the mark. Sir Michael – we are very grateful to you – you have control.

Not bad for bombers – No 45 Sqn, 27 March 1969.

OPENING REMARKS BY SEMINAR CHAIRMAN

Air Chief Marshal Sir Michael Knight KCB AFC DLitt BA FRAes

Ladies and Gentlemen.

May I add my personal welcome to that of our Society's Chairman.

Last week the Royal Air Force celebrated its ninetieth birthday; and, for 55 of those years, the old English Electric Canberra, in its many manifestations, served in the front line. That is, in itself, a remarkable testimony to the foresight of the Company's team of designers, manufacturers and engineers.

I'm sure that I don't need to remind an audience of this collective eminence, wisdom and experience of the great variety of roles which this genuine thoroughbred performed over the years. But I will, albeit briefly: high-altitude light bomber and low-altitude intruder (both nuclear and conventional); high-altitude strategic reconnaissance; low-altitude tactical reconnaissance; ground attack; target-marking; survey and such varied, but important, supporting roles as target facilities, ECM training, VIP transport and trials work.

In a number of previous seminars, the Society has touched on some or all of those topics: they were mentioned, sometimes in depth, in our discussions on the Suez campaign, the history of RAF Germany and of the Royal Air Force in the Mediterranean.

So, today, we're going to concentrate on other facets of the Canberra's long career.

All our speakers have very relevant experience of the aircraft; and I believe that, together, they form a particularly strong team. I myself have spent the odd hour or two in various Canberra cockpits and though I'm now getting very old – I may just remember enough to keep our speakers in check!

Could I offer them the usual words of fatherly advice? We have a seriously busy programme, so I'm going to be pretty strict on timing. I'm sure you've all got your observations down to the nearest half-second. But I will 'advise' you if you're straying too far beyond your allotted times.

ORIGINS OF THE PROJECT

Bob Fairclough

Bob Fairclough joined English Electric as an apprentice in 1960, gaining a BSc in Aero Engineering five years later. He spent the next sixteen years as a member of the Design Team, working on Concorde, Jaguar, the AFVG, UKVG and MRCA projects and, ultimately, the Tornado. Following a number of senior management appointments within the company, he took early retirement in 1992, since when he has been the historian of the Warton Heritage Group and has written and lectured widely on Warton-related topics. He is co-author of the English Electric volume in Putnam's celebrated company histories series.

The Company - English Electric (EE)

During the 1930s EE made a wide range of electrical products at five main factories, ranging from small electrical equipment items to the heaviest power station generation plant. One of the factories was that at Strand Road, Preston, its main products being tramcars and tramway electrical equipment. In 1938, as part of the huge re-equipment programme for the RAF, EE received contracts to build bomber aircraft. These were allocated to the Preston factory, and were initially for the Handley Page Hampden medium bomber. After 770 had been completed, production switched to the Halifax heavy bomber. Between 1941 and 1945, 2,145 Halifaxes were produced; always at a higher rate than the minimum specified in the contract, and at a lower cost than any comparable factory. Quality was also high, in spite of the works staff increasing in number from under 1,000 in 1938 to over 14,000 in 1944, and the factory being doubled in size over the same period. In addition, a new flight test airfield with three hard runways and five hangars was built at Samlesbury, a few miles from the Preston factory.

As a result of their excellent experience, the Company decided in 1944 that it would stay in aircraft work at Preston after the end of the war. However, it was obvious that post-war contracts would not be

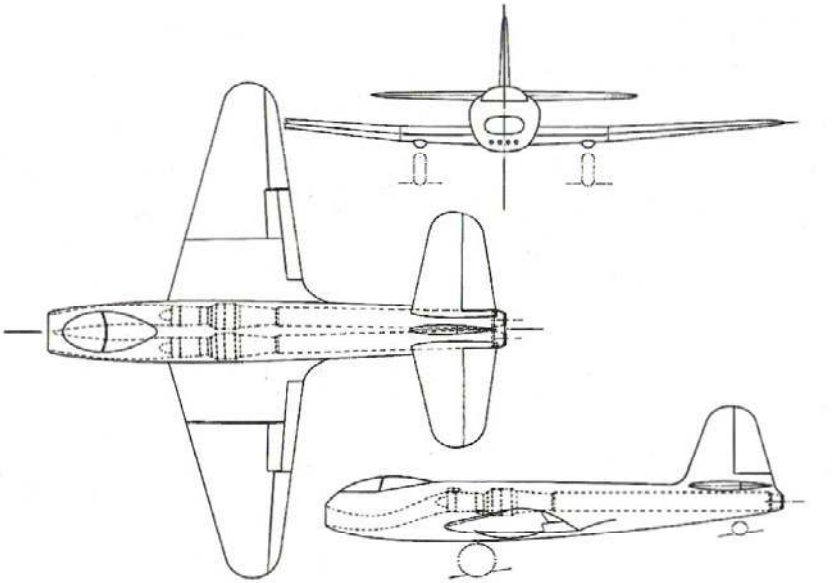
available to build other company's aircraft; therefore EE would have to design and build their own aeroplanes, in competition with the older established manufacturers. EE therefore needed to create a design team with suitable staff and facilities, and the first steps in that direction were taken in 1944. However, also in 1944, the Air Ministry decided that EE should receive contracts to build the new De Havilland Vampire jet fighter; the first was completed in 1945, and in the period to 1951, 1,369 were delivered. After Halifax production ceased in 1945, Vampire work provided valuable continuity of aircraft work for the Preston factory, until EE's own design could enter production. There is evidence in official records that the Ministry gave EE active encouragement in setting up their own design team.

The Man – Teddy Petter

Probably the most critical step in setting up EE's new design team was the selection of the leader, who would have to form the team and conceive the first new design. At the right time, in 1944, a suitable man became available. He was W E W Petter (known as Teddy) who was, at the time, Technical Director/Chief Designer at Westland Aircraft. His father was the founder of Westland, but the company was controlled by major shareholders. By mid-1944 Petter had conceived the basic design for a jet fighter-bomber, that was regarded as a jet replacement for the Mosquito. The Air Ministry showed real interest in the proposal; but the Board of Westlands decided that they should proceed with the design of a strike fighter for the Royal Navy. This was to be propeller-driven and regarded as a lower risk; it became the Wyvern and had very limited success. Teddy Petter did not agree with this decision, and resigned from Westland.

Probably through the Ministry, he was contacted by EE, and in July 1944 he joined the company as Chief Engineer of the Aircraft Division at Preston. At that time he was 35 years of age. He was thus the founder member of the Design Team; his first task was to recruit the key senior members of the new team. His first recruit, in March 1945, was F W (Freddie) Page; who was to have a critical role in the future of the Canberra. He soon effectively became Petter's deputy.

The team's home was a building occupied by EE in Corporation Street, Preston, about a mile from the Strand Road factory. These premises were controlled by the Ministry of Labour, and had been

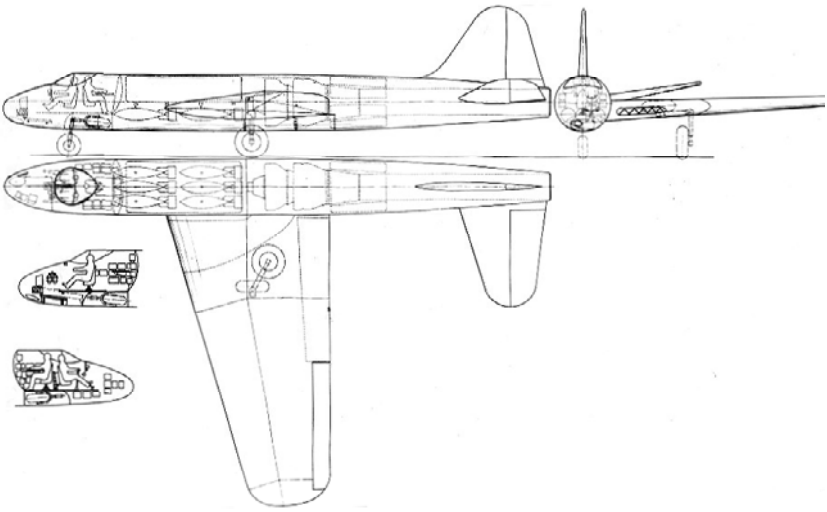


Petter's March 1944 Westland twin-jet fighter bomber concept.

used as a training centre for building workers. They were officially known as the 'Government Training Centre' or GTC; during EE's occupancy this was shortened to just 'TC'. The TC building had been built in the 1930s for Barton Motors, a large firm of car dealers, and had spacious showrooms, offices and workshops. EE occupied the building initially for overflow work from the Strand Road factory, but in 1944 most of the building became the home of the new Design Team and other technical support functions, plus the development workshops.

The Project – A Jet Bomber

While Petter was leaving Westland, he had obtained their agreement that he could take with him the embryonic ideas for his jet fighter bomber. As these ideas had already received favourable comment from the Air Ministry, it was potentially EE's first new and original project. The first important task for Petter and Page, therefore, was to prepare a brochure describing their ideas for the new aircraft for submission to the Ministry so that funding could be obtained for a full study of the proposed jet bomber. This brochure was submitted in

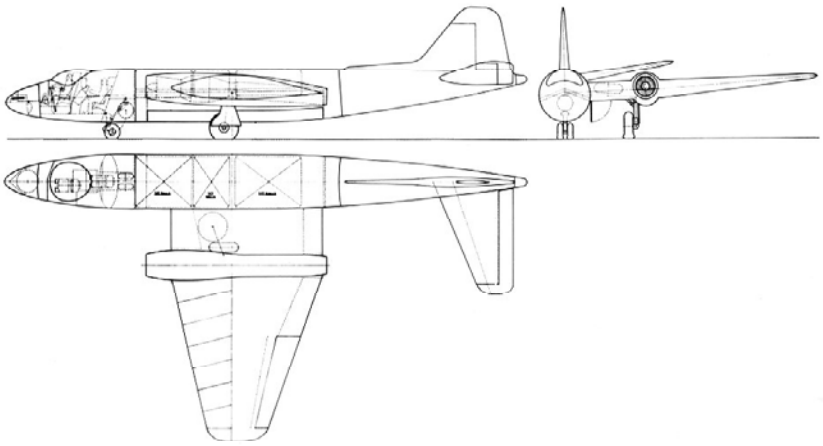


The May 1945 brochure configuration with a single large centrifugal engine.

May 1945, and a study contract, valued at £1,000, was received on 13 June. This enabled more staff to be recruited, which Ministry of Labour regulations would not permit unless there was a contract to prove they were necessary. The contract was for work on a high-speed, high-altitude jet bomber to specification E3/45.

Evolution of the Basic Configuration

The aircraft described in the May 1945 brochure was to have one large centrifugal compressor engine in the centre fuselage. This engine was to be basically a scaled-up Rolls-Royce Nene with 12,000 lb thrust. It had wing-root intakes, and an exhaust through the rear fuselage. A centrifugal engine of this large size was rather ambitious, and its position in the centre fuselage was right where the fuel and bomb-load wanted to be! Therefore, when Petter and Page heard from Rolls-Royce that they were considering a much more compact axial flow engine with 6,500 lb thrust (the AJ65, later to become the Avon), they produced a revised proposal for the Ministry. This was submitted in July 1945. The modified layout had one of the proposed AJ65s in each wing root, leaving the fuselage clear for fuel and bomb-load. At about this time information was starting to become available on the

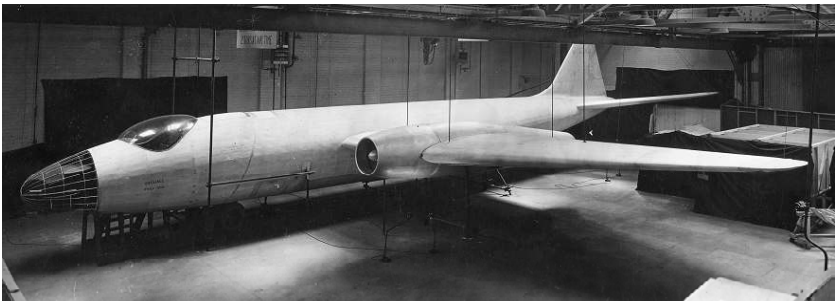


EA1.00.3 Drawing Issue J, dated 5 March 1947. Still a two-seater with a radar in the nose, but, in most other respects, the Canberra.

benefits of swept wings for jet aircraft. The aircraft in the July brochure was shown with 30^{o} of sweep-back, but after considering the benefits and penalties, the brochure concluded that swept wings were not 'yet considered essential or desirable'. Both brochures had the large radar for navigation and bomb-aiming (the H2S Mk 9) in the lower part of the nose.

In the following months the configuration was further revised, the engines being moved out of the wing roots and placed in separate nacelles in the wings. This layout is shown in a general arrangement drawing dated December 1945, and numbered EA1.00.3. This drawing number was the start of EE's use of the standardised SBAC drawing numbering system. In this system EE was identified by the letter 'E', and the first version of the E3/45 High Altitude Bomber was designated the 'A1'. Previously usually known within EE as the 'HAB', the aircraft now became generally known as the A1. In official and Ministry circles it was usually referred to as the E3/45.

The layout defined in December 1945 proved to be the final iteration, as it remained unchanged for the rest of the aircraft's life. This layout was the subject of a revised proposal to the Ministry (by now the Ministry of Supply). This was accepted and a formal contract to complete detail design and build four prototypes was received by



The full-scale mock up.

EE on 15 January 1946. The serial numbers of these prototypes were to be VN799, VN813, VN828 and VN850. Shortly afterwards the experimental specification number of E3/45 was changed to the definitive B3/45, which defined the requirements for the initial production standard of the aircraft. Thus the new design team (which had started with just three men at TC) had gone from initial proposal to prototype contract in only 9 months.

Design and Build of the Prototypes

During 1946 and 1947 detail design work proceeded at TC, where full scale mock-ups were built of the nose and cockpit areas, and also of the complete aircraft. Recruitment of staff was also in progress, and a wide variety of skills and levels of experience was acquired. The basic design point of the aircraft was a still air range of 1,400 nmls at a cruising speed of Mach 0.75, at 45,000ft with 6,000 lbs of bombs. In 1946 these requirements were a major challenge! There were to be two crew plus the large and complex navigation and blind bombing radar. This radar, H2S Mk 9, was at that time in the early stages of development, which was to prove very difficult, and threaten the life of the A1 bomber. The parts for the prototypes were made in the Strand Road factory, and assembly was done at TC and at Strand Road. From the start TC had been regarded as an interim home for the Design Team, and a suitable flight test airfield was required. Samlesbury airfield would be satisfactory for production test flying, but would not be suitable for experimental work. EE therefore looked for a new design and flight development centre.

The chosen site was at Warton, about five miles west of the Strand Road factory. Warton had been a major USAAF maintenance base

during WW II, but by 1947 it was only used by the RAF as a storage unit. EE arranged to lease a hangar and an office block, and use the large airfield, which was eminently suitable for development as a flight testing centre. During 1947 EE designed and built a large low-speed wind tunnel and a structural test rig, both being housed in the large No 25 Hangar at Warton. During 1948 testing of A1 models and major structural assemblies started in 25 Hangar, and in September the Design Team (by now about 100 strong) moved from TC to the L Block office at Warton. By this time EE had recruited a Chief Test Pilot, R P (Bea) Beamont, who was based at Warton. Early in 1949 assemblies for the first A1, VN799, began to arrive at 25 Hangar, the front part of which was used as the prototype flight hangar.

Serious Problems

While the basic aircraft was making good progress in 1947 and 1948, the radar bombing system and the AJ65 Avon engine both ran into serious problems. The H2S, which was being developed by an electronics company, was proving to be a much bigger and more complicated task than expected. The project was running several years late, and the number and size of the equipment items to be installed in the aircraft had exceeded that possible in the A1. Accordingly, in 1947, the decision was made by EE and the Ministry that the A1 would not have a radar bombing system; instead it would have a visual bombsight in the nose and an updated wartime navigation system. A third crew member was added to operate the revised equipment fit. To reflect these changes, the B3/45 specification was superseded by B5/47, although the four prototypes already on order would continue to be built to B3/45. These prototypes would be used to test and evaluate the basic aircraft; in March 1948 further prototypes were ordered to reflect the provisions of B5/47.

The problem with the AJ65 engine, by now designated the Avon RA1, was persistent surging during test bed running. This threatened to delay the availability of flight-cleared engines for the A1. To avoid delays to initial flight testing, it was decided that the second A1 prototype would be fitted with two well-proven Rolls-Royce Nenes. Accordingly, this aircraft, VN813, was built with rather fatter engine nacelles to contain the bulky centrifugal Nene engines.

The necessary design and engineering work was undertaken while

The first prototype, VN799, in the later stages of final assembly in Hanger 25 at Warton.

construction of the first four prototypes was underway and while work began on the design of variants of the basic A1 that were expected to be ordered in addition to the basic bomber version.

Completion and Flight Testing of the Prototypes.

By the spring of 1949, the first A1, VN799, was being assembled in 25 Hangar at Warton and it was rolled out for first engine runs at the beginning of May. Taxi trials started on 7 May, and Beamont took VN799 off the ground on the 9th for a short 'hop' to check unstick speed and low-speed control feel. A few more hops were made before, on Friday 13 May, VN799 was cleared for flight. Beamont took off at 10.46am for a 30 minute flight. After the flight he recorded in his log book 'Satisfactory, overbalanced rudder.' This was a very low-key way of recording a very successful flight; the remark about the rudder was not serious, as it was known to be difficult to get the size of the horn balance correct before flight testing. To facilitate adjustment, if any should be needed, the top of the rudder was made of wood, so that it could be easily changed. Before the second flight, the top of the rudder was cut down, altering the fully round tip to a more flat-topped shape. This was the shape featured on all subsequent aircraft. By the end of May Beamont had made ten flights, totalling just over 12

First take off – 13 May 1949 – and the only time she flew with the rounded tip to the rudder.

hours. Freddie Page later wrote, 'thus started one of the most straightforward and successful flight test programmes in post-war history.' By the end of 1949 all four A1 prototypes had flown, and the aircraft obviously had no significant faults. Any snags found were minor, and readily rectified. The first assessment by the customer, the A&AEE at Boscombe Down, had been completed with VN799, and was 'extremely satisfactory".

A Name and a New Chief Engineer

The question of a proper name for the A1 was raised soon after the first flight. By then Australia was showing interest in acquiring the aircraft, and EE Chairman, Sir George Nelson, proposed that the name should be 'Canberra', after the Australian capital city. The Ministry agreed; and the first four prototypes became the Canberra B Mk 1. A less happy event at the end of 1949 was the resignation of Petter as Chief Engineer of the EE Aircraft Division. For some time he had been having disputes with certain senior EE people and when he could not get them to agree to certain management and organisation issues, he resigned. This decision mirrored his earlier resignation from Westland, before he joined EE. Freddie Page became the new Chief Engineer; he was just 32 years old at the time and he was to guide the Canberra through its long and varied career for most of the next 20 years.

THE EARLY DAYS

AVM John Brownlow

John Brownlow joined the RAF in 1947 and flew as a navigator with Nos 12 and 101 Sqns and as a pilot with Nos 103 and 213 Sqns before attending the ETPS Course in 1958. His later Service appointments included: Defence and Air Attaché, Stockholm; CO Experimental Flying, RAE Farnborough; Commandant, A&AEE Boscombe Down; Commandant, RAF College, Cranwell and, finally, Director General of Training. He spent 1984-94 with Marshall Aerospace and another three years with the CAA before his final retirement in 1997.

The Canberra was conceived as a jet bomber with a performance comparable with, or better than, the jet fighter aircraft in service at the end of WW II, or that were projected to enter service in the near future. English Electric was invited to bid for the design and production of four prototype aircraft to specification E (later B) 3/45.

The underlying design philosophy for the English Electric proposal was said to be – an aircraft which was at ‘the extreme in adventurous conventionalism’. The company was awarded the contract in January 1946, and the first aircraft, VN799, the English Electric A1, was rolled out at Warton on 2 May 1949; the first flight was made on the 13th. All four prototypes were completed and made their first flights in 1949. VN799 was powered by Avon RA2 axial flow engines, each producing 6,000 lbs of thrust. The Avon for the production B2/PR3 was the Mk 101, or RA3, developing 6,500 lbs of thrust.,

The second iteration of B3/45, which had been drafted in response to OR199, included the statement, ‘The aircraft is to be laid out for bomb aiming by radar, and other mechanical vision systems, and for the use of guided projectiles.’ During the prototype design and build phases it was therefore expected that the Canberra would be equipped with the H2S Mk 9 radar bombing system, so there was no provision for visual bomb aiming and the four prototypes were designed for a crew of two. However, the radar was not developed in time, and for

the B2 production aircraft the cockpit was redesigned to accommodate two navigators sitting side by side behind the pilot with provision for visual bombing, using a T2 bombsight with the bomb aimer lying in the nose – much the same as in the Lincoln.

Some five months after its first flight, the A1 was delivered to the A&AEE at Boscombe Down for preview trials where it was flown by Wg Cdr Davies, Sqn Ldr C K Saxelby and Flt Lt A E Callard. These test pilots were the first serving RAF pilots to fly the Canberra and, with a few relatively minor observations and recommendations, they were all very impressed with its performance and handling. By this time the PR3 had been designed and the prototype, VX181, first flew on 19 March 1950. Only 35 PR3s were built; compared with the B2 the fuselage was stretched by 14 inches to accommodate an additional fuel tank, and a camera and flare bay. It had a two-man crew.

So much for the early development background, what follows largely covers my own experiences when the Canberra was entering and becoming established in RAF service, and some of the personalities involved at that time. First, I will cover the period 1950 to '52 including No 12 Sqn's Goodwill Tour of South America, Operation ROUND TRIP. Then I will deal with 1954 to 1957, when Canberra squadrons were becoming operational in Germany, finishing off with a brief mention of the nuclear role of the B6s, B(I)6s and B(I)8s. Where possible, I have tried to include information that I have not seen published before. Later on in my career, I was involved with the Canberra as a trials platform at Farnborough and Boscombe Down, although these activities fall outside my brief for today, which was to focus on 'The Early Days'. I should add that, in preparing for this presentation, I have referred: to the excellent and comprehensive book on the Canberra by Ken Delve, Peter Green and John Clemons; to the splendid history of No 213 Sqn by Frank Leeson; and to Humphrey Wynn's encyclopaedic work, *RAF Nuclear Deterrent Forces*. Finally, a health warning – you will appreciate that my views and memories may be coloured by the facts that it was a long time ago, and that I was a very junior officer at the time.

In 1950 I was serving at Binbrook as a member of No 12 Sqn which was equipped with Lincolns. As well as squadron flying, I was deputed, together with Flt Lt R A G Barlow of No 101 Sqn, to fly with our Wing Commander Flying, Hamish Mahaddie, a highly decorated

Pathfinder pilot. ‘Rags’ Barlow, as he was known, was an experienced wartime navigator and, as the junior boy in the crew, I was more or less taken along to make sure the transport arrived on time and to carry the bags. Flying with Hamish, we led the Bomber Command King’s Birthday Flypast down the Mall to Buckingham Palace on 8 June 1950, and the RAF Display Flypast at Farnborough on 7 and 8 July. Good fortune flew with us and we managed to get to the Palace and to Farnborough on time – without the aid of GPS, I might add.

Strange though it may seem, I think these flights eventually led to Rags and I becoming members of the first station-level Canberra crew. Hamish always led from the front, so he and Sqn Ldr Ernest Cassidy, OC 101 Sqn, were the first station pilots to convert. Rags Barlow and I joined them as the first two navigator/bomb aimers then serving in operational squadrons to train as Canberra aircrew. As you can imagine, as a mere pilot officer, in the midst of all this seniority and experience, I was expected to be first in line to buy the beer if we were diverted.

None of us had flown in a jet aircraft before. Some ground and flying training was obviously in order, so we travelled to Farnborough to spend a few days with the Institute of Aviation Medicine. They provided lectures on hypoxia along with practical experience of the rigours of the decompression chamber, including explosive decompression from, I seem to remember, 25,000 ft to 45,000 ft, plus familiarisation with use of the pressure waistcoat and the Canberra’s oxygen system. In order to acquire some initial jet experience, we also flew in a Meteor 7 with Wg Cdr Ruffell-Smith, a well-known aviation specialist medical officer/pilot at the time. My own Meteor flight was on 10 September 1950. Compared with the Lincoln, we all found this first jet flight a revelation in terms of speed, rate of climb, smoothness, low noise level and high cruising altitude. We were then detached to English Electric at Warton, on an opportunity basis, for conversion to the Canberra under the supervision of the Chief Test Pilot, Wg Cdr ‘Bea’ Beamont and his team. Bea’s team included Johnny Squier and Peter Hillwood, both of whom had been sergeant pilots in the Battle of Britain, and the company’s navigator, Dennis Watson.

Flight instruction was given from the rumble seat. Ground school was largely confined to briefings at the aircraft and self-study. Personally, I first flew in a Canberra on 17 October 1950. This was

Flt Lt 'Rags' Barlow, Wg Cdr Hamish Mahaddie and Fg Off John Brownlow – the first station-level aircrew to convert to the Canberra.

with Hamish Mahaddie at Warton during his type conversion. The aeroplane was WD929, the first of an initial production batch of 132 Canberras, which had made its first flight just nine days earlier on 8 October. This batch included ninety B2s, thirty-four PR3s and eight T4s. On 19 January 1951 the Right Honourable R G Menzies, Prime Minister of Australia, officially named the aircraft 'Canberra' using WD929 for the ceremony.

Later, a Jet Conversion Flight was formed at Binbrook to convert squadron aircrew, first to the Meteor and then the Canberra. This flight was up and running by mid-1951 as an integral part of No 101 Sqn. It was commanded by Flt Lt Bill Morley, an experienced jet QFI, assisted by Flt Lt Debenham and Fg Off Young, also jet QFIs.

There was considerable concern at the time about the ability of the bomb aimer to get back from the nose and strap into his ejection seat in an emergency. Rags Barlow and I spent quite a lot of time during 1950 and early 1951 practising this move and timing how long it took to strap-in. Our conclusion was that it was very difficult to do rapidly, especially, as was very likely to be the case, if any 'g' was being

L-R: Wg Cdr 'Bea' Beamont, Gp Capt Wally Sheen (Stn Cdr) and Wg Cdr Pat Connelly (Wg Cdr Flying) pose in front of Binbrook's Control Tower on 25 May 1951 when the first aircraft, WD936, was delivered to No 101 Sqn.

pulled (or pushed). We recommended that easy-to-release clips should be fitted to the sides of ejection seats so that the parachute and seat straps could be left lying open, instead of in a heap, thus minimising strapping-in time. This modification was eventually incorporated.

The only navigation aid, other than VHF bearings, and Rebecca, was GEE, and, of course, an Air Position Indicator. The GEE box was the Universal Indicator, allowing GEE or G-H to be selected. The controls and CRT display were mounted on the left hand side of the navigator's seat, about level with his left thigh. This positioning made the box awkward to operate and one often developed a painful crick in the back and neck during longish trips. It also made it impossible for the GEE box to be operated by the navigator in the right hand seat, which was a significant limitation. The GEE Indicator and controls were eventually moved to the central navigation panel.

At the time, Bomber Command navigators were trained to stick to track and take a GEE fix every 6 minutes. This basic procedure was no more difficult in a Canberra than in a Lincoln, and generally it was easier to track accurately because of the higher speed and smaller drift

angles. From the start, navigators were responsible for maintaining the HOWGOZIT graph, taking periodic fuel readings and plotting them against planned time, predicted fuel remaining and distance. The published fuel consumption figures for the Canberra were, incidentally, very accurate, which was just as well, as the fuel reserve margins were much lower than those to which we were accustomed in the Lincoln, and at that time the aircraft were not fitted with tip tanks.

The B2 received its Release to Service in the spring of 1951 and Bea Beamont delivered No 101 Sqn's first aircraft, WD936, to Binbrook on 25 May.

Perhaps inevitably, there were considerable delays in delivery of new aircraft to the squadron, so Canberra flying was rather spasmodic during 1951. Concentration was obviously on conversion of crews and it was not until March 1952 that we took part in an Exercise BULLSEYE – a Bomber Command high level cross country exercise – and routine bombing practice started in earnest. The T2 bombsight was very similar, if not the same, as in the Lincoln, and both visual and G-H bombing soon became the norm, using 25 lb practice bombs on the East Coast and Wash Ranges.

During these early days the motorised Alvis Bomb Loading Trolleys, which were tailor-made for the Canberra and featured an hydraulically-operated means of lifting bombs into the bomb bay, were found to be unable to cope with repeated long distance journeys to and from the bomb dump. The consequent bombing-up problems were solved largely through modifications and procedures devised by Binbrook's Senior Armament Officer, Sqn Ldr Ken Wallis. In essence, he had loaded Type F Bomb Trolleys pre-positioned at the dispersals, from which bombs could then be easily transferred to the Alvis Trolleys for loading into the aircraft; once relieved of its load, the more robust Type Fs could be shuttled back to the dump to collect another batch of bombs. Ken Wallis deserved, and eventually received, considerable credit for the solutions he proposed which were rapidly introduced to service. He also played an important part in investigating the cause of a number of early Canberra accidents by eliminating the possibility of inadvertent detonation of the explosive collar in the elevator circuit that was required to allow the control column to go forward before pilot ejection. The cause of these accidents was eventually determined to be loss of control following a

runaway of the pitch trim actuator. Much later, Ken Wallis became well-known for his work on autogyros, and his contribution to the James Bond film *You only Live Twice.* So far as I am aware he is still flying his autogyros at the age of 92 or so.

Early in 1952 I was posted to HQ 1 Group at Bawtry as ADC to the AOC, AVM Dermot Boyle. The AOC converted to the Canberra at Binbrook with the Jet Conversion Unit, and I flew with him throughout his conversion, and regularly during 1952. This included our unofficial record flight from Binbrook to Malta and back on 25 September 1952. Our total flying time was 6 hours 10 minutes. Sergeant Tommy Cramp from No 12 Sqn was the second navigator. Coincidentally Tommy and I had been on the same navigators' course at No 1 ANS at Topcliffe in 1947-49. On this flight our navigation aids were GEE, VHF bearings and map reading.

Meanwhile, during 1952, the Canberra Wing at Binbrook was building up. No 101 Sqn was joined by 617 Sqn in January, 12 Sqn in March, 9 Sqn in May, and 50 Sqn in August. As an indication of training priorities, the records show that in August No 12 Sqn dropped 200 25 lb practice bombs – 140 of them by G-H and 60 visually. By this time No 231 OCU at Bassingbourn had been established and the first formal Canberra conversion course began in May 1952. About 50% of student aircrew going through the OCU at this time were National Servicemen.

During mid-1952 the Goodwill Tour of South America (Operation ROUND TRIP) was being conceived. The original idea was to celebrate, on behalf of the UK, the change of Presidency in Chile, but once other South American and Caribbean governments learned that the first British jet bomber was visiting their continent the demands for visits escalated. The tour covered some 24,000 miles, and was flown by No 12 Sqn in four Canberra B2s led by Dermot Boyle. I was lucky enough to go along as his navigator and ADC. The route was as follows:

> Binbrook – Gibraltar – Dakar – Recife – Rio de Janeiro – Montevideo – Buenos Aires – Santiago – Lima – Bogota – Caracas – Belize – Mexico City – Havana – Kingston – Ciudad Trujuillo – Port of Spain – Belem – Recife – Dakar – Gibraltar – Binbrook (St Eval)

The captains of the Op ROUND TRIP Canberras, L-R Sgt Bruce Fraser, Sqn Ldr Les Press, AVM Dermot Boyle, Flt Lt Jimmy Stroud and Sgt John Simms.

We set off on 20 October and arrived back at St Eval on 5 December, having been diverted because of bad weather at Binbrook. Navigation, and the relatively short range of the B2s for the South Atlantic crossings, were initially regarded as major problems. However, the B2's range was extended by fitting a single 300 gallon auxiliary tank in the bomb bay. This was in addition to the normal tip tanks which were in general use by then.

Navigation was helped by the addition of a Marconi radio compass in each aircraft, and a Marconi HF radio in the aircraft flown by OC 12 Sqn, Sqn Ldr Les Press. I had the benefit of a Hughes periscopic sextant in WD987 which was flown by Dermot Boyle with the reserve pilot, Sgt John Simms, also on board. A Marconi employee, Mr Shelton, was given a temporary commission as a pilot officer, and flew with Les Press to operate the HF set, maintain long distance communication, obtain bearings and service the radio compasses if

required. WD987 had previously been used for a record flight from London to Nairobi, captained by Wg Cdr Pat Connelly who had taken over from Hamish Mahaddie as Binbrook's Wing Commander Flying.

Since we had no idea what the winds would be at cruising altitude, our chief anxiety was the strength of any jet streams that we might encounter. In those days, jet streams were little understood, of course, and no information on them existed for the South Atlantic or South America. For about 600 nm during the crossing we would be without external navigation aids. The strategy was, therefore, for each crew to navigate independently to the start of the 600-mile gap, around 1¼ hour's flying. However, we all started off using a common flight plan, based on an assumed wind, and we took off with no more than a minute or two between aircraft. On reaching the start of the gap, each crew was to check its fuel state and, if excessive consumption was evident and it was concluded that they could not complete the flight against a 100 knot jet stream, they were to return to Dakar. To everyone's relief, as each Canberra reached the checkpoint, the crews reported that they were continuing.

In fact, once we were out of VHF range the Hughes periscopic sextant was useful for plotting single position lines using the sun, and these gave what proved to be quite accurate track checks. This was confirmed when we were eventually able to pick up an NDB situated on an island north east of Recife which indicated that we were pretty well on track and on ETA. I can't recall whether we ever got an HF bearing. The east-west crossing was made in an unofficial record time of 4 hours and 27 minutes on 23 October. And west to east in 4hrs. We all arrived in the circuit at Recife at about the same time, and taxied in together. This was the first jet crossing of the South Atlantic in both directions.

There were few operational problems during the tour. The main ones being due to the weather. On arrival at Rio de Janeiro, for instance, it was so bad that we had to let down to low level over the sea using the radio compass and the Santos Dumont NDB, and then pick our way visually through coastal hills to Santos Dumont airfield at Rio. The next problem involved a very strong jet stream flowing north to south, roughly parallel with the Andes, which we came across en route from Santiago to Lima, and which had not, of course, been forecast. The approach to Lima was also a little fraught, because of

The Canberras of Bomber Command's unique, and short-lived, Germany-based No 551 Wg are rarely illustrated; this is one of No 103 Sqn's B2s being fired up on a winter's day at Gütersloh.

poor visibility. We had to make a visual approach to an unfamiliar airfield, the only assistance being the local NDB and a map.

An engine handling problem that cropped up occasionally was caused by the two-position swirl vanes on the earlier Mk 101 Avon engines. When taking off in a strong cross wind the swirl vane blades would stall on initial engine acceleration unless the aircraft was first positioned into wind on the runway and then held on the brakes until the vanes opened. The aircraft then had to be edged round onto the runway heading before take off power could be applied.

However, throughout the tour, the serviceability of the Canberras was excellent. And, as usual, the RAF ground crew, all members of No 12 Sqn, were superb. We were supported on the trip by two Hastings, one of which was captained by Flt Lt Jock Kennedy, later Air Chief Marshal Sir Jock.

There is no doubt that the South American Tour was a great success, and it resulted in many export orders for the Canberra to South America, notably to Argentina, Peru, Ecuador, Chile and Venezuela.

On completion of my tour with AVM Boyle I started pilot training in April 1953, and nineteen months later I joined No 103 Sqn, one of the four Canberra B2 squadrons of No 551 Wing at Gütersloh. This wing was really an extension of Bomber Command in terms of policy

direction and, hence, the concept of operations. We used G-H Mk 2 for blind bombing and the T2 bombsight for visual bombing, as we had done from the outset. The main focus was on G-H, dropping 25 lb practice bombs, usually on Nordhorn Range. Strategic operational control of the wing was retained by HQ Bomber Command but day-to-day control of routine flying and administration was devolved to 2nd Tactical Air Force via HQ 2 Group. For exercise and operational planning purposes we were integrated with the Bomber Command Canberra wings, and we used the same aircrew classification system. A most significant operational limitation of G-H was that it covered the UK and Europe only up to a line roughly Rostock–Magdeburg–Munich.

As I recall there was no knowledge among the aircrews of No 551 Wg about an impending change of role to tactical nuclear strike for the Germany-based Canberras. However, in January 1956 I was posted with my crew to join No 213 Sqn that was reforming at Ahlhorn. Our Squadron Commander was Wg Cdr Harry Dodson, a qualified test pilot. We were briefed that our role would initially centre on day and night interdiction, and that training for this role would eventually lead to a tactical nuclear strike capability when our aircraft had been suitably modified. In March the first six brand new Canberra B(I)6s arrived, and we eventually built up to a strength of sixteen.

As delivered, the aircraft were painted silver. The B(I)6 had a Boulton and Paul gun pack, containing four 20 mm Hispano Suiza cannons, in the rear of the bomb bay. Each gun was provided with 525 rounds, enough for fifty seconds' firing. In addition three 1,000 lb bombs could be carried in the bomb bay, and two more on underwing pylons. We had a Mk 3N reflector gunsight above the instrument panel and a G45 gun camera in the starboard leading edge. There was also provision for a forward-facing F95 camera in the nose and we could carry sixteen 4.5 inch flares in the bomb bay. Needless to say, the B(I)6 was a joy to fly compared with the relatively old B2s we had flown before. No 213 Sqn had a mixture of experienced Canberra aircrews with different backgrounds, and newly trained crews straight from the OCU at Bassingbourn.

For the first couple of years after 213's re-formation our main task was night low level interdiction. Among our planned targets were radars, communications centres, supply depots, indeed the whole

No 213 Sqn's B(I)6s were initially delivered in silver but they soon acquired warpaint. This one, WT313, was photographed at Luqa in 1964. (MAP)

range of typical interdiction targets in Eastern Europe. Obviously we had to work up to this. A programme of intensive training was soon instituted, based on a lot of low level cross country map reading by day and night, but at the time we badly needed a low level navigation aid, later to be provided by Decca Mk 1(Air), a GPI Mk 4A and a roller map, both of the latter being driven by a BLUE SILK Doppler radar, as part of the upgrade for the tactical nuclear strike role.

Our role conversion included instruction in basic ground attack patterns by a Pilot Attack Instructor in a Vampire T11, followed by live firing with the Canberra gun pack on the nearby Stroehen Range. To get a feel for the aircraft's response to firing the gun pack, and to practise cockpit procedures before going live on the range, we fired into the North Sea. The Canberra turned out to be a very stable gun platform and the squadron was soon achieving respectable fixed target scores both by day and by night.

Once qualified for ground attack the squadron was tasked with 'Light Strike', which involved detachments to Valkenburg, a Dutch naval airfield near The Hague. This operation entailed simulated attacks on E-Boats in the North Sea by day and night in collaboration with a Shackleton. At night the Shackleton identified the target and dropped flares to illuminate it. The Canberra crew then acquired the target visually and attacked using the gun pack. Diving into the ball of light created by the flares, concentrating on the attack, and then pulling up into complete blackness, with one's night vision completely destroyed and thus being obliged to revert instantly to instruments,

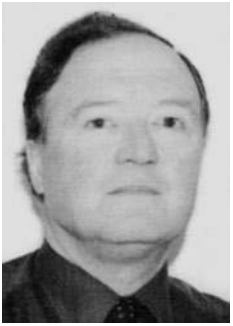
was one of the most disorientating situations I have ever experienced. Perhaps surprisingly, crews seemed to cope with it, but I can't help feeling that eventually there would have been a big splash. Valkenburg was not a very suitable airfield for night operations, since it had neither approach lights nor approach path indicators, and was difficult to identify, since it was located very close to the large, well-lit residential areas around The Hague.

As I have mentioned, we knew that a tactical nuclear role was planned for the Canberra force in Germany using the Low Altitude Bombing System (LABS). Together with some B6s of Bomber Command, the B(I)6s and B(I)8s in Germany were modified from 1957 onwards to be capable of the nuclear role. My understanding is that sometime between 1955 and 1957 the US lifted its embargo on the export of atomic weapons information and gave the UK data on the size, weights, and attachment systems for US weapons. This led to the four Germany-based Canberra squadrons being fitted out to carry the American Mk 7 bomb. Meanwhile, some Bomber Command B6s were also equipped with LABS, and two squadrons, Nos 9 and 12, were moved from Binbrook to Coningsby in 1959, where there were facilities for the storage of special weapons. These two squadrons were nuclear capable and both were declared to SACEUR with American weapons. QRA was introduced in October 1960. Interestingly, Nos 9 and 12 Sqn's aircraft were not provided with DECCA, or a roller map or BLUE SHADOW sideways looking radar (as used by No 139 Sqn in its target marker role), but they did still have G-H.

At squadron level, I was involved with the Canberra for only the first few years of its long career but, as will, I hope, have become apparent, the aeroplane had evolved significantly during that period and the B(I)6 of 1956 was a very different, and far more capable and flexible, aeroplane, than the original B2 of 1951. And, by this time, of course, the Canberra was beginning to take on many other roles and specialist tasks. But that is another story.

ARIES FLIGHTS TO THE NORTH POLE AND OTHER LONG DISTANCE FLIGHTS

Wg Cdr Terry Hayward



Terry Hayward joined the RAF in 1955 and, as a navigator, flew Canberras (with Nos 12 and 213 Sqns) and Vulcans. A graduate of the 'Spec N' Course, he was responsible for Aries Polar Flights 1966-1970 and OC the RAF Navigation School 1977-1980. Following retirement from the staff of ACAS(Pol) in 1984 he was Bursar to an Independent School and became involved in local politics and a number of national committees concerned with education. He is a Fellow of the Royal Institute of Navigation and currently its senior Vice President.

I have limited this presentation to the flights of Canberras WH699 and WT528 or *Aries IV* and *Aries V* as they were perhaps better known. I recognise, of course, that there were other, perhaps almost as, epic flights.

Before talking about the Canberra *Aries* Flights in the North Polar Region and other long distance flights I think it will be useful to say a little about flights to the North Pole and the associated difficulties. Until recently it was accepted that an American aviator, Lt Cdr Richard E Byrd, together with his pilot, Floyd Bennett, had been the first crew to fly to the North Pole; more recently this has been called into question and that honour is now given to Amundsen, Ellsworth and Nobile with a Norwegian navigator, First Lieutenant Riiser-Larsen, in the airship *Norge* in 1926. What is so difficult about flying to the North Pole? Well, to state the obvious, it's a long way, not just as an absolute distance but also from the practical viewpoint of the availability of bases from which aircraft can operate. And then there are the inhospitable weather conditions and the means of forecasting them. There is a paucity of easily identifiable features and, until recently few accurate maps by which to navigate and the trusty magnetic compass becomes increasingly less trusty the further north you travel.

The Russians had carried out a series of exploratory flights in the 1930s and both the Americans and British flew various aircraft in Polar regions during WW II. In 1945 the RAF sent *Aries I*, a modified Lancaster, on a series of experimental and exploratory flights, to locate the magnetic pole accurately and to develop methods of navigating in Polar Regions and these flights were continued by two Lincolns, *Aries II* and *III*. All of these flights were carried out by crews from the RAF Flying College. In the spring of 1953 the College took delivery of *Aries IV*, a Canberra B2, WH 699, which was fitted with a 650-gallon auxiliary fuel tank in the bomb bay. This aircraft had already made one remarkable record flight while still in the hands of its makers. Two English Electric test pilots had flown from London to New York and back in a single day. For several years navigator pupils on the Specialist Navigation Course at Manby had carried out high-latitude flights as part of their syllabus in piston-engine aircraft. In February 1954 *Aries IV*, flown by Wg Cdr Stanbury, flew to Churchill, on Hudsons Bay, and carried out an Arctic proving flight from there. A few months later Air Cdre G A Walker, the then Commandant of the Flying College, instigated a series of experimental flights using a base in northern Norway as a jumping off point for Arctic flights. These flights led to the first attempt by an RAF jet to reach the North Pole. Not the first jet, unfortunately, because the Americans had already achieved this with a B-52 in the previous year.

The successful flight took place during the night of 14/15 October when *Aries IV*, flown by Wg Cdr Andrew Humphrey and navigated by Sqn Ldr Dougie Bower and Flt Lt F R Wood, took off from Bardufoss at 69^{O} North in Norway, overflew the Geographic North Pole and, after a flight of some 6¾ hours landed at Bodø. They took off at just after 2100hrs and, after climbing to 40,000ft, cruise climbed to around 45,000 ft over the pole and eventually reached over 50,000ft on the return flight. The return did not go entirely to plan. Adverse weather conditions prevented a return to Bardufoss and the aircraft was diverted to Bodø where it landed at 0400hrs on 15 October. The flight had covered some 2,620 nms. That short summary reveals only the bare bones of the flight. Bearing in mind its purpose, it seems appropriate to look in a little more detail at what the planning and actual navigation involved.

Needless to say, careful planning was necessary in order to

consider all of the implications of the pioneer flight including the possibility of bad weather. The round trip to 90^{O} North was only possible from Bardufoss, where the airfield lies in a narrow valley flanked by 4,000 ft mountains, so good visibility and cloud base were essential. The primary aim of the planning was to achieve a maximum radius of action with fuel reserves fixed beforehand according to forecast terminal weather. Fortunately, because of the less stringent weather limitations at Bodø, the fuel reserves required were exactly the same as for Bardufoss so it was possible to take-off from Bardofoss, fly over the Pole and return to Bodø. This arrangement left no margin to cover the loss of an engine or cabin pressure, but, beyond the single-engine point-of-no-return, it would still be possible to divert to Thule in NW Greenland. Nearly half of the total available fuel was carried in auxiliary tanks and, because there was no guarantee that these would drain completely, and because no forecast weather information was available for north of Spitsbergen, it was necessary to cater for in-flight revision of the radius of action.

The aircraft's navigation fit was rudimentary by modern standards and consisted of: a Mk 2 periscopic sextant; a back-up hand-held Mk 9 sextant, which would have been hung on a suspension bracket under the canopy next to the pilot's seat; a radio compass; an air mileage indicator (the use of the API was impracticable when gyro-steering unless the gyro wander rate was both small and regular); and REBECCA distance-measuring equipment. The standard gyromagnetic compass unit was used for gyro steering. The radio compass and REBECCA were used solely for the terminal homing and letdown. This was an important aspect of the flight and portable EUREKA beacons were erected at the two airfields.

A well-tried and satisfactory high-latitude navigation technique already existed for piston-engined aircraft and it appeared from the outset that it was both practical and desirable to apply it to the Canberra flights with the minimum of modification. Grid navigation was used throughout the flight but gyro steering was not used until 75^{O} North. Once at height the only fixing aid available was astro. For administrative reasons the flight had to be carried out in mid-October, at which time the relative positions of the sun and moon were not favourable for good fixing, so a night flight was planned. The relative shortness of the night further complicated planning.

The length of the flight demanded the best climbing-cruise procedure and to ensure the best performance the existing graphs were recalculated to determine the optimum condition; this proved to be a ratio of cruising EAS[1] to minimum drag speed of 1:10. It became apparent that, in the Canberra, the relationship between all up weight (AUW) and relative pressure was critical and might well be used as a controlling parameter during cruise. A table was constructed so that the navigators could monitor in-flight conditions and performance.

After a normal climb the aircraft was stabilised at initial cruising altitude and astro fixing commenced shortly afterwards. Astro was also used for heading checks. A full precomputation technique was employed. The plan was to produce two position lines on the half hour as intermediate progress checks and a full four position line box fix on the hour but, for much of the flight, fixes were actually obtained every half hour. On the northbound trip the stars selected were either substantially ahead of the aircraft or on the beam. This was so that the pilot only had to concentrate on flying an accurate speed *or* heading so that he was not obliged to concentrate on both simultaneously. Acceleration errors were thus kept to a minimum. On the return flight this procedure was not possible because a suitable selection of stars was not available. Thus it became necessary to take shots on relative bearings of around 45^{O} and 315^{O}, which made the pilot's task correspondingly more demanding because both heading and speed had to be held accurately.

During this and subsequent flights the behaviour of the steering gyro was more erratic than that previously experienced in piston-engined aircraft with the same type of instrument. This was especially so after the 180^{O} turn at the Pole. One consequence of this behaviour was that the star selected might fall out of the sextant's field of vision and it proved difficult to identify the selected star. On subsequent flights it was found helpful to carry sketches showing the pattern of minor stars in the vicinity of the required navigation stars.

Throughout the flight, troubles were experienced with radio aids and this was subsequently shown to be due to the temperature in the radio bay falling below the design limits of the equipment; additional heating and insulation was installed prior to later flights and this

[1] Equivalent Airspeed (EAS) is true airspeed corrected for altitude effects.

solved the problem.

The results of the flight were judged to be sufficiently encouraging to warrant going ahead with the plan to run a series of similar flights for the benefit of Flying College students attending the Specialist Navigation Course (*aka* 'the Spec N'). All of the navigators concerned had previous high-latitude experience, having taken part in polar flights in Hastings earlier in the year, and they had all flown on long range-range exercises in the Canberra in medium latitudes. Practice flights to Jan Mayen Island shortly before leaving for Norway, enabled the navigators to become familiar with the new techniques. The training flights proper took place during the period 13-17 December and used Bodø as their base. As before, the flights took the form of radius-of-action exercises with fixed fuel reserves, the latter being increased to suit the different circumstances. Four of the five planned missions were accomplished successfully, the last and longest attaining a latitude of $87^{O}30'$ North.

These flights, and those subsequently flown in the Canberra by the Spec N students, provided excellent training for navigators and contributed to the development of navigation and flying techniques, which was their primary purpose. In addition, the performance of airframes, engines and instruments in conditions of extreme cold was tested in actual working conditions and this provided invaluable information for aircraft designers.

WH699 had already flown its way into the record books. On 17 December 1953, to celebrate the 50th Anniversary of the Wright Brothers' first powered flight. It was flown by Wg Cdr C G Petty, Sqn Ldr T McGarry and Sqn Ldr M Craig, the 5,168 nms from London to Cape Town being covered in 12 hours, 21 minutes and 3.8 seconds. This new record was about twice as fast as that achieved by one of its predecessors, *Aries II*, nearly seven years before. The return journey established another record time of 13 hours, 15 minutes, 25.2 seconds. The crew on this occasion was Wg Cdr Humphrey Sqn Ldr Bower and Sqn Ldr R F B Powell.

On the 23 June 1955 *Aries IV* , crewed by Wg Cdr M Lyne, Sqn Ldr Bower and Sqn Ldr R Seymour flew from Bardufoss, over the North Pole to Ladd AFB in Alaska, a distance of 2,776 nautical miles in 6 hours, 30 minutes. From there *Aries IV* was flown on to Ottawa and on the night of the 27/28 June 1955, this time piloted by Wg Cdr I

Seen shortly after landing at West Malling after their record-breaking flight from Ottawa in Aries IV*, Sqn Ldr Bob Seymour, Sqn Ldr Dougie Bower, and Wg Cdr Ivor Broom are greeted by the Station Commander, Gp Capt P A Hamley, SASO Flying Training Command, AVM Gilbert Nicholetts and Air Cdre Gus Walker, Commandant of the RAF Flying College at Manby.*

G Broom, but with the same navigation team of Bower and Seymour, it broke the Ottawa to London record by flying the 2,864 nms in 6 hours, 42 minutes and 12 seconds. This was the swan song for WH699 as *Aries IV*, although it soldiered on at the RAF Flying College until it was written off in a crash at Strubby on 28 November 1959.

You may have noticed that one name kept recurring in my account of the *Aries IV* flights; Sqn Ldr Dougie Bower was at the heart of the aircraft's success and possibly the most experienced long distance Canberra navigator in the RAF. I am indebted to his written reports for much of my information.

Aries IV's replacement – *Aries V* – was a Canberra PR 7, WT528, which had a much greater fuel capacity than its predecessor, its extra fuel tanks enabling it to carry 4,065 gallons. This aeroplane had already been used for long distance flights. It had broken the London

The christening ceremony for Aries V.

to New York and New York to London records on 23 August 1955 in 7 hours, 29 minutes, 56.7 seconds and 6 hours, 16 minutes and 59.5 seconds respectively. In doing so it also achieved the first two-way crossing of the Atlantic in a single day. A total distance of 5,947 nms in 14 hours, 21 minutes, 45 seconds, including a 35-minute refuelling turn round at Floyd Bennett Field.

The silver-painted aircraft with its 'Arctic red' fin, tailplane, wing tips and fuel tanks soon added to its laurels when it was flown over the North Pole from Haneda Airport, Tokyo to West Malling in Kent on 25 May 1957, a distance of 5,110 nms in 17 hours, 42 minutes, 2.4 seconds.

In the spring of 1958 it was flown on an around-the-world trip. The journey included a Manston to Nairobi leg of 8 hours, 12 minutes. Although this was a new fastest time for the journey, it was not formally claimed as a new record. *Aries V* continued on its round-the-world flight, visiting Rhodesia, South Africa, Australia and New Zealand. The crews developed new navigation techniques for operating in areas of limited ground aids and discussed operational procedures and training methods with Commonwealth Air forces, pretty much as the crews of *Aries I* had done some 13 years earlier in

For many years (it was finally broken up in 1996) WH699 stood outside Cranwell's Trenchard Hall as a reminder of its exploits as Aries IV. *But the real* Aries IV *had been written off in 1959 – this was actually another B2, WJ637. (MAP)*

1944. The flight returned to the UK on 14 May and this proved to be the final flourish both for *Aries V* and for the whole *Aries* programme. By this time, larger jet aircraft were becoming available for testing navigation equipment and it was judged that there were other agencies better equipped to carry out trials on new techniques. A new round of economic cuts was also imposed and it was decided that maintaining a dedicated *Aries* aircraft at the RAF Flying College could no longer be justified. With *Aries IV* having met its untimely end in 1959, *Aries V* was sold to BAC at Warton in 1962. After overhaul and modification to PR57 standard for the Indian Air force, it was re-serialled as BP746, one of a pair of additional PR Canberras it had ordered in 1964.

Thus ended the *Aries* enterprise, and its series of famous aircraft, with which, I suspect, their crews will have been very proud to have been associated. They had done an important job, combining 'showing the flag' – by making record breaking long distance flights – with the less public, and certainly less glamorous, task of refining navigation aids and techniques during the difficult period before the advent of the new technologies which produced the printed circuit, transistors and, ultimately, the computers and satellite navigation systems that are now taken for granted.

MORNING DISCUSION PERIOD

Paddy Long. Can someone tells us how the aeroplane actually got its name?

Bob Fairclough. As I explained, the aeroplane had still to be named when it first flew, by which time the Australians were already expressing an interest in acquiring some. The current policy was that RAF bombers should be named after large towns or cities and Sir George Nelson, English Electric's Chairman, who was very keen on the principle of the Commonwealth – and equally keen on trying to sell the aeroplane to the Australians – suggested naming it after Australia's capital. That was agreed – so Canberra it was. The formal naming ceremony took place about two years later. I would add that, a close eye was kept on export prospects from the outset and that the early long distance flights, notably those done by *Aries IV* and *V* provided excellent pre-sales publicity.

The Australian Prime Minister, Bob Menzies, christening the Canberra at Biggin Hill on 19 January 1951.

David Reade. I was a navigator with No 109 Sqn in the early 1950s. John Brownlow spoke of fixing every six minutes with GEE; on some flights we used to fix every two minutes. All the squadrons at Hemswell were pathfinder squadrons – target markers – under the command, incidentally, of Gp Capt John Searby, the Master Bomber on the Peenemunde Raid. No mention has been made of BLUE SHADOW, a navigation aid that became available to us when we re-equipped with B6s. I found it very accurate – as accurate as GEE – in fact we even did some simulated bombing with it. Can anyone say anything about BLUE SHADOW?

AVM John Brownlow. I only mentioned fixing in passing. Six minutes was the way we did it in the early days, although this was

later reduced to three minutes, three being a very convenient time span. I can't say much about BLUE SHADOW myself, beyond the fact that it was a sideways-looking radar that was used, as you say, by the marker squadrons.

Air Chf Mshl Sir Mike Knight. I was a Flight Commander on No 139 Sqn when we had BLUE SHADOW. Target marking could be quite exciting – the sort of thing John spoke about – diving underneath flares. In our case, we dropped the flares ourselves and then dived underneath them to lay target indicators and I recall a very sad occasion at El Adem when one of the squadron's Flight Commanders followed his TIs into the ground and, with ghoulish black humour, the cry was 'Bomb the burning Canberra'!

Ian Strachan. As a pilot, I have flown, I think, eight marks of Canberra. I think that Bob Fairclough may have mentioned the 10,000 lb store, later known as the BLUE DANUBE, and I remember carrying those in the Valiant – we eventually got rid of the dummies on a sandbank in the Wash; they are probably still there! Did the Canberra ever carry the 10,000 lb store?

Knight. Not to my knowledge. None of us on the panel can shed any light. Can anyone else?

Wg Cdr 'Jeff' Jefford. I suspect that, when the aeroplane was being designed, long before we had a practical British atom bomb, that '10,000 lbs' would have been a notional figure – the eventual BLUE DANUBE, which had a diameter of about five feet, could not have been shoe-horned into a Canberra. So far as I am aware, the only nuclear weapons that were associated with the Canberra were American Mk 7s, supplied under Project E, which had to be tossed and were later superseded, on the squadrons stationed in Germany, by the US Mk 43 lay-down bomb – plus the British RED BEARD, which was confined to squadrons assigned to NEAF and FEAF.

Sqn Ldr L Goodman. I was on No 80 Sqn, and I would just make the point that in the PR world we carried only one navigator, rather than two. What I would like to ask, however, is why did it take so long to solve the runaway trim problem?

Fairclough. The runaway tailplane wasn't well understood at the time. As the aircraft was already in service, however, it was necessary to solve the problem as quickly as possible and a number of solutions were applied simultaneously – which is never a good idea, because you can't be certain which one actually worked – nevertheless, the incidents did stop. The fault probably lay in the cabling. There were both power lines and wires carrying electrical signals running along the side of the fuselage in a single loom and it was suspected that currents were being induced in the signal wiring by the electricity in the power line, the result being undemanded control movements. The two sets of cabling were divided, to separate the power and signals looms, and the problem stopped. Other changes had been made, to the control actuators, for instance, which is why I don't think that we were ever 100% certain what had solved the problem – but I am pretty sure that it was the wiring looms.

Brownlow. As I understand it there were really two problems. Apart from the cabling, there was the actuator itself, which could simply 'run away' of its own accord. As originally installed, the actuator was a very fast-acting device and one remedial measure was simply to slow it down. Other modifications were introduced too – you may recall that it became necessary to select and hold 'trim' before you could actually change the incidence on the tailplane, which meant that the circuit was only live when you wanted it to be and could not, therefore, operate inadvertently. Similarly, if you let go of the 'trim' button, the tailplane actuator was electrically isolated and thus instantly deactivated.

Ken Wallis did a lot of work on this problem in the early days at Binbrook when it was suspected that the problem might be associated with inadvertent operation of an explosive device fitted within the elevator circuit – the 'snatch unit'. If you remember, there was switch that you were supposed to operate prior to ejection, which fired the charge, severing the mechanical control link to the elevator and allowing a powerful spring to pull the control column forward out of the way – so that you would not part company with your kneecaps as you left the aeroplane! It later became clear, that this explosive

Much of the Canberra's fin was made of plywood, serving as a dielectric protective housing for the G-H aerial. The G-H was soon withdrawn, but the wooden fin panels remained and they would occasionally lose the protective fabric (madapolam?) covering that was doped on, which is what may have happened to this B16, No 6 Sqn's WJ780 – although the unpainted rudder may hint at something even more dramatic. (MAP)

'collar' was not actually a problem – but it was thought to be at the time.

Fairclough. There was another 'fix' applied to the tailplane – a mechanical stop that simply prevented it from running to full deflection. It was thought that the first ones might not have been strong enough to guarantee that they would stop an overrun, so more robust models were fitted. That too, contributed to solving the problem so, as you can see, quite a number of solutions were devised.

AVM Nigel Baldwin. Some members of the audience may have been surprised to have heard that bits of this wonderful aeroplane were made of wood. Just how much wood was there?

Fairclough. Not all that much, really. I explained about the tip of the rudder on the first prototype being made of wood. That was because it is always difficult to predict the precise area of a horn balance, and it often has to be adjusted in the light of feedback from the test pilots. Following the first flight, 'Bea' reported that the rudder was overbalanced so it was 'filed down' to arrive at the final shape and the rudder was subsequently all-metal. Other than that, there was a big plywood panel in the fin leading edge, acting as a dielectric for the G-H aerial. I am not aware of any other wood, or even plywood,

anywhere else on the Canberra – English Electric didn't really go in for carpentry.

Air Chf Mshl Sir Jock Kennedy. I was on No 27 Sqn with Wg Cdr Peter Helmore, who did the investigation into the runaway actuator problem and, although there were many possibilities, Peter always maintained that it was the wiring that was the culprit and that separating the looms was the cure. But, that said, we do have to accept that the Canberra did kill a lot of people.

However on another aspect, mention was made of the four pre-production Canberras. When I was at the Radar Research Establishment at Pershore in 1957, I remember people talking about a Canberra with Nene engines. (**Fairclough.** Yes that was the second prototype.) And I think that when it came to Defford, where RRE was at the time, they also spoke of its having variable flaps – I'm not sure about that – but I am sure about the Nenes which were later replaced by the usual Avons.[1]

Arthur Spencer. A one time navigator, long ago. In talking about the first polar flight of the *Aires*, Wg Cdr Hayward referred to the Mk 9 sextant; was it actually the Mk 9 or a 9A? (*Laughter*) Well there was a very considerable difference.[2]

Wg Cdr Terry Hayward. There was indeed, but according to the records, upon which I am, of course dependent – I don't remember that far back myself – it was the Mk 9, but who knows how precisely that was recorded?

[1] The Nene-engined second prototype,VN813, was with the RRE at Defford from September 1951 until August 1952 in connection with trials of BLUE STUDY (a G-H type bombing system which never entered service). It later passed to Rolls-Royce, DH Engines and Follands, but I believe that it retained its Nenes throughout. **Ed**

[2] Not as funny as it sounds. The Mks 9 and 9A were indeed different, in operation, at least. Structurally, they were much the same (a Mk 9 could actually be converted into a Mk 9A by the addition of the clockwork mechanism – Stores Ref 6B/219) but the Mk 9 was only able to deal with, up to, six single shots, taken at random, with the observed altitudes averaged by a built-in mechanical 'totaliser'. The Mk 9A had a clockwork motor which ran for two minutes (selectable as one or two minutes on the Mk 9B) during which, while the celestial body was sighted continuously, sixty readings were automatically recorded and averaged. **Ed**

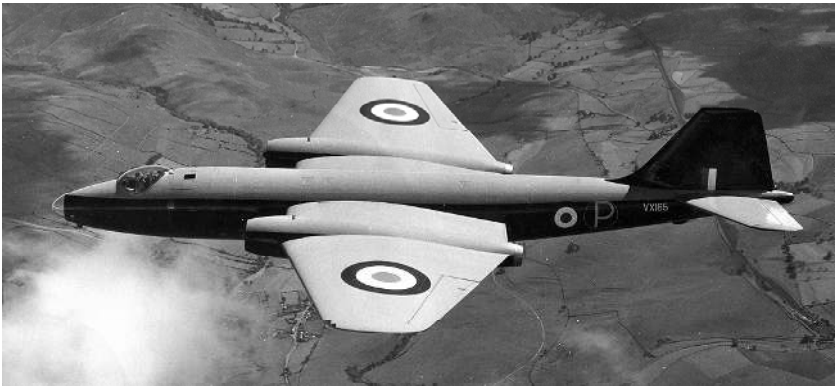
DEVELOPMENTS FOR THE RAF

Bob Fairclough

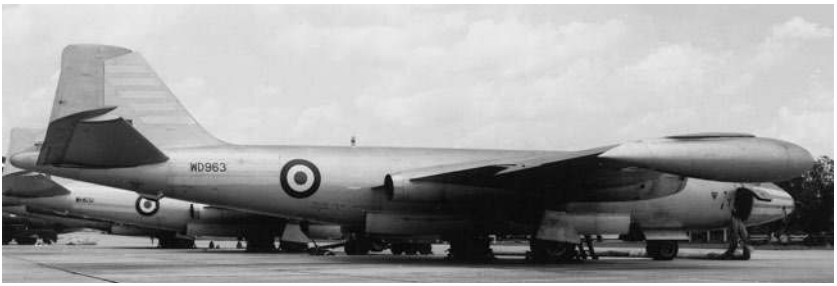
Canberra B Mark 1. As described earlier in this seminar, the B1 was the original Canberra standard; which did not go into production due to the non-availability of the radar bombing system. Three of the four B1 prototypes had Avon RA2 engines of 6,000 lbs thrust and were used for proving and evaluation of the basic aircraft, and for engine and equipment development. Details of the first flights of these aircraft are as follows:

Serial	First Flight	Location	Pilot
VN799	13 May 49	Warton	R P Beamont
VN813 (Nenes)	9 Nov 49	Warton	R P Beamont
VN828	22 Nov 49	Samlesbury	R P Beamont
VN850	20 Dec 49	Samlesbury	J W C Squier

Canberra B Mark 2. Built to specification B5/47, the B2 was the first variant of the Canberra to enter quantity production. It had a third crew member who sat in an ejection seat alongside the navigator or lay prone in the visual bomb-aiming station in the nose. The B2 had Avon RA3 engines of 6,500 lbs thrust. There were two B2 prototypes, VX165 and VX169, which made their initial flights from Samlesbury on 21 April and 2 August 1950 respectively. The B2 was built in larger numbers than any other variant. In the UK there were four



VX165, the prototype of the classic B2.



The ubiquitous T4; any self-respecting Canberra outfit had at least one. This one, No 45 Sqn's WD963, was lost 2 miles south of Tengah on 29 June 1967 when its crew ejected following a double flame out.

manufacturers – English Electric, Short Brothers, Handley Page and Avro. A generally similar version was built in Australia, and the B2 was the starting point for a series of models built in the USA. The first Canberra delivered to the RAF was a B2, WD936, on 25 May 1951.

Canberra PR Mark 3. The two-man PR3 was derived from the B2 as a specialised photo-reconnaissance aircraft, to specification PR31/46. The fuselage was lengthened by 14 inches to accommodate an additional bay, forward of the bomb bay, to house seven cameras. Flares could be dropped from the rear half of the bomb bay and there was a tank in the front containing sufficient fuel to extend the aircraft's range by almost 1,000 miles. It had the same RA3 engines as the B2, and, apart from the increased range, performance was very similar. The prototype, VX181, made its first flight from Samlesbury in the hands of Peter Hillwood on 19 March 1951.

Canberra T Mark 4. Since the Canberra would fly twice as fast and twice as high as the Lincoln, the type which it was to replace, the need for a dual-control trainer had been recognised from the outset. The front fuselage was modified to seat the instructor pilot alongside the trainee. The bomb-aiming station was deleted, along with its glazed nose, and the single navigator was seated behind the pilot. Bea Beamont flew the first T4, WN467, from Samlesbury on 12 June 1952. Sixty-six T4s were built as such and another sixteen were added by recycling B2s.

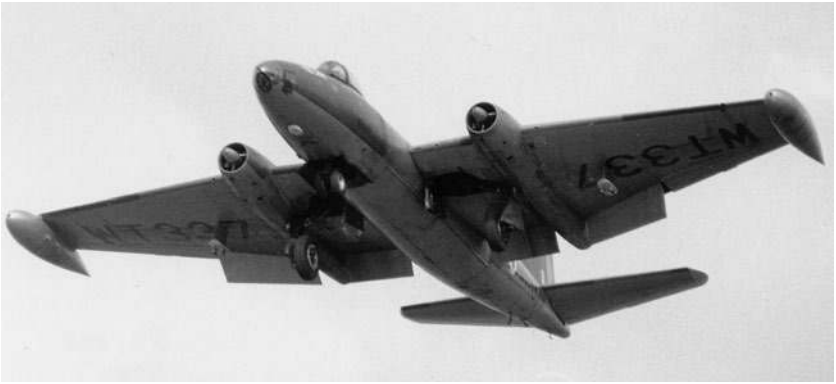
Canberra B Mark 5. When the B2 entered production it was still

regarded as an interim standard, with the radar bombing and navigation system to be added at a later date to create what would become the definitive Canberra bomber – the B5. In the event the radar system was still not available when the prototype was built, and the B5, which had actually been ordered as a target marker to Specification B22/48, did not enter production. However, it did have several features that were to be introduced into later Canberras, the most significant being integral fuel tanks in the leading-edges of the outer wing panels. These tanks contained 900 gallons of extra fuel, which conferred a substantial increase in range, and, to compensate for the additional weight, the B5 had Avon RA7 engines, providing 7,500 lbs thrust. The sole example, VX185, was flown for the first time from Samlesbury by Johnny Squier on 6 July 1951.

Canberra B Mark 6. The increased fuel capacity and up-rated engines of the B5 were applied to the basic bomber to create the B6, conferring a range advantage of some 800 miles compared to the B2. Since VX185 was considered to have proved most of the innovations, there was no B6 prototype, as such, and the first production aircraft, WJ754, flew from Samlesbury on 26 January 1954. Thereafter the B6 became the main production version, although it was built only by English Electric and Shorts.

Canberra B (I) Mark 6. The I in B(I)6 stood for 'Interdictor', the Mk 6 being known as the 'Interim Interdictor'. The role involved low-level attacks, mostly at night, typically against transport targets. The B(I)6 was basically a B6 ,with some changes to the weapons fit. The most significant of these was the fitting of a gun pack, containing four 20mm cannon, in the rear of the bomb bay. To compensate for the loss of internal capacity, a pylon, capable of carrying a 1,000 lb bomb, was provided under each outer wing. Again, there was no prototype and the first of twenty-two production aircraft, WT307, flew for the first time on 31 March 1955.

Canberra PR Mark 7. The PR7 was essentially a PR3 incorporating the upgrades that had been applied to the B6 – Avon RA7 engines and integral wing tanks which extended the range by a further 750 miles. The first example, WH773, took off for the first time from Samlesbury on 16 August 1953.



No 14 Sqn's WT337, a B(I)8, the definitive two-seat interdictor (MAP)

Canberra B (I) Mark 8. The B(I)8 was the definitive interdictor. It was basically a B6, featuring the gun pack and underwing bomb pylons of the B(I)6, but with a completely redesigned crew compartment. The pilot's ejection seat was still offset to port, but he now sat higher and under a fighter-type canopy which provided much better visibility. While this canopy could be jettisoned in an emergency, it did not open and access was still via the crew entry hatch on the right hand side of the front fuselage. The navigator was no longer provided with an ejection seat, his options being confined to a seat fixed to the bulkhead (which he was supposed to use for take off and landing) or a swivelling seat at his work station, which was now in front of and below the pilot, or he could lie in the nose when map reading or for visual bomb aiming. In terms of navigation equipment, armament and performance the B(I)8 was much the same as the B6/B(I)6. Since the new nose was a major departure, a prototype was required and this was created by rebuilding the sole B5, VX185, which made its first flight as a B(I)8 when Bea Beamont took off from Samlesbury on 23 July 1954. The first production aircraft, WT326, flew on 8 June 1955 and the RAF received a total of fifty-five aircraft, which served exclusively with squadrons based in Germany.

Canberra PR Mark 9. The PR9 was the last British newbuild Canberra variant. The basic design work was done by English Electric at Warton; detail design and modification of the prototype was delegated to its subsidiary company, D Napier & Son at Luton, but the

twenty-three production models were eventually built by Shorts at Belfast. The Mk 9 was intended for high altitude photo reconnaissance at altitudes up to 60,000 ft or even higher, and was initially designated the HA PR9. In order to reach these higher altitudes, the wing area was increased by extending the wing chord inboard of the engine nacelles, and by increasing the span by 5 ft 5 ins through the addition of new squared-off wing tips. A substantial increase in power was provided by installing Avon RA24s of 11,250 lb thrust. Cameras were carried in bays fore and aft of the bomb bay, which carried flares and an extra fuel tank, as in the PR7.

The prototype was a modified PR7, WH793, which made its first flight with the new wings and engines, but retaining the standard PR7 nose, in the hands of Mike Randrup from Luton on 8 July 1955. The first production aircraft featured a B(I)8-style nose but its limitations were clearly demonstrated when this aircraft was lost in an accident; the pilot survived by using his ejection seat while the navigator died because he did not have one. As a result, the nose was completely redesigned. The pilot's ejection seat was still offset to port under a fighter-type canopy but this one was hinged at the rear to provide access via an external ladder. The crew entry door was deleted and the navigator was now provided with an ejection seat in a separate compartment in the extreme nose which was hinged and could be swung to starboard to permit entry. Incorporation of this modification delayed production and it was 1960 before the first PR9s were delivered to No 58 Sqn, although, having served for 46 years, the last of them would not be withdrawn until as late as 2006

Canberra U Mark 10. The U10 was the first Canberra variant to be produced by converting earlier models that had been withdrawn from service. The U10 was a pilotless target drone for use in guided weapons development. About twenty-five were converted from B2s, the first being WJ624. Deliveries began in late 1958, most aircraft being used at the Woomera weapons range in Australia.

Canberra T Mark 11. Designed and re-manufactured from redundant B2s by Boulton Paul, the T11 had an AI 17 radar in the nose, protected by a distinctive conical radome, and was intended to provide airborne experience for prospective radar operators destined for all-weather fighters. The first of eight T11s, WJ610, first flew as such on

All eleven of No 14 Sqn RNZAF's B(I)12s on the ramp at Ohakea.

29 March 1958.

Canberra B (I) Mark 12. The B(I)12 was built against an RNZAF order for eleven B(I)8s, differences from the RAF version being confined to some minor equipment changes.

Canberra T Mark 13. To support its B(I)12s, the RNZAF ordered two T13s, which were similar to the T4.

Canberra D Mark 14. The six D14s (initially designated as U14s) were converted from U10s for the Royal Navy for use as pilotless target drones in ship-to-air missile trials; the first one, WH921, was delivered in May 1961.

Canberra B Mark 15. The B15 was a conversion of the B6 for operation in the low-level tactical strike role. In terms of armament and avionics, the thirty-nine aircraft produced differed little from the B(I)6 except that they were armed with underwing rocket pods, instead of a gun pack, and thus retained the full use of the bomb-bay. From 1962 B15s were further adapted to carry the Nord AS30 air-to-ground missile which involved an additional pylon being mounted outboard of the existing one.

Canberra E Mark 15. After being withdrawn from front-line service, several B15s were refurbished and modified to become E15s for service with No 98 Sqn on radar calibration duties. The first E15, WH972, was delivered in August 1970.

Canberra B Mark 16. The nineteen B16s were converted from B6s and were similar to the B15s except that the equipment fit included a

A T17, WJ565, of No 360 Sqn.

BLUE SHADOW sideways looking radar on the starboard side, which meant that one of the rear crew ejection seats had to be deleted, the second navigator being obliged, as in the B(I)8, to use a portable chest parachute following his escape via the entry door.

Canberra T Mark 17. The T17 was a B2, extensively modified to permit it to create a hostile ECM environment in which to provide realistic training for all branches of the armed forces. This involved the aircraft being equipped with a number of aerials installed beneath a bulbous nose radome and a variety of other unsightly excrescences, which did nothing to enhance the Canberra's graceful lines. To power the jamming equipment, much of which was carried in a crate mounted in the bomb bay, the T17 had a bleed-air turbine-powered generator installed in each wing just outboard of the engine. The development aircraft, WH863, began testing at Warton late in 1964. The first of twenty-four 'production' conversions, all of which would serve with the jointly RAF/RN-manned No 360 Sqn, was WJ977 which first flew in September 1965.

Canberra TT Mark 18. The TT18 was a target tug created by modifying retired B2s to carry a Rushton winch (made by Flight Refuelling Ltd) under each wing from which a variety of targets could be towed up to 50,000 feet behind the aircraft. Beginning with WJ632 in March 1966, twenty-two TT18s were eventually produced.

WH718, a TT18 of No 7 Sqn displaying its stripey bottom. (MAP)

Operated by both the RAF and the RN, the Mk 18 remained in service until 1997.

Canberra T Mark 19. With the run-down of the Javelin force, the requirement for an AI 17 trainer had lapsed by 1966, rendering the T11 redundant. The radars were, therefore, removed and replaced with ballast weights. The seven aircraft involved (the first was WH903 which appeared in June 1966) were redesignated as T19s and soldiered on as targets for interception exercises.

Canberra Mark 20. Forty-eight Canberras were built under licence for the RAAF in Australia as the Mk 20. The first twenty-seven were similar to the B2, the remainder being equivalent to the B6, but all were designated as Mk 20s.

Canberra Mark 21. To support its Canberra bombers, the RAF converted two B2 pattern aircraft that had been supplied by the UK plus five of its locally manufactured Mk 20s into dual-controlled Mk 21s, equivalent to the RAF's T4s.

Canberra T Mark 22. The T22, the final Canberra variant to be produced for the British armed forces, was a PR7 conversion fitted with a Buccaneer's BLUE PARROT radar in the nose. The first T22, WT510, appeared in June 1973 and was followed by six others, all of which served with the FRADU to train the battle management staffs of HM Ships to engage hostile aircraft.

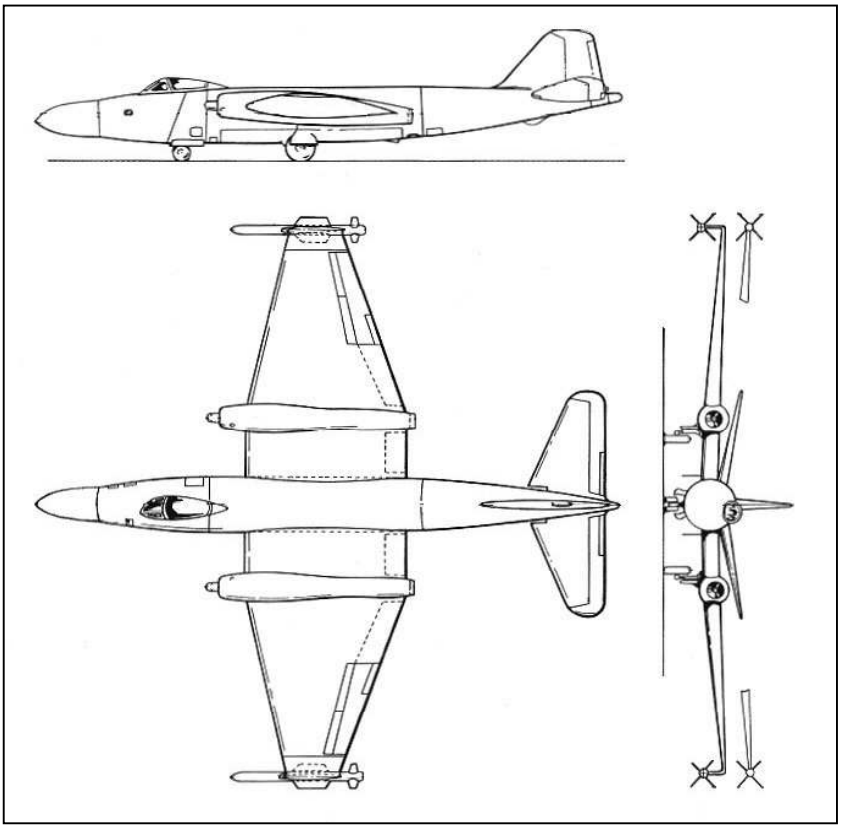
Production Summary

	Company					Customer	
Mark	**EE**	**Avro**	**HP**	**Shorts**	**Total**	**RAF**	**Export**
B1	4	–	–	–	4	–	–
B2	208	75	75	60	418	410	8
PR3	36	–	–	–	36	36	–
T4	75	–	–	–	75	66	9
B5	1	–	–	–	1	1	–
B6	57	–	–	49	106	94	12
B(I)6	22	–	–	–	22	22	–
PR7	71	–	–	–	71	71	–
B(I)8	72	–	–	–	72	55	17
PR9	–	–	–	23	23	23	–
B(I)12	17	–	–	–	17	–	17
T13	1	–	–	–	1	–	1
PR57	8	–	–	–	8	–	8
B(I)58	71	–	–	–	71	–	71
Totals	**643**	**75**	**75**	**132**	**925**	**782**	**143**
				Built in Australia	48		
				Built in USA	403		
				Grand Total	**1376**		

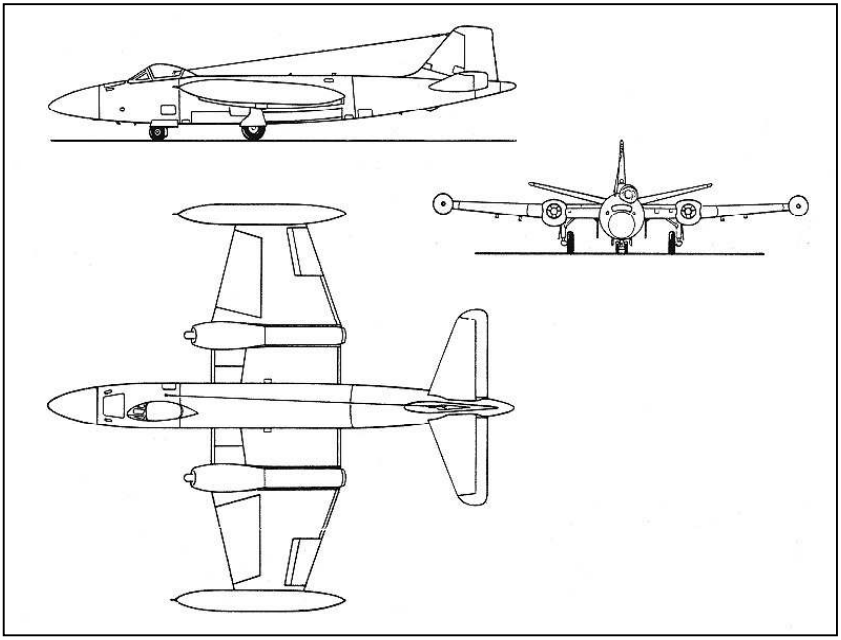
Notes:
1. This table reflects only newbuilds; there was a lively second hand market.
2. All export models were built by the parent company.

What Might Have Been

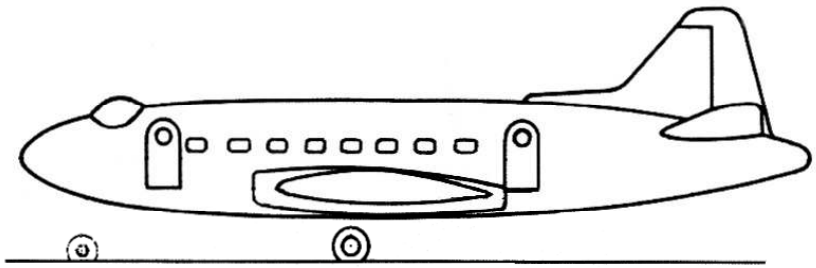
Having realised the mature Mks 6, 7 and 8, the Drawing Office continued to exploit the basic design to produce increasingly sophisticated potential derivatives of the Canberra.



This is the P12 all-weather fighter project of 1956. Based on the B(I)8 airframe but with the RA24 Avons of the PR9, it had additional fuel in the forward bomb bay and the options of a (Scorpion?) rocket motor or the standard gun pack in the rear. Primary armament was to have been a pair of semi-active homing RED DEAN missiles with target illumination provided by an AI 18 radar in the nose. In the late 1950s this would appear to have been a more than adequate bomber destroyer (*albeit lacking an ejection seat for the nav – **Ed***).



The P28 low-level strike/attack project of 1958 was the ultimate expression of the B(I)8 concept. Wingspan was significantly reduced and additional fuel was carried in 500 gallon tip tanks. This is a late (1965) variation on the theme which would have had a 57-foot wingspan, Spey engines, the avionics from the recently-cancelled TSR2 and the crew compartment of the PR9 (*with ejection seats for both crew members, **Ed***).



In the early days, some thought was even given to adapting the airframe as a transport seating up to 34 passengers.

RECCE CANBERRAS – SOME UNTOLD STORIES

By Chris Pocock

Currently the defence editor of Aviation International News *and the European editor of* Cargo Facts, *Chris Pocock has studied all aspects of airborne intelligence-gathering in depth. His main focus having been on the Lockheed U-2, his* Dragon Lady – A History Of The U-2 Spyplane *(1989) and* 50 Years Of The U-2 *(2005) are recognised as the definitive works on the subject. The only foreign civilian to have flown in this remarkable aircraft, the Official Historian of the CIA has described him as 'today's foremost authority on the U-2 and its development.' He knows a lot about the Canberra too.*

When the Society asked me to cover the reconnaissance history of the Canberra, I soon realised that this story cannot be fully addressed in a 30-minute talk, or in a short paper for the Journal. I have therefore limited my ambition to a description of how this splendid aircraft quickly became a significant platform for reconnaissance in the RAF during the 1950s, and to some specific episodes in that decade. Although I will not venture beyond 1960, I will describe three very distinct airborne intelligence-gathering activities: photo-reconnaissance, signals intelligence and nuclear sampling. And as I proceed, you may notice two recurring themes. These are Anglo-American Co-operation, and the Quest for Higher Altitude.

Behind the Iron Curtain

On 4 October 1950, the RAF's leading practitioners of, what is today known as, imagery intelligence gathered at RAF Benson for a Strategic Photographic Reconnaissance Conference. The drawing on the cover of the conference programme depicted a reconnaissance aircraft peeling back the Iron Curtain. Evidently, though, this represented an aspiration, rather than actuality. In his opening remarks, ACAS(Int), Gp Capt G J C Paul, lamented that 'we have virtually no photo-intelligence of the enemy at present.' He noted that Soviet forces had anti-aircraft systems capable of shooting-down aircraft flying at 46,000 feet, and suggested that hundreds of MiG-15

An early Canberra PR3, WE137, of No 540 Sqn. (MAP)

jet fighters would soon be in service. Other speakers noted that the RAF's fleet of specialist PR aircraft was short on both range and altitude. This consisted of Second World War Spitfire Mk 19s and Mosquito Mks 34/35. Meteor PR10s were replacing the Spitfires, but with no great advance in navigation equipment. They were also vulnerable to the new Soviet jets. As for cameras, the standard F52 was also wartime-vintage, and its 36-inch focal length lens could not provide the required scale for interpretation when flown above 45,000 feet. What was really needed? An aircraft that could fly at 50,000 feet or above, equipped with good 48-inch focal length lenses, and eventually a panoramic camera for the maximum area coverage. This technology was still under development – in the US.[1]

As specification PR31/46, the Canberra was already the designated replacement for the PR Mosquitos. Indeed, the PR3 version made its first flight in March 1950, six months before the Benson conference. As we learnt this morning, the early Canberra bombers were already capable of flying above 50,000 feet, although the service clearance was limited to 48,000 feet because of aircrew oxygen limitations. But long-range navigation would be a problem, now that the H2S radar set was deemed too bulky, at least until the GREEN SATIN Doppler became available in 1954-55. In fact, aerodynamic vibration issues were largely responsible for a two-year delay to the PR3 entering service. The first examples did not reach No 540 Sqn until December 1952. Even then, their performance was less than advertised, with an endurance only just exceeding four hours when flown to the practical ceiling of 48,000 feet.

Discussions at the Benson conference were at the Secret level. Therefore, only tangential references were made to the contribution that the US could make to solving the problem of photographic intelligence-gathering behind the Iron Curtain. In fact, the UK and the US had recently agreed to 'a full and frank interchange of all classified military information and intelligence,' except for a few declared technologies (such as atomic weapons). This Top Secret 1950 Burns-Templar Agreement has not been fully explored by historians, but it did lead to the sharing of all strategic target material between the RAF and the USAF.[2]

The agreement also fostered co-operation in the gathering of strategic intelligence on the Soviet Union and the Warsaw Pact. A summit meeting between Prime Minister Attlee and President Truman in December 1950 possibly discussed the sharing of risks and rewards in this sensitive business. At any rate, in August 1951 the RAF set up a Special Duty Flight to train on USAF RB-45C aircraft for penetration flights behind the Iron Curtain. The RB-45C was a conversion of an interim nuclear jet bomber and was equipped for daytime imaging and for radarscope photography. The latter could be done at night. Indeed, it was under the cover of darkness that the Special Duty Flight subsequently flew over the Soviet Union in April 1952 and again in April 1954. Even so, flying at only 45,000 feet, these sorties were vulnerable to Soviet air defences, especially as Soviet radar coverage and night interception capability improved.[3]

Going Higher

Meanwhile, an American whom I consider to have been the father of strategic high-altitude photo-reconnaissance, had taken a particular interest in the Canberra. USAF Col Richard Leghorn[4] believed that none of the USAF's converted bombers – RB-36s, RB-45s, RB-47s – could properly perform this mission. He envisioned a smaller machine, capable of flying so high that it could not only evade Soviet interceptors, but even escape detection by Soviet radars. In 1951, Leghorn was assigned to the USAF's Wright Air Development Center. He commissioned a study from English Electric, on how the Canberra might be adapted for very high-altitude flight. The study led to a meeting at Wright Field in May 1951 between Leghorn and representatives from English Electric. Two months earlier, the USAF

had agreed to buy a licenced-produced version of the B2, as the B-57A. But Leghorn had in mind a more significant modification, that would enable the aircraft to reach more than 60,000 feet.[5]

No copy of the 1951 study that Leghorn commissioned has been uncovered, in either British or American archives. But I have found another study by English Electric dated September 1953 which explored the same possibilities. The study showed that by increasing the wing area and adding more powerful engines, the Canberra could reach 60,000 feet and go 4,000 nautical miles – though it would not achieve both values on the same flight.

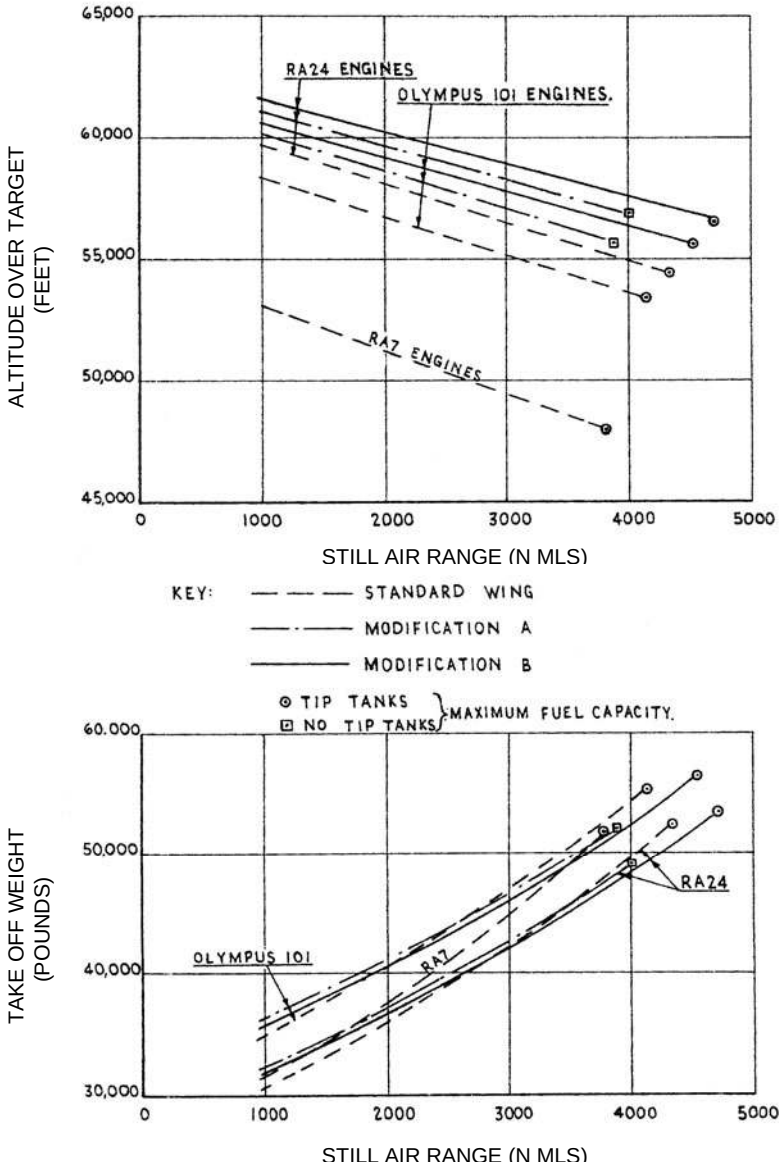
The wing area would be increased by either adding wingtip extensions, or extending the leading edge inboard of the engines. Three engine developments were considered:

a. The RA7 Avon that was already selected for the improved Canberra PR7.
b. The Bristol Olympus designed for the Vulcan bomber, that was already flying on a Canberra testbed. This aircraft reached 63,668ft in May 1953 – a new world altitude record.
c. The RA24 Avon, a much more powerful version that became the Avon Mk 206.[6]

It's interesting to note that the leading edge extension and the RA24 were eventually included on the PR9, together with a different wingtip extension. But this ultimate PR version of the Canberra did not fly until July 1955; did not enter service until 1960; and never really achieved the performance that Leghorn and its designers had hoped for. Despite this, the PR9 served with distinction. There are more untold or little-known stories here, of the RUBY missions to photograph Soviet warships, of flights over troublespots such as Iraq (1961), Indonesia (1964-65) and Yemen, and the use of the U-2's excellent B-camera as System III from 1970.

Kapustin Yar and all that

In 1994, journalist and researcher Paul Lashmar produced a television documentary and a book, *Spy Flights of the Cold War*, which revived and reinforced an old story that the RAF had flown a Canberra deep into Soviet territory to photograph the ballistic missile test site at Kapustin Yar. The story was repeated by author Robert Jackson, in his contribution to the Society's 1997 seminar on Air Intelligence. It has



Altitude Over Target versus Range and Take Off Weight for a projected High Level PR Canberra – from a 1953 English Electric brochure.

therefore well and truly entered the mythology.[7]

This 'daring mission' took place in 1953 or 1954, according to Lashmar, but he was unable to find any records or living witnesses to support the story. That said, there is some circumstantial evidence that the RAF did indeed fly Canberras over Warsaw Pact territory in 1953-54. For instance, in November 1952, a British intelligence official sought permission from the Norwegian government to stage reconnaissance missions over northwest Russia through Bodø airbase using 'the new two-engine British jets.'[8] And while there is nothing in the declassified records of the RAF's new Canberra PR3 squadrons for 1953-54 to confirm such missions, the same records also reveal the existence of three slightly unusual B2s that were also assigned to the Canberra PR squadrons for 'camera trials.'[9]

But there is also declassified documentary evidence that Kapustin Yar was not photographed from the air until a U-2 overflew the site in September 1957.[10] I am sceptical that such a flight as described by Lashmar, Jackson and others took place. There is insufficient time to permit me to explain my reservations today but I did research the matter in some depth and my findings were published in 2002.[11]

The Real Op ROBIN

Lashmar suggested that the flight over Kapustin Yar might have been flown as part of Operation ROBIN, by one of the aforementioned Canberra B2s, WH726. He uncovered some details of this Top Secret operation, for which (he said) a 100-inch focal length side-looking camera designed in the US was fitted to a B2. But why use such a camera, with all the attendant pointing and photogrammetric complications, on a direct overflight that might not be repeatable for political reasons?

In fact, Op ROBIN entailed the use of a new 240-inch focal length framing camera that was specially built for LOng-Range Oblique Photography (LOROP). This formidable piece of folding optics was designed at the Boston University Optical Research Laboratory for carriage by aircraft that could fly high enough to return useful imagery of 'denied territory' from within friendly airspace. It was probably devised specifically for the B-57/Canberra, because it fitted neatly into that aircraft's bomb bay using the existing lugs. Indeed, it was colloquially known as 'The Bomb Camera'.[12]

PR3, WH726, having its LOROP 'Bomb Camera' installed at Hanscom AFB in 1954 in preparation for Op ROBIN.

On 1 March 1954, WH726 was flown to the US by a crew from No 58 Sqn, the second unit to re-equip with the PR3. The B2 was modified at Hanscom Air Force Base, near Boston, to accept the bomb camera, which took pictures through a large optical window cut into the aircraft's port lower fuselage, adjacent to the main undercarriage bay. After WH726 returned to the UK in mid-April 1954, it was used by 58 Squadron on at least nine LOROP missions along the borders of the Warsaw Pact in Central Europe and the Eastern Mediterranean. A second aircraft flew alongside, to warn of tell-tale condensation trails. The flights continued until at least July 1955.[13]

Meanwhile, the Canberra PR3 was rapidly superseded in RAF service by the more capable PR7, which became a tactical reconnaissance and survey photography workhorse, rather than a strategic reconnaissance platform. In 1955, the Americans modified one of their equivalent RB-57As to take the 240-inch bomb camera (Project *Sharp Cut*). It apparently took over the ROBIN mission from the RAF. Ten more RB-57As were stripped of non-essential weight – including the navigator! – so that they could reach 65,000 feet (Project *Heart Throb*). These aircraft were followed by the more heavily-modified RB-57D, including much longer wings (Project *Black Knight*). From Germany and Japan, these aircraft flew over denied communist territory in 1955-56, until they were replaced by the remarkable Lockheed U-2. This purpose-built aircraft capable of

reaching more than 70,000 feet was what Richard Leghorn had really had in mind for dedicated and (hopefully) undetectable strategic reconnaissance.

Incidentally, on 29 August 1955 the Olympus-powered Canberra B2 testbed that I mentioned earlier, claimed a new world altitude record of 65,889ft. This record stood for two years – officially. In fact, the U-2 surpassed that record within days, just a month after making its first flight in early August 1955. But the Americans couldn't brag about it – the U-2's very existence was secret then, and its maximum altitude is still officially secret now, more than 50 years later!

Radio-Proving Flights

In an age when Signals Intelligence (SIGINT) dare not speak its name, the euphemism for airborne collection was Radio Proving Flights (RPFs). No 192 Sqn specialised in electronic reconnaissance, and was collocated with the Central Signals Establishment (CSE) at RAF Watton. It received two Canberra B2s in February 1953, and two Canberra B6s in December 1954. These joined the squadron's three Washingtons (B-29s) on RPFs along the borders of the Iron Curtain. The Washingtons were replaced by Comet 2Rs in 1957-58, and the unit was renumbered as No 51 Sqn in 1958.[14]

Often, the Canberras and Washingtons flew together on co-ordinated missions. The Canberras would fly fast and high to stimulate the opposition's air defence radars and communications, sometimes 'popping up' from low-level. Meanwhile the Washingtons would record and analyse the signals. So too would ground intercept stations. The Washingtons carried six-to-ten Special Operators in the rear fuselage, whereas the Canberras had only one, working in cramped conditions next to the navigator, both crew being situated behind and below the pilot.

Tasking for the RPFs was co-ordinated with GCHQ (aka 'The Y-Service'), which also did much of the post-flight analysis. The major targets were: Soviet and Warsaw Pact VHF air defence control and reporting networks; overall Soviet Air Force VHF and HF communications; Soviet radio countermeasures methods (electronic warfare); Soviet ground radars for early warning, air intercept and ground controlled approach; the Soviet *Box Brick* ELINT ground stations; intercepts from Soviet guided missile ranges and warships.

The latter operations were codenamed CLARET and CHIANTI, and also involved other assets, such as Shackleton maritime reconnaissance aircraft.

Political control over when and where the squadron could fly was exercised at the highest levels. The 'Rules of Engagement' were revised in August 1953 by a Cabinet committee. This established five basic conditions: operations could take place only on dark moon nights; Canberra flight tracks had to be at least 30 nautical miles from the border (70 nm for the Washingtons); Swedish airspace could not be violated; Turkey had to consent to operations that flew in its airspace; the Foreign Office had to be informed of all flights in advance. Over the following years, these conditions were sometimes varied, but not without negotiation within Whitehall. Proposed schedules were drawn up well in advance and submitted, through CAS, to the Air Minister and on to the Foreign Secretary and the Prime Minister.

The first missions flown by No 192 Sqn's Canberras were probably part of Operation REASON, a series of flights over the Baltic, Black and Caspian Seas in 1953-54 to investigate Soviet air defences. The flights were staged out of Bodø, Wunstorf, Luqa and Nicosia. The main discovery came over the Caspian Sea in May 1954, when the first signals from a Soviet air intercept radar were collected – the *Scan Odd* system on the MiG-17. ACAS(Ops) immediately requested permission for three more combined Washington/Canberra missions over the Caspian. But the Foreign Office refused, because the Geneva Conference had reached a critical stage.[15]

In fact, No 192 Sqn flew only nine operational missions in 1954, out of twenty that had been approved. This was mainly because of concerns over navigational accuracy. In August 1954, the Canberras were grounded so that the GREEN SATIN Doppler navigation system could be installed.[16] The SIGINT receivers were also upgraded.[17] There were no more RPFs for the next 10 months.

In June 1955, prompted by CAS and the Chiefs of Staff, the Air Minister lobbied Prime Minister Eden for more RPFs. The PM wanted to restrict the annual total to no more than that flown in 1954 – which was a relatively small number, as just noted. 'It is of the utmost importance that we should make a larger effort...' he told Eden. 'There is a very close and profitable relation between our air intelligence and

that of the Americans. This can only continue if we are able to put valuable information into the common pool,' he continued. Eden relented for the time being, but again restricted the activities of No 192 Sqn after the Buster Crabbe episode in May 1956. There was another five-month stand down from the regular schedule, although the squadron was active during the Suez Crisis.[18]

In 1956, Western intelligence generally concluded that there were serious shortcomings in the Soviet air defence system. That conclusion was largely due to the SIGINT flights by British and American aircraft, including those by No 192 Sqn. This was comforting news for the RAF, as it planned the introduction of the first V-bombers in the following year. And, of course, the RPFs brought back ELINT that was key to the design of electronic warfare protection systems for the Valiants, Victors and Vulcans.

In between the RPFs, also known as 'Air Ministry Operations' (AMOs), No 192 Sqn accomplished some other tasks. For instance, it helped to evaluate the night-fighter version of the Meteor.

Airborne SIGINT in the later 1950s

After the RPFs resumed again in October 1956, valuable intelligence on the new Yak-25 *Flashlight* interceptor was gained during a combined Washington/Canberra mission into the Barents Sea. A new Soviet height-finding radar was also identified, and VHF (as opposed to HF) communications between Soviet air defence ground stations were recorded for the first time. In March 1957, the area of operation was again extended eastwards, with two combined missions flown over Iran and the Caspian Sea. Collection over the Mediterranean Sea against the radars of Egypt, Israel and Syria began in May 1957.

But the Soviets were thought to be getting wise to the flights only operating during dark moon periods. The 30-mile limit was limiting the areas that could be covered. Whitehall agreed to allow flights in up to half moonlight. As an additional precaution against interception, the minimum operating height of the Canberra was raised from 35,000 feet to 40,000 feet.[19]

In early 1958, No 192 Sqn was operating three Canberra B6s and two B2s. Over the next two years, the B6s received new British-designed SIGINT sensors – the ARI 18050/18058 (BRETON) high-band system for ELINT, and low-band systems such as the wide-open

One of No 51 Sqn's modified B6s,WJ775, circa 1970.

ARI 18167 (OVERCOAT) VHF receiver. But the latter's excellent performance was spoilt by the Canberra's high ambient electrical interference level, according to a report by the CSE. New tape recorders finally began replacing the obsolete, American-designed wire recorders. An experimental tail-warning receiver operating in X-band was added to one of the B6s.[20]

The three Canberra B6s continued flying with No 51 Sqn right up until 1976. In the early 1960s, they were fitted with the same extended nose radome as the T11 variant. Later, this was replaced by a larger, rounded radome. The mission was the same, though the technology was more advanced – on both sides. It seems likely that the squadron's RPFs (or AMOs) experienced more frequent airborne interceptions, as the Soviet Union introduced longer-range fighters, such as the Yak-28 and the Su-15. Unlike the American 'ferret' squadrons, No 51 Sqn has never had an aircraft shot down, although there may have been some close calls!

Nuclear sampling

There are four means of gathering intelligence on nuclear explosions: seismic, acoustic, radiomagnetic, and collection of gas and debris. Aerial collection of the latter proved vital throughout the years of nuclear testing. Indeed, when in 1949 the Soviet Union exploded its first atomic device, the test was only detected through radiochemical analysis of aerial samples.

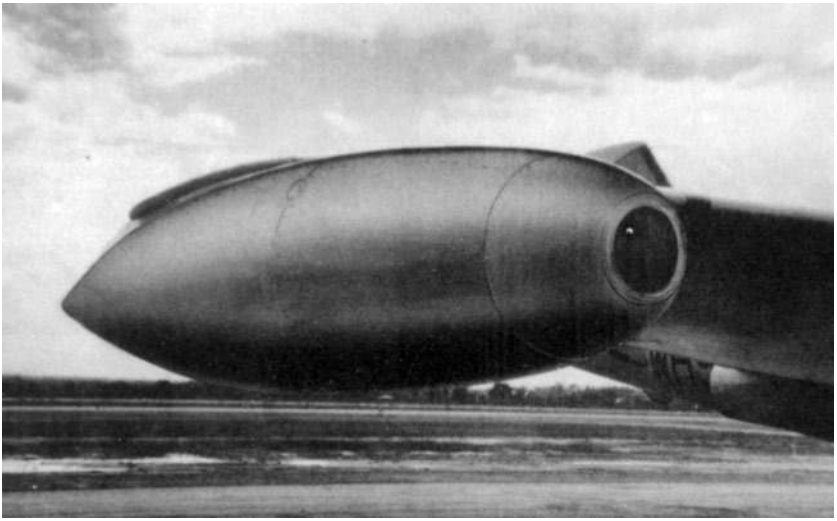
During the Cold War, airborne nuclear sampling was done for

three main reasons. The first was to measure the background radiation in the atmosphere, the result of cumulative testing by the superpowers. The second was for weapons diagnostics purposes, since the scientific analysis of even minute particles of debris from a nuclear test shot could produce significant intelligence on the design of the exploded weapon, the efficiency of the nuclear reaction, and so on. Operations and techniques connected with weapons diagnostics were usually classified at a higher level. And they could be honed by the UK and the US during tests of their own nuclear weapons, then applied to the collection of intelligence on Soviet tests. The third reason was to estimate the nuclear weapons stockpile of adversary countries. This could be done by measuring the amount of krypton-85 in the atmosphere, since this radioactive gas was uniquely emitted during the production of plutonium. (Of course, the estimate necessarily relied on an accurate accounting of such production by friendly countries, to subtract from the overall totals of Kr-85 that were detected).

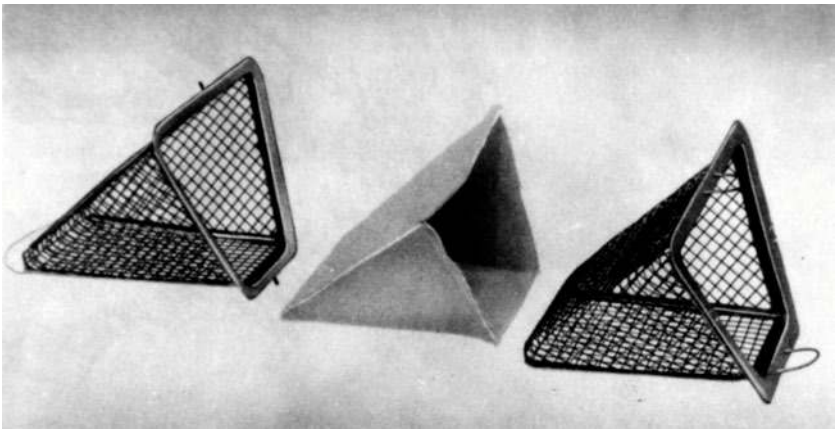
We have already heard of the strong Anglo-American co-operation in imagery and signals intelligence. But nuclear intelligence was another matter, thanks to the McMahon Act, which prevented the US from sharing nuclear weapons know-how, even with the UK, its closest ally. However, the situation was far from clear-cut, and some interesting transatlantic politics were practised by the experts in nuclear intelligence.

In the UK, the Atomic Energy Authority (AEA) at Harwell was responsible for the measurement of background radiation. The responsibility for nuclear intelligence-gathering was shared by the Technical Research Unit (TRU) in MoD, and the Technical Atomic Liaison (TAL) unit in MI6. In the 1950s, both TRU and TAL were led by the same man, Eric Welsh. Of him, the historian of British nuclear intelligence has observed: 'The McMahon Act was cunningly circumvented by the head of British atomic intelligence, who was able to procure significant information and vitally, resurrect relations with Britain's most cherished partner.'[21]

With all this in mind, let us briefly examine the RAF's efforts in this field, particularly the important role of the Canberra. Until 1953, airborne sampling was done at medium altitude by large transports and bombers. During the first British nuclear test at Monte Bello Island in Western Australia in October 1952, sampling rockets had



(*Above) A Mk3 Sampling Duct mounted on a Canberra wingtip and (below), the filter that was installed inside.*



been fired into the ascending cloud to collect 'hot' material from higher altitude. But this had not proved satisfactory. A follow-on series of test shots codenamed TOTEM was planned for South Australia in October 1953. The Air Ministry arranged for a Canberra B2 (WH738) to be modified, so that its starboard wingtip tank became a sampling duct that contained filter papers to trap nuclear particles. This Mk 3 duct system was controlled by the observer (ie the third

crewmember). An extra 600 gallon fuel tank was fitted in the bomb bay. This aircraft was expected to reach 50,000 feet during the forthcoming test shots. At this Society's autumn 2007 seminar on aviation medicine, Air Mshl Sir Geoffrey Dhenin provided an excellent description of the subsequent use of that aircraft in Operation HOTBOX, flying out of Woomera airfield during the first TOTEM shot. Having absorbed too much radiation on that flight, as indicated by their film badges and the aircraft's dosimeter, Dhenin and his crew were barred from flying during the second TOTEM shot.[22]

No 1323 Flight

Apart from collecting samples, Operation HOTBOX provided valuable experience about aircrew safety, the behaviour of the aircraft in the unstable nuclear cloud, and aircraft contamination. Just five days after the first TOTEM shot, No 1323 Flight was established at RAF Wyton with six Canberra B2s as a dedicated nuclear sampling unit. In February 1954, it deployed four aircraft to RAAF base Laverton to help sample the CASTLE series of tests conducted by the US at Bikini Atoll. This was Operation DOGSTAR. Unfortunately, one of the Canberras (WH738 in fact) went missing over the Pacific Ocean with the loss of its three crew. Another aircraft was written-off after a forced landing. The survivors returned to the UK in June 1954.[23]

The patterns of fall-out dispersal from early nuclear tests varied according to the weather and the winds in the troposphere. But after the US and the Soviet Union began testing thermonuclear weapons in 1952 and 1953 respectively, dispersal became more predictable, since the fireball rose into the stratosphere, where winds were lighter and airflow more stable. From mid-1954, No 1323 Flight was tasked to fly regular north-to-south sampling lines over the UK and the eastern Atlantic, to intercept debris for diagnostic analysis. These operations, codenamed LIKEWISE, DREAM, and eventually RAKISH, came to account for one-third of the unit's flying hours, and sometimes involved detachments to Gibraltar and Scotland. Another third was devoted to Operation BACCY, the measurement of background fallout for the AEA, from 42,000 and 47,000 feet.

The other one-third of flying involved gas sampling. This modification was developed on a Canberra B6 at the RAE in autumn

Gas sampling cylinder installed in the bomb bay of a Canberra.

1955. Air was pumped from the engine 12th stage compressor into a rubber bag contained within a large metal cylinder mounted in the bomb bay. Seven more B6s were subsequently modified.

There were no British or American tests in 1955, but the Soviets' first shots from a new northern test site at Novaya Zemlya inside the Arctic Circle began in September 1955. Tipped off by SIGINT, No 1323 Flight sent aircraft to Goose Bay in August 1955 to collect against these Soviet tests, in Operation COLD NIP. In November 1955, the unit was re-designated as No 542 Squadron (ex-PR7) and moved to Weston Zoyland to prepare for a major deployment to Australia in spring 1956 to monitor the UK's MOSAIC test series. Another existing Canberra squadron (No 76, ex-B2) also became a specialist sampling unit and joined the air task force for the MOSAIC tests that was being gathered at the Somerset base.[24]

Seven Canberra B6s were deployed in March 1956 to RAAF Pearce, WA for the MOSAIC series, where they photographed and tracked the radioactive clouds from the two test shots at Monte Bello in May and June 1956, as well as doing sampling. Another three aircraft were added in July 1956, in preparation for the BUFFALO series of UK tests. These took place at Maralinga in Southern Australia in September-October 1956, with the Canberras flying from

RAAF Edinburgh, SA. After the four BUFFALO test shots, the aircraft were kept in Australia to await the GRAPPLE shots in spring 1957. These were airdrops in the South Pacific, from a base at Christmas Island, and included Britain's first thermonuclear (H-bomb) test. Then it was back to Edinburgh and on to Maralinga for the ANTLER series of three more UK tests in September-October 1957. Eight sampling Canberras returned to Christmas Island in late October 1957 for the GRAPPLE-X thermonuclear test.[25]

Higher and Higher

GRAPPLE-X was a megaton-yield shot, and the radioactive cloud rose higher then ever before – beyond the 54,000 feet ceiling of the Canberra B6. Looking ahead to the next planned GRAPPLE explosion, British nuclear scientists wanted airborne sampling at 60-62,000 feet for at least 10 minutes. But there was a potential solution. Since June 1956, a Canberra B2 (WK163) had been serving as testbed for the Napier Scorpion rocket motor (originally intended to boost the Lightning's altitude). In August 1957 this aircraft set a new world altitude record of 70,310 feet.[26]

In September 1957, it was decided to add a Double Scorpion to a couple of B6 Canberras for sampling. This was a rush job, but then so was Britain's entire nuclear test effort by now, since negotiations for a ban on atmospheric tests were pending. Two of No 76 Squadron's aircraft were returned to the UK for the installation, and two test pilots were assigned to fly them. WT208 made its first Scorpion-assisted flight in February 1958. Despite doubts over the controllability of the aircraft at 60,000 feet, it was quickly ferried to the South Pacific, where the GRAPPLE-Y test shot took place on 28 April 1958.

Three days before that test, however, the second B6 to be converted (WT207) crashed on a test flight in the UK after the rocket motor exploded upon ignition at 56,000 feet. The crew ejected at 54,000 feet and survived what was billed as the highest-ever escape from an aircraft. This sealed the fate of the Scorpion Canberra sampling experiment. WT208 was not even used during the GRAPPLE-Y shot, which was sampled instead by the B6s as before. Their task was made easier because the tropopause was at its lowest-known point over Christmas Island when the weapon was fired – 48,000 feet. This kept the cloud within range of the Canberras. The

During its air sampling days No 76 Sqn spent much of its time operating from Edinburgh Field (Adelaide) and Whenuapai (NZ). This is one of the squadron's B6s. (MAP)

redundant Scorpion Canberra aircraft was flown back to the UK in June for de-modification.[27]

Reduced Sampling Requirements

The final four British nuclear tests took place at Christmas Island in August-September 1958. By now, the crews of No 76 Sqn were seasoned veterans in the art of sampling. Using up to six B6s, they successfully juggled the collection requirements of the scientists against the requirements for personal safety, ie avoiding an overdose of radiation.

Meanwhile, back in the UK, the collection of particle debris for weapons diagnostics (Op RAKISH) had ended by mid-1957. The Royal Canadian Air Force was best placed to intercept material emanating from the Soviet tests at Novaya Zemlya and the US had just introduced a sampling version of the U-2, which could fly higher and further. No 542 Squadron was now based at RAF Upwood, and its five B2s still did radiological fallout sampling for AEA (Op BACCY).

The squadron's other main task was now the TRU's MUSIC programme. This was gas sampling for krypton-85 measurement, and it was also conducted by a detachment of two B6s at RAAF Laverton, as Operation UNSPARING. The RAF also operated five ground stations around the world for the collection of Kr-85. In October 1958, No 542 Sqn was re-badged as No 21 Sqn, but the squadron's days were numbered. By then, British scientists were questioning the value of the MUSIC programme, and it ended in June 1959.

Sqn Ldr Robinson, the first RAF pilot to fly the U-2, had previously been one of very few pilots to fly the Scorpion Canberra.

No 76 Sqn returned from Australia in November 1959, and although there were no more UK, US or Soviet tests in the atmosphere, it was kept on standby in case the test ban broke down, or the French should begin nuclear testing. The BACCY fallout monitoring task was taken on by a detachment of No 35 Sqn at Upwood, but the last flights were in April 1960.

The advent of the Canberra B(I)6 offered a cost-effective solution to the much-reduced requirement for nuclear sampling. The Mk 8 ducts that had been fitted to the bomb bay doors of the dedicated sampling Canberras, could be modified for carriage on the B(I)6's underwing pylons. At a meeting of the Joint Intelligence Committee (JIC) on 7 April 1960, this option was approved, and it was decided to disband No 76 Sqn at the end of the year. [28]

There is, of course, much more that could be said about nuclear sampling in the 1950s – the flying techniques, the aeromedical aspects, decontamination procedures, the 'shock and awe' of flying into a nuclear cloud, and so on. Alas, time does not permit.

I will end with a postscript concerning that test pilot who flew the Scorpion Canberra back to the UK after its unproductive trip to Australia. He was Sqn Ldr Robbie Robinson. As soon as he landed back in the UK, he was summoned to the Air Ministry and informed that he had been selected for a top secret project in the US that required high-altitude flying experience. Robinson soon found himself in Texas, being trained to fly the U-2. He subsequently commanded the RAF U-2 detachment in Turkey, that flew alongside Gary Powers

et al. As the unofficial historian of the 'Dragon Lady', I may be biased, but in all three roles of photographic, electronic and nuclear intelligence-gathering that we have discussed today, the U-2 offered a performance of which those who designed and flew the modified Canberras could only dream!

Notes:

[1] TNA AIR14/3879.

[2] TNA DEFE7/2102, AIR40/2547.

[3] Crampton, John; 'RB-45 Operations' in *Air Intelligence* (RAF Historical Society, 1997), pp118-125.

[4] For more on Leghorn, see Pocock, C; *50 Years Of The U-2* (Atglen, PA, 2005), p9 and Hall, R Cargill: 'Strategic Reconnaissance in the Cold War' in *Prologue* magazine, summer 1996, pp107-121.

[5] Author's interview with Leghorn, June 2004.

[6] TNA AIR20/9747.

[7] Lashmar, Paul; *Spy Flights of the Cold War* (Stroud, 1996), pp76-94 and Jackson, R; 'Strategic Air Intelligence Post-War' in *Air Intelligence* (RAF Historical Society, 1997), p115.

[8] I am grateful to Stale Hansen of NRK (Norwegian Television) for providing translations of formerly Top Secret minutes of Norway's intelligence co-ordination committee.

[9] TNA AIR27/2622, AIR27/5000, AIR28/1292. These documents, the Operations Record Books of the units concerned, make no mention of specific camera fits or modifications to the three B2s in 1953.

[10] 'Accomplishments of the U-2 Program', CIA memo TCS-7519-60 dated 27 May 1960, declass 2001, p3.

[11] 'Operation Robin and the British Overflight of Kapustin Yar: A Historiographical Note' by Chris Pocock, *Intelligence and National Security*, Vol 17, No 4, Winter 2002, pp185-193.

[12] Author's interview with Dr Jim Baker, March 1995. I am grateful to Clayton Laurie and Cargill Hall, formerly historians with the US National Reconnaissance Office (NRO), for providing photos of WH726 undergoing modifications in the US to accept the 240-inch camera.

[13] TNA AIR19/1106.

[14] Ford, Keith S; *Swift and Sure – Eighty Years of No 51 Squadron* (privately published by the 51 Squadron Association, circa 1995), p247 *et seq*., and Lake, Jon; 'Wyton's Cold War Spyplanes' in *International Air Power Review*, Vol 1, 2001, p130.

[15] TNA AIR19/1105.

[16] The author has been unable to determine whether the BLUE SHADOW sideways-looking radar was added at the same time, or earlier. This provided a useful additional means of navigation, especially when the aircraft were flying along Soviet coastlines. Eventually, all four of the squadron's Canberras B6s were equipped with this SLAR.

[17] American equipment, such as the ALR-8 ELINT receiver and QRC-7 COMINT receiver was apparently fitted to the Canberras initially.
[18] Crabbe was a diver employed by MI6 and Naval Intelligence to investigate the hull of the warship that brought Soviet leaders Bulganin and Khrushchev to Portsmouth. He disappeared during the dive; his headless body was washed up on a nearby shore many months later. Suez Crisis activity from Lashmar, *op cit*, p125-6.
[19] TNA AIR19/1105.
[20] TNA AIR68/97.
[21] 'Spying on the Nuclear Bear – Anglo-American Intelligence and the Soviet Bomb' by Dr. Michael Goodman, *Stanford Nuclear Age Series*, 2008.
[22] 'Operation HOTBOX' by Air Mshl Sir Geoffrey Dhenin, *RAF Historical Society Journal 43* (2008), pp109-113.
[23] TNA AIR29/2245.
[24] The author has been unable to distinguish the precise movements and responsibilities of Nos 76 and 542 Sqns in 1956-58. It seems that No 76 Sqn became the unit deployed to Australia throughout the period, while No 542 Sqn remained in the UK to continue Operations BACCY, LIKEWISE, etc.
[25] TNA AIR20/10811.
[26] Again, I should point out that the U-2 could fly as high as 75,000 feet, and therefore held the world *unofficial* altitude record!
[27] TNA AIR20/10811.
[28] TNA AIR20/12137.

THE CANBERRA IN FEAF

Wg Cdr Jeff Jefford

'Jeff' joined the RAF in 1959 as a pilot but (was) soon remustered as a navigator. His flying experience included tours with Nos 45, 83 and 50 Sqns and instructing at No 6 FTS. Administrative and staff appointments involved sundry jobs at Manby, Gatow, Brampton and a total of eight years at HQ Strike Command. He took early retirement in 1991 to read history at London University. He has three books to his credit and has been a member of the Society's Executive Committee since 1998; he is currently editor of its Journal.

Canberras were first deployed to the Far East in 1955 when they replaced the previous detachments of Lincolns as Bomber Command's contribution to the Malayan Emergency – Operation FIREDOG. First up were No 101 Sqn followed in turn by Nos 617, 12, 9 and 101 again until September 1956 when the Suez affair disrupted this arrangement. The answer was to provide FEAF with some Canberras of its own and in late 1957 No 45 Sqn, then based at Butterworth, began to dispose of its Venoms while a new eight-aircraft Canberra air echelon was being assembled at Coningsby. The squadron began to deploy to Singapore – Tengah – in December and the first strike by in-house FEAF Canberras, Operation GINGER, was flown on 18 March 1958 when four aircraft each dropped six 500 pounders.

Compared to the squadron's earlier aeroplanes, its Canberras could lift a lot more bombs, carry them a lot further, fly a lot higher and go a lot faster. In September 1958, for instance, they dropped sixty 1,000 pounders in the course of ten sorties. It is a measure of the considerable increase in offensive capability conferred by the Canberra that for the squadron to have delivered 60,000 lbs of bombs with its Hornets would have required sixty sorties, or thirty by Venoms. So – progress – of a kind, because a Canberra crew in 1958 was no better able to see terrorists in the jungle than a Beaufighter pilot of 1948. So, apart from visual aiming, which was very rarely employed, as jungle targets were hardly discernible, the squadron used three basic methods of bombing, all of which were already well-

One of No 45 Sqn's Canberra B2s.

established in-theatre.

The first was the Flare Datum Technique. In short, this involved overflying, at about 12,000 feet and precisely on track for the nominated target co-ordinates, an army patrol, who indicated their presence by a flare or smoke, and simply doing a timed run to release. The system was inherently inaccurate and was of real use only against area targets, the bombers flying on slightly diverging tracks to scatter the bombs within a one-kilometre square.

A more accurate method of assisted bombing employed a Target Director Post (TDP). A TDP was a gun-laying radar (specifically an AA Radar No 3, Mk 7) adapted from its original role to work in the reverse sense – instead of aiming at the aeroplane it was used to guide it. Knowing both its own position and that of the target, and using its best guess at the wind, the TDP was able to project a narrow beam of energy in the direction of the target, but aimed off to allow for cross-trail. The aircraft flew over the TDP, already heading in the right direction, and then proceeded outbound, kept on track by the director on the ground until told to release the bombs. It was much like a visual bomb-run except that the bomb-aimer wasn't in the aeroplane. The usual height was, again about 12,000 feet and this method could be employed with 100% cloud cover. There were only two such radars in Malaya but their range and mobility was such that a blind bombing

service could be provided virtually anywhere. The only significant drawback was that, if it was necessary to move the TDP, it could be slow to respond. The radar was a relatively cumbersome piece of kit and, depending on the distance involved, it could take up to two days to reach its new location, survey the site, set up the transmitter and then go through the process of levelling, tuning and calibration to achieve the desired accuracy. Incidentally, this was not a new idea – 2nd TAF's Mitchells had been bombing through cloud directed by a controller on the ground using an SCR584 radar way back in 1945.

The third, and most demanding, method of bombing was 'Auster marking'. The bombers would fly to a prearranged Initial Point (IP), ideally sufficiently far away to be out of earshot of the CTs (Communist Terrorists) to preserve the element of surprise, and co-ordinate the final details of the attack with the Auster over the radio. The Auster, whose pilot already knew the precise location of the target, would be orbiting at another pre-briefed position. Allowing for the differences in speed between the Auster and the Canberras, the aircraft would leave their respective positions and head for the target, the idea being to arrange matters so that the Auster flew across the target at about 90^{o} to the bombers' track a few seconds before the latter arrived, marking the target with smoke as he passed. The trick was to spot the Auster on its run-in and then aim for the point at which it pulled up after dipping its nose to drop the marker. With luck, smoke would begin to percolate through the trees in time for last minute adjustments to be made but, if not, the bottom of the Auster's dive trajectory served as a makeshift point to aim at. Auster marking permitted precision surprise attacks to be carried out at fairly short notice against targets that would otherwise be invisible to the bombers, but it did required reasonable weather as it was necessary to be able to see the target from a typical bombing height, when delivering 500 pounders, of about 4,000 feet.

In mid-1958 the resident Australian Lincolns and New Zealand Venoms were withdrawn and replaced by No 2(B) Sqn RAAF, which set up shop at Butterworth with home-grown Canberra Mk 20s while No 75 Sqn RNZAF operated out of Tengah with B2s hired from the RAF. Led by the Brits, the Australians flew their first Canberra mission on 3 September 1958 and the Kiwis joined in on the 30th. Although the three-squadron 'Commonwealth Strategic Reserve' was now up and running, the fire in Operation FIREDOG was rapidly

going out. The demand for Canberra strikes declined quite rapidly until the last ones were flown in August 1959. By that time No 45 Sqn had flown 175 operational sorties, delivering a little over 300 tons of bombs.

A word about navigation. The B2s were equipped for Bomber Command operations in the European theatre using GEE, which was not available in the Far East, so navigation consisted of a mechanical air plot, monitored by bearings from the Marconi radio compass (or 'cunim homer') and ranges from the handful of EUREKA beacons which were scattered thinly around the region. It was also possible to request radio bearings from a few airfields, but only if you did not venture too far from land as the B2 had only VHF radio.

Some early attempts were made to use astro but taking sights with a Mk 9 bubble sextant while crouching beneath the pilot's canopy, with its highly distorting double-glazing, was hardly satisfactory. The OCU Notes say that, with a hand-held sextant, it is only practical at altitudes of between 40^{o} and 80^{o} on relative bearings between 345^{o} and 045^{o}. At one stage the squadron made a concerted effort to calibrate the canopies of each aircraft by taking a series of simultaneous shots on the ground with one nav inside the aircraft and one outside. This exercise produced an average error of 24 miles – confirming the OCU Notes which suggest 25! The OCU Notes also claim an accuracy of as little as 5 miles using a periscopic sextant. I cannot vouch for that personally, because no one ever used astro during my time, but the New Zealanders, who did, said that it was only worthwhile with the autopilot engaged. The RNZAF's B(I)12s had an autopilot as standard; the RAF's Canberras did not.

All things considered, apart from the speeds and altitudes involved (and the cramped accommodation), a Wellington navigator of 1942 would have been pretty much at home with the techniques being employed twenty years later in FEAF's Canberra B2s – such is progress.

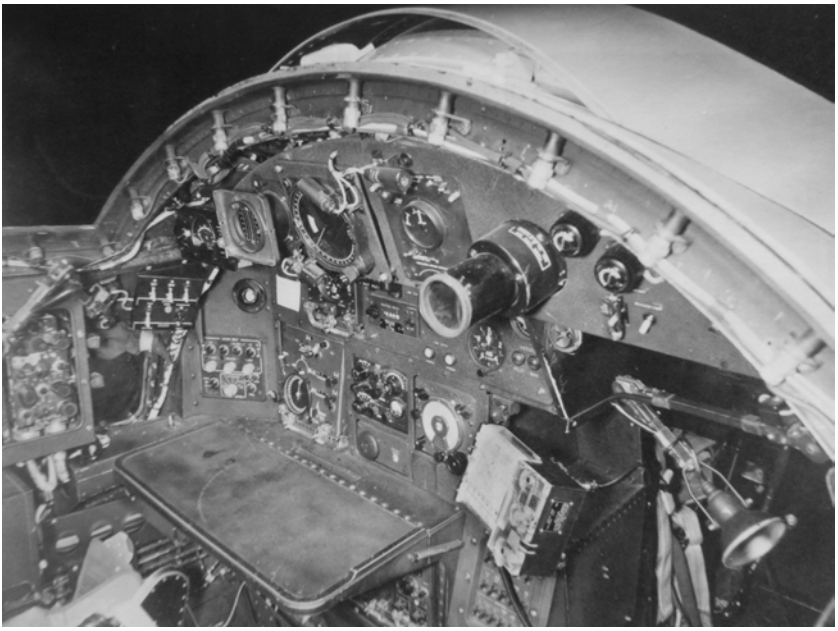
For the cognoscenti it is also worth noting that, since most flights were carried out within a few degrees of the equator, there was no perceptible difference between a Lambert's and a Mercator's projection, so we were untroubled by the esoteric complications of convergence and conversion angle – none of that great circle versus rhumb line baggage. Even better, variation was almost zero, so there

was virtually no difference between True and Magnetic North. I apologise for the navspeak, but someone has to do it.

With FIREDOG virtually defunct by 1959, all three squadrons settled down to a peacetime training programme involving navexes, medium and high-level bombing, normally on the local ranges at China Rock and Song Song and occasionally at Batti Mali in the Nicobars. This was all done against a Bomber Command-style classification scheme supervised by HQ 224 Gp. The routine was varied by Lone Rangers, the usual allocation being an annual weekend in Hong Kong, routing via Clark Field in the Philippines, and a trip to New Zealand towards the end of your tour. And then there were the frequent exercises – local air defence efforts, often involving the Navy as there was usually a carrier east of Suez in those days, 'Commonwealth' training events requiring deployments to Darwin, and SEATO-sponsored exercises, which meant trips to Bangkok, Chieng Mai and the Philippines. There was also a fairly steady trade in shepherding fighters about the place – Hunters to Hong Kong, for instance, and escorting No 60 Sqn's new Javelins in from as far afield as Karachi. Finally there was a regular UK/US squadron exchange programme which involved away matches to Okinawa, and hosting visitors to Singapore.

While all of this activity was going on, Tengah was given an extensive facelift in 1960-61 which included the construction of a new 3,000 yard long V-bomber class runway, which required the levelling of a fairly substantial hill, and a substantial upgrade in the domestic and support facilities including new bomb storage facilities, a new Operations Block, a new Air Traffic Control tower, a new church, additional accommodation and even, on a selective basis, some air conditioning!

Meanwhile the loss of Gary Powers' U-2 in 1960 had put everyone on notice that the surface-to-air missile had finally matured, which more or less meant the end of the high-level bomber. By the autumn of 1961, No 45 Sqn was flying its rather tired B2s at low level and, with the Hunters of No 20 Sqn having arrived in FEAF at about the same time, it was decided to try to persuade them to operate together as the Offensive Support Wing and in the spring of 1962 Wg Cdr Ian Pedder was posted in to referee the match. For this to be a realistic concept, however, we needed a rather more capable Canberra – the

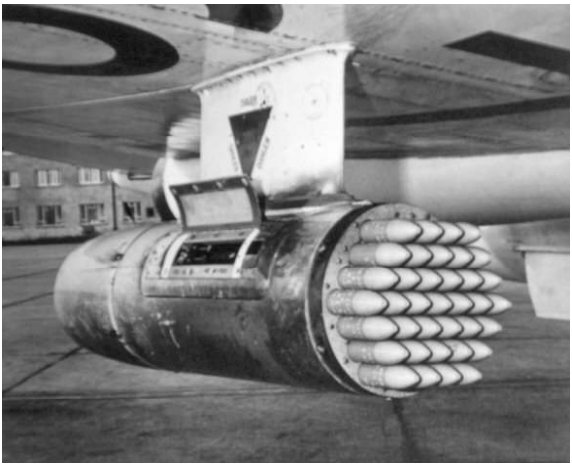


The nav's station in a B15.

B15 – but, last as usual, FEAF had to wait until the Akrotiri Wing, had got theirs. The first B15 arrived at Tengah in August 1962 and the last pair of B2s, the last B2 bombers in the RAF, were flown back to the UK in December, the whole ferry programme being carried out by squadron crews as an in-house exercise.

The B15s were not new aeroplanes. They were warmed over B6s, which meant an extra 1,000 lbs of thrust per side, with the luxury of a three-shot starting capability in place of the B2's single cartridge, and integral wing fuel tanks making them much longer-legged than the B2 – we could now do Hong Kong direct, without having to stage through Clark. The most significant difference, however, was the major increase in operational flexibility conferred by the B15's avionic fit and its range of weapon options.

The radio compass and REBECCA had been retained, but the Air Position Indicator had been replaced by a Ground Position Indicator driven by a BLUE SILK Doppler radar which provided a reasonably accurate and self-contained means of navigation. There was also a tail-



Canberra-related literature contains a number of figures relating to the capacity of the Microcell 2-inch rocket pod. It was thirty-seven.

warning radar, ORANGE PUTTER (although this particular navigator never actually saw anything on it). A radio altimeter was another addition – potentially useful over open country but questionable over dense jungle, because you could never be sure whether the signals were bouncing off the forest floor or the tops of the trees. The communications fit had been sub-stantially upgraded and, in addition to the original VHF radio, we now had UHF and HF. The only thing that seemed to have been overlooked was safety equipment and, despite the fact that the B15s (and 16s) were specifically intended for low-level operations, the opportunity had not been taken to upgrade the ejection seats. Rather than having the ground-level/90 knot capability which was rapidly becoming the industry standard by that time, we were still stuck with Mk 1 seats which had recommended operating parameters of 1,000 feet and 250 knots. I believe that more capable seats may have eventually been retrofitted in about 1966.

The ability to carry six 1,000 pounders internally, was unimpaired but the new variant also had a pylon under each wing, each of which could take another 1,000 pounder. I don't think that this option was ever exercised in FEAF but the pylons were used to carry 25 lb practice bombs when toss-bombing was added to the range of attack options. Alternatively, each pylon could be fitted with a Microcell pod containing thirty-seven 2-inch rockets giving the potential to fire a salvo of up to seventy-four which, since this did not interfere with the ability to carry bombs, provided the aircraft with a quite respectable

ground attack capability.

On 8 December 1962 the Brunei Revolution broke out, which caught the squadron at a rather awkward moment, as it had not yet received all of its new aeroplanes; some of those that it did have were still undergoing post-ferry servicings; none had yet been calibrated for bombing and they all lacked gunsights – and it was in the throes of a change of command, the new CO taking over on the 17th. Nevertheless, the Canberras were promptly put to good use as high speed taxis, ferrying VIPs back and forth between Singapore and Labuan, the first such trip actually being flown on the 8th. Visual reconnaissance sorties were flown on the 10th and 11th and, although the crew did not realise it at the time, the first of these had had a significant impact. The rebels had been talking to the Shell representatives at Seria by telephone and threatening to use their hostages as a shield in an attack on the police post at Panaga. At that moment the Canberra roared over; a new voice promptly came on the line and promised that the hostages would come to no harm. The mere presence of an aeroplane had been sufficient to moderate the aggressive attitude of the rebels.

By February 1963, two months later, the squadron had made considerable progress with the B15 and, along with No 20 Sqn, it had begun to train some of its aircrew as Forward Air Controllers (FAC). Although it had yet to carry out any full-scale co-ordinated exercises, the Offensive Support Wing was able to respond when Operation COLD SHOWER was ordered. This was to have involved four Canberras, each carrying six 1,000 pounders, and eight Hunters, conducting a strike against the rebel leader, Sheikh Azahari, who was believed to be at large with a band of hard core followers in a tract of difficult swampy country near Limbang (just to the south of Brunei). The aircraft had been fuelled and armed, and the Canberra crews had been briefed. All that was missing was the word ‘Go’, but it never came. The mission was cancelled at the eleventh hour, on political grounds, and it soon became clear that ‘bomb’ really was ‘a four-letter word’ and that, short of WW III, only forward-firing armament was ever likely to be authorised.

Over the next few months the squadron re-established a training routine, now embracing rocketing and low-level navigation in addition to its original medium and high level commitments which it still

retained. In October of 1963 the squadron also began to train with the Low Altitude Bombing System (LABS). This was an approach to the problem of low-level bombing, particularly in the context of delivering a nuclear weapon and hoping to get away with it – in this case, RED BEARD.

The first ripples to disturb this period of relative calm had been made when the Anglo-Malayan plan for the establishment of the sovereign state of Malaysia had come to fruition in September of 1963. Always opposed to, what he chose to represent as, an 'imperial plot' President Sukarno of Indonesia began to promote what came to be known as 'Confrontation', a state of armed political and economic hostility, sometimes including direct military action, but stopping short of outright war. Bands of guerrillas began to make incursions across the border from Indonesian Kalimantan and the frequency of these steadily increased.

By this time, in fact in 1962, the New Zealanders had handed back their RAF B2s and gone home to take delivery of their own B(I)12s which were to be based at Ohakea, although the squadron was still committed to the Strategic Reserve and under an obligation to return to Singapore as and when circumstances dictated. By 1964 circumstances did so dictate and No 14 Sqn RNZAF flew up to Singapore in April.

Their presence at Tengah provided an opportunity to compare tactical notes informally and these discussions provide an interesting commentary on the state of low-level bombing in the mid-1960s. The New Zealanders were practising straight-in attacks at 250 feet. When it was pointed out that their bombs would almost certainly skip and go off underneath them, they countered that this would not be the case if the bombs were retarded. This was true but, although retarded tail units were just beginning to become available, there were none in the Far East. Unperturbed, the Kiwis wanted to be ready for when they did arrive and anyway, they said it was 'more fun that way.'

The Australians, up at Butterworth, favoured a low-level approach and a pop-up to 2,000 feet. This would certainly reduce the incidence of bombs skipping but, using 1,000 pounders, there was a significant risk of self-damage and at this relatively low altitude the aircraft would be very vulnerable to the target's defences, including small arms fire. As 2(B) Sqn had only eight aeroplanes, it was questionable

whether *any* such risks were acceptable.

For its part, No 45 Sqn was advocating a pop-up to 3,500 or even 7,000 feet which would guarantee that the bombs would stay put where they hit, eliminate any risk of self-damage and avoid the threat from all but AAA, with which the Indonesians were not well provided (and in the mid-1960s they lacked any form of surface-to-air missile). On the other hand, bombing accuracy obviously degrades with height and there was a significant chance that the aeroplane would climb into cloud.

I should stress that none of the squadrons was practising one tactic to the total exclusion of all others; nevertheless they all tended to have different starting points in crewroom discussions. As the controlling formation, one might have expected HQ 224 Gp to have laid down the law, but the wide range of prevalent opinion was symptomatic of the fact that wholesale low-level tactics had been introduced only recently. In 1964, in the absence of appropriate weapons, there were a number of alternative solutions to the problem of low-level bombing, but there was no right answer.

In the summer of 1964 the Offensive Support Wing finally perfected its joint strike. Using four Canberras and two four-ships of Hunters, various combinations were tried, but a typical strike would involve the Canberras saturating the area with a barrage of 296 2-inch rockets followed by the two sections of Hunters with their heavier 60 lb rockets. As the last of these cleared the area the Canberras ran back in to drop 24,000 lbs of bombs and the Hunters then returned to rake the target with cannon fire. It was tried out on Exercise RAVEN in July, using the inland range at Asahan, the usual venue for live FAC training, and if nothing else it certainly raised a lot of dust.

Although the opposition had some Tu-16 *Badgers* and late-model MiGs, the most likely threat to Tengah, was a strike by MiG-17s and WW II-vintage B-26s and P-51s. All of these were potent enough as ground attack aircraft and a low-level approach from Indonesian airspace, which was only fifteen miles south of Tengah, would have provided minimal warning.

As a counter to this, a survival scramble procedure was introduced, and when the tension began to ramp up in December 1963 it was exercised for the first time, which – since it involved a variety of reinforcement aircraft, including a number of Victors, in addition to

A pair of rocket-armed B15s of No 45 Sqn leaving Tengah's Canberra dispersal – note No 81 Sqn's still silver PR7s at the far end of a sometimes long, and vulnerable, line-up of aeroplanes.

the four-squadron home team of Javelins, Hunters and Canberras – was quite 'exciting'.

There was considerable concern over the vulnerability of our aeroplanes, which were routinely parked in neat rows, more often than not supplemented by a long line of naval aircraft whenever a Carrier Air Group was ashore, topped off by several Victors. In an effort to reduce the risk of losing all of one type to a single strafing run, we tried mixing them up so that a dispersal might contain two or three Hunters, a couple of Canberras, a Victor, a Javelin and the odd Britannia or Hastings that was passing through. It proved to be quite impractical, as the increased demand for MT simply could not be sustained. If a fitter needed to collect a grommet or a widget, his squadron's Stores was no longer just across the pan. It was now likely to be a couple of miles away on the far side of the busiest runway in the RAF, which could be crossed only during rare intervals in the intensive flying programme. The alternative meant going off camp through one gate and in through another, which involved laborious security checks, and then retracing one's steps. Minor engineering snags could take hours to clear. There were even cases of aeroplanes being 'lost' because they had been parked on a different dispersal from the one from which they had taken off! After a few days of this chaos the aircraft all returned to their own pans but, where space permitted, they were no longer parked in neat rows but staggered, with aircraft sometimes being pushed right back onto the grass.

By mid-1964 Tengah had been provided with an active defence system with an outer ring of radar-laid army-operated AAA and an

Muscling in on the air defence act, one of No 45 Sqn's Canberra B15s leading a Javelin FAW9 of No 64 Sqn and a Hunter FGA9 of No 20 Sqn.

Who?	When?	Where?
No 73 Sqn	Sep 64-Nov 64	Tengah
No 3/14 Sqn	Oct 64-Nov 64	Kuantan
No 32 Sqn	Nov 64-Feb 65	Tengah
No 16 Sqn	Feb 65-Jun 65	Kuantan
No 249 Sqn	Jun 65-Aug 65	Kuantan
No 6 Sqn	Aug 65-Sep 65	Kuantan
No 73 Sqn	Sep 65-Nov 65	Kuantan
No 32 Sqn	Nov 65-Dec 65	Kuantan

Table 1. Canberra bomber reinforcement of FEAF during 'Confrontation'.

RAF Regiment Bofors squadron within the airfield perimeter. In addition, a few 20mm Oerlikons had been sited at random locations for use by anyone in the mood to engage the enemy.

The overall plan for the air defence of Singapore was conducted under the nickname FRANCISCAN and from time to time the alert state called for dawn and dusk patrols to the south of the island. Usually conducted by Javelins and/or Hunters, on occasion No 45 Sqn was co-opted into the system and rocket-armed Canberra 'fighters' flew a number of these sorties during 1964.

Another element of the FRANCISCAN plan called for the strike force to be dispersed and, following seaborne and parachute landings on the Malayan peninsula by Indonesian commandos in August and September, No 45 Sqn moved up-country to Kuantan where it lived under canvas, while maintaining a dawn-to-dusk stand-by for about a month with armed aircraft.

At much the same time FEAF was reinforced by No 73 Sqn from Akrotiri and a month later an eight-aircraft detachment of B(I)8s flew in from Germany to relieve No 45 Sqn up at Kuantan. The B(I)8s were withdrawn after a few weeks, leaving just one additional squadron in-theatre but that level of reinforcement was sustained for the next fifteen months – see Table 1.

A word about what FEAF's bombers were going to do. As I have indicated, the B15 was nuclear-capable and No 45 Sqn's crews maintained currency with LABS but, as a very junior flying officer, no one ever saw fit to tell *me* why. We surely weren't going to 'nuke'

Djakarta, so I imagine that there must have been some sort of plan for 'doing it' to China. I have a vague recollection that there may have been some highly classified stuff relating to China held in the Ops Block vault – but I was never given access to any of *that*. What we did have squirreled away in the vault was a selection of mission folders, which we drew up ourselves, for various conventional targets in Indonesia. My personal war plan involved an attack, so far as I was aware, by just *one* Canberra on Djakarta airport after which we were to recover to Labuan where we were to re-arm, refuel and do it again on the way home after lunch, this time to something at Pontianak in Kalimantan.

When radars were installed at Kuching and Labuan in 1964 my crew was sent across to Borneo for a week to do the calibration sorties. Our aeroplane had a bomb beam, triple carriers and empty, but operational, rocket pods and we were at the disposal of COMAIRBOR for offensive tasking as required. We were far more interested in bombing or shooting someone than droning about for the benefit of the radar guys so, as soon as we landed at Kuching, we asked where the bomb dump was – there wasn't one. We asked about rockets, but there were none of those either. We insisted that they must be there somewhere, because it was 'in the plan'. We eventually had to accept that the only reload capability at Kuching amounted to a few Firestreak missiles and some ADEN gun packs, and we found the same situation at Labuan. When we got back to Tengah we reported this to Ian Pedder, who looked a trifle concerned and told us to keep it under our hats. So we did.

At the end of 1964, the Indonesians infiltrated some more troops into the south western tip of Malaya – on Kukup Island. Operation BIRDSONG was mounted to dislodge them. This involved simulated strikes by Hunters and Canberras on the 23 and 24 December, followed by a four-ship Hunter attack using live ordnance on the 24th and, on Boxing Day, a rocket attack by one of No 45 Sqn's Canberras controlled by an FAC in a helicopter, which finally did the trick. This was the last live offensive sortie to be flown by an RAF Canberra.

From January 1965 onwards the squadron had one or two aeroplanes more or less permanently deployed to Labuan and/or Kuching for much of the next eighteen months, indeed from April to June the whole squadron was at Labuan while Tengah's runway was

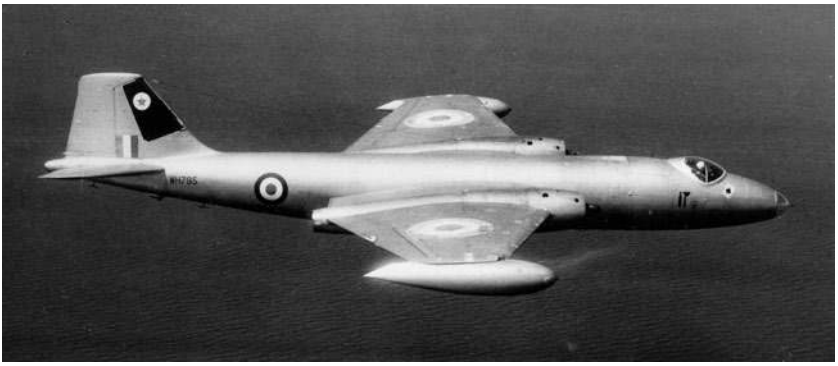
An AS30 missile being loaded on a B15 at Labuan.

being patched up. While in Borneo the Canberras flew numerous border patrols, exercised with FACs and dropped some 1,000 pounders on a new weapons range that had been hastily laid out and licensed at Balambangan – so OC Offensive Support Wing had evidently managed to paper over the bomb-availability crack by then.

By this time, President Sukarno was becoming increasingly isolated in diplomatic circles and, since an attempted Communist coup in October 1965, which was very bloodily suppressed, Indonesia had become increasingly preoccupied with internal affairs. Border incursions into Borneo continued to occur but '*Konfrontasi*' had been Sukarno's baby and as his personal influence began to wane, the steam began to go out of his campaign and it was finally brought to a close by a treaty signed in Bangkok on 11 August 1966.

This was the beginning of the end for the Canberra in FEAF. The New Zealanders flew back to Ohakea in November 1966 and in the following April the Australians redeployed from Butterworth to Phan Rang to participate in the fighting in Vietnam; by the time that they were withdrawn in 1971 they had racked up some 12,000 sorties.

But No 45 Sqn still had one more shot in its locker – the AS30



A Canberra PR7 of No 81 Sqn.

missile. The AS30 had been in prospect since the end of 1964 but, it took a long time to materialise. As always, FEAF had to wait until the Cypriots had had a go and the first AS30-capable aeroplane didn't reach Tengah until June 1966. Thereafter four Exercise HOTSHOTs were mounted, two from Labuan and two from Woomera, during which no fewer than 128 missiles were fired – which seems to have been a remarkably generous allocation of what must have been fairly expensive toys.

Although I have focused on the bombers, because that is where my experience lay, I have to mention No 81 Sqn which also operated Canberras in FEAF, in the photo-recce role. They acquired their first PR7 in 1960 and flew them for the next ten years. As with most PR outfits, they tended to keep things a bit close to their chests, so one can't be too sure of everything that they got up to, but they certainly kept on flying FIREDOG-related sorties, both by day and by night, long after the Malayan Emergency had been terminated in July 1960. Chin Peng OBE and the remnants of his followers continued to lurk on the Thai border where No 81 Sqn kept an occasional eye on them until it disbanded in 1970 – although it was 1989 before Chin Peng and his team finally laid down their arms of their own free will.

Beyond that the major commitment was survey work. Initially, during 1961 and '62, filling in gaps left in the Thai survey that had been done by Valiants flying out of Butterworth. Following the Brunei Revolution in 1962 and its subsequent evolution into Confrontation, the Borneo survey was afforded the highest priority. No 81 Sqn had

begun this project as early as 1947 and it had been going on intermittently ever since, but, despite these efforts, it was still not complete in 1970, because some parts of Borneo were permanently shrouded in cloud and they stubbornly refused to have their pictures taken.

During the Confrontation era, 1964-66, the squadron was more or less permanently reinforced by detachments mounted by Nos 13, 39 and 58 Sqns and, during that period, there were sundry operational tasks, including locating guerrilla insurgents and taking surreptitious snaps across the Indonesian border. Whether this ever involved actual incursions I couldn't possibly say – as they say – but No 81 Sqn certainly had a library of pre-planned Indonesian pre- and post-strike recce sorties. Beyond that, like No 45 Sqn, 81 ranged far and wide from Thailand to Hong Kong to the Philippines and Australia and to Cocos and Gan.

Reverting briefly to No 45 Sqn, before it began to run down, it mounted a series of five FAC training detachments to Kai Tak, whence it had also flown three slightly unusual tasks in 1965, '66 and '67 under Operations MONOMANIA and TENNON. These involved air sampling sorties, following Chinese nuclear tests, sometimes employing B6s that had been provided for that purpose.

The squadron had had a good run, but it had not been without the occasional accident and, in all, it managed to write off nine Canberras in fourteen years, which was probably about par for the course in those days. It all came to an end with the British withdrawal from east of Suez. No 81 Sqn disbanded in January 1970 and No 45 Sqn followed it into limbo a month later. The Canberra would continue to fly as a front-line aeroplane in the photo-recce role for more than thirty years but the disbandment of No 45 Sqn had marked the end of the twenty-year career of the RAF's first jet bomber – it was the end of an era.

SECOND LINE ACTIVITIES

Wg Cdr Andrew Brookes

Having gained a degree from Leeds University, Andrew Brookes completed his flying training in 1968, subsequent tours providing experience on Victors, Canberras and Vulcans. He held appointments in Hong Kong, at HQ Strike Command, at the Greenham Common cruise missile base, with the Inspectorate of Flight Safety and the DS at Bracknell. He is currently the Aerospace Analyst at the International Institute for Strategic Studies. He has written a dozen aviation books.

The sharp end of the RAF of the 1950s was represented by the Hunter and Canberra. In the 1960s these were superseded by the more demanding Lightnings and V-bombers. So, while there were, of course, some exceptions, manning policy dictated that the majority of folk would not be let loose on these much more expensive aeroplanes until we were reasonably confident that they would be able to cope without breaking them – which implied that they ought to have about 1,000 hours under the belts, which meant that they needed to be second tourists.

By the 1960s the Hunter and Canberra were becoming yesterday's aeroplanes, but we still had lots of them in squadron service defending imperial outposts and the various Western alliances, running from NATO-commitments in Germany, through CENTO-obligated Cyprus via colonial Aden and Hong Kong to SEATO-aligned Singapore. Throughout the '60s the majority of fast-jet first-tourists cut their teeth on these relatively cheap and cheerful aeroplanes and those who avoided wrapping themselves around a sand dune or a palm tree were permitted to move on to bigger and better things.

By the early 1970s the front line was flying Phantoms, Buccaneers, Jaguars and Harriers in the very demanding high speed, low-level environment and, although the Lightnings and V-bombers were now getting to be a bit long in the tooth, they could still be a handful for a tyro. As a result, there was still a requirement for some post-FTS, pre-OCU consolidation flying for a number of people. After all, even in

'It was not uncommon to have as many as a dozen Canberras on the flight line.' There are ten in this picture, which was taken at Karup and shows a vari-coloured selection of aeroplanes fielded jointly by Nos 85 and 100 Sqns for Exercise NORTHERN MERGER in 1974. (Phil Wilkinson)

those days it was beginning to cost something like £1M to train a pilot or a navigator to 'wings' standard, and to 'chop' someone who just needed a few more hours to acquire a little more situational awareness or confidence would have been both short-sighted and uneconomic.

The answer, as in the 1960s, was still the Hunter and the Canberra. The Hunter in the form of Nos 45 and 58 Sqns which provided this facility at Wittering from 1972 until 1976 when its pre-OCU flying task was effectively taken over by the TWU at Brawdy. Many other pilots, and a lot of navs, whom, it was thought, might benefit from being given some more flying hours before being let loose on the heavy metal, spent time on Canberras.

As a result, having evolved from the silver, high level bombers of the 1950s, into the camouflaged low-level strike/attack workhorses of the 1960s, the Canberra embarked on the third, and longest, stage of its long career in the 1970s. I should make it quite clear, however, that the second line Canberra units of the '70s and '80s did not simply represent a kindergarten for baby pilots and navs. They were all providing useful services and their flying time was highly productive.

And it all made a lot of financial sense too. I seem to recall that the sort of figures that were bandied about at the time were that a Phantom cost about £3,000 per hour to fly, whereas a Canberra came in at something like £400. Since we had hangars full of redundant Canberras squirreled away at places like Wroughton, it made a lot of sense to use them – and you got much higher utilisation rates out of them. It was not uncommon to have as many as a dozen Canberras on

the flight line in those days. If the one you had been given was disinclined to start, you could climb out and take the next one instead. Can you imagine that on a Typhoon squadron today?! You will be lucky if you get your hands on an aeroplane at all and if you break it, it's the long walk back to the crew room.

There was a high success rate too. Virtually every young nav I flew with went on to bigger and better things, mostly Buccaneers or Phantoms. I had a browse through my log book the other day and was taken back to an occasion when I was obliged to chastise a young pilot officer by the name of Nigel Maddox. He is now an air vice-marshal, of course, and I have to duck into someone's office when I see him coming in case he remembers my abusing him when I was a flight lieutenant.

One other thought about the people involved. As with the operational Canberra squadrons of the 1960s, the second line units of the 1970s tended to have two sorts of aircrew, a lot of first tourists frolicking on the flight line under the supervision of a handful of old men on their third of fourth tours on type – an exaggeration, of course, but that is how it sometimes felt. There was one significant difference, however – in the 1960s the first tourists had all been flying officers, or even pilot officers; in the 1970s, because of the 'Green Shield Stamp' syndrome, practically everyone was a flight lieutenant, so you had to look closely to see whether he was one of the wrinkly ones before you answered back.

What were these second line outfits, and what did they do? Well, there was No 7 Sqn at St Mawgan which had TT18s, with a big Rushton winch under each wing from which they could tow either a target 'dart' or a sleeve which other folk would then shoot at – often the Royal Navy, which is probably why 7 Sqn was where it was. Then there were Nos 85 and 100 squadrons at West Raynham, which were also in the target facilities game and I will expand on them in a moment. Alongside the OCU at Cottesmore there were No 98 Sqn, which spent its time calibrating navigation aids, and No 360 Sqn whose aim in life was to spoil the day for all sorts of people, but mainly those trying to operate air defence radars on the ground and/or on HM ships. This electronic warfare activity was covered in Journal 28, so I will not dwell on it today beyond noting that in the mid-1970s No 360 Sqn moved to Wyton where it joined No 51 Sqn,

One of No 85 Sqn's Canberra B.2s. (MAP)

another Canberra operator, although one that was engaged in more mysterious activities and which was not inclined to seek publicity.

So, having set the scene, I am going to spend the next few minutes reminiscing about what were, for me at least, 'the good old days'. Apart from being a useful way to provide newly trained aviators with some additional flying hours, the Canberra was also one way for experienced guys who had been on ground tours to get back up to speed, and that was where I came in.

My background was that I spent my first tour as a co-pilot on reconnaissance Victor Mk 2s with No 543 Sqn at Wyton. When it was my turn for a captaincy, there were no vacancies, so I was put out to grass on a ground tour. By the time that that expired, I was in my mid- to late-twenties and somewhat behind the drag curve in terms of flying hours. So, while one would be patted on the head by one's Boss and told that one was doing well, it was also observed that I really ought to have logged a few more flying hours by this time. So it was that I came to be posted onto Canberras; it was a way to play catch-up which I needed to do, because 'they' had sort of managed to mismanage my career thus far. This was nothing new, of course, it was a result of the air force's failing to get its manning pattern right, something it seems to find very hard to do – right now we are going from accepting nobody this year, to recruiting 5,000 next year.

I finished up on No 85 Sqn at West Raynham which had B2s, T4s and T19s – T11s with the original AI 17 replaced by a lump of concrete – we called it the BLUE CIRCLE radar. The T19 had no drop tanks, which limited its range a bit. We couldn't make Malta in

one go, so we used to night stop at Istres, jug up on cheap vino at the *Routier Café* and carry on to Luqa the next day. It was Hell!

Our routine activities were quite varied. Typically, we would work in pairs, exercising with one of No 8 Sqn's Shackletons or the radar station at Neatishead, where fighter controllers were trained. Basically, one of the aeroplanes would act as the target while the other one was vectored in to an interception by the third party. Once it had all ended in the inevitable stern chase, you broke off, switched roles and did it again until the fuel began to run low – about an hour and a half as a rule. It was quite fun actually because we were in No 11 Group and that meant fighter-style rules, so formation flying was standard procedure. If you were briefed as a pair, you took off together, if it was a threesome, same thing, and when you came home, it would be a fly-past in formation or a run-in and break – all of which was great fun and a good way to do business.

We would often detach to Lossiemouth, or wherever else that practice intercepts might be required. There was always somebody who wanted someone to play the bad guy, and that was our trade – we were the professional bad guys. Apart from these routine training events, there were more formal fixtures, two or three JMCs (Joint Maritime Courses) every year, for instance, and the occasional major air defence exercise. For exercises we might deploy to somewhere in Denmark for a couple of weeks – under canvas sometimes. And from there we would fly back to the UK to 'attack' it at low-level to provide the air defenders with something to do. They would have all these unidentified radar responses popping up on their screens, because we didn't file flight plans, and if No 360 Sqn was playing, as they usually did, they made it all the more difficult for them, because our blips were hidden in a lot of 'noise'. It wasn't always Denmark, of course, we might go to Wildenrath or Gütersloh, but wherever it was, it was always good to get away.

Another occasional activity involved escorting Hunters to and from Gibraltar. This was still General Franco's era and relations with Spain were a bit tense, so we used to maintain a couple of Hunters at North Front and, because fighter pilots have a limited range (intellectually) we used to look after navigation and radio traffic for them between Gib and Brawdy – down on Friday, back on Monday.

Some of No 100 Sqn's Canberra fleet: nearest the camera is a T4, then two B2s and a pair of T19s. (Warton Heritage Group)

And then there was West Raynham itself. It was a very traditional set-up – a two-squadron wing, ourselves and No 100 Sqn, with about twenty crews on each – and practically everybody lived on base, including all the administrators, the educator, the doctor, the dentist – everyone. Even so, it wasn't a mega-station with hundreds of people, so that when there was a party in the Mess, you knew just about everyone. It was a bit old-fashioned I suppose, but I look back on my time at West Raynham with great affection.

All good things have to come to an end, of course, and towards the end of 1975 the air force instituted one of its periodic culls to trim off a bit more fat in the name of 'cost effectiveness'. This time the Ministry had No 85 Sqn in its sights and we got our marching orders. Fondly imagining that the Minister might be persuaded to change his mind, we wrote to Roy Mason, asking him to reconsider – we even had a whip round so that we could send him a squadron tie, with our famous hexagon motif – as if that would have made any difference! It didn't, of course, and shortly before Christmas we lost our identity.

I was part of the rump of No 85 Sqn that was absorbed into No 100 Sqn, which almost immediately relocated to Marham. That meant that we had been transferred from No 11 Group to No 1 Group – and what a culture shock that was! 1 Gp rules were really – what? – ponderous – that's the word. In December we could fly in formation; in January

A trio of No 85 Sqn's aeroplanes up from West Raynham in July 1974. The transfer to No 1 Group soon put a stop to this sort of thing. (Phil Wilkinson)

we couldn't. Life just wasn't such *fun* anymore. The clamp on formation flying is just an example, but it is a good one, because formation flying is good for you – it focuses the mind, sharpens your judgement, hones your skills and generally makes you a better pilot and that, to a significant extent, is what these second line Canberra outfits were really about.

No 98 Sqn had been disbanded at much the same time so we inherited some of their E15s along with the calibration task – and what a bore that was! On the other hand the Mk 15 had a lot more poke than the rest of the fleet, which were all B2 derivatives, and it was much more fun to fly. Those of you who are familiar with the aeroplane will recall that there is a 20 knot gap between lift off and safety speed, which is to say that, once you were airborne, if you lost an engine, you had to find another 20 knots from somewhere before you could guarantee to stay in the air. The instinctive thing to do, of course, was to increase power on the good engine. That was a very bad idea, however, because there wasn't enough rudder authority to prevent the aeroplane yawing to such an extent that it induced a roll so that you eventually crashed upside down. One way to improve the situation was to get rid of the tip tanks, which reduced both weight and drag – but how to do it? You had one hand juggling the throttle to manage

the asymmetric problem and one on the stick trying to stop the thing rolling and you needed to get at the little tank-jettison toggle switch which was just in front of you on the coaming – but how were you supposed to operate it – with your teeth?! But I thought the '15 was a marvellous aeroplane. I loved it. It could go a long way – no problem getting to Malta, and we used to do low levels over Sicily.

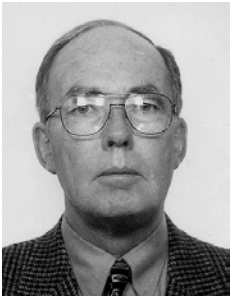
I eventually left in May 1977 to become a Vulcan captain. I mention this because, with hindsight, I reckon that the Canberra was actually more difficult to fly than the Vulcan. I joined No 35 Sqn, taking the place of another flight lieutenant who had wanted a change and had moved over to Canberras. He was back on 35 within six months; he had been chopped because he couldn't handle the asymmetric, so he was sent back to the Vulcan. The fact is that the Canberra, nice as it was, could kill, even very experienced people; indeed we lost a very good Station Commander at Wyton many years later, I think in an asymmetric incident in a T4. But it was that unfortunate asymmetric problem that actually made the Canberra such a worthwhile training aeroplane.

Thirty years after my time, No 100 Sqn is still providing the RAF with target facilities but now it does it with the Hawk. The last of its Canberras was retired in 1991 and since then we have not had a cheap and cheerful aeroplane for young folk to fly in order to polish their skills. All of today's aircraft are *very* expensive. But in this new age of realistic simulation and computerised fast jets that fly themselves perhaps we no longer really need that sort of halfway house aeroplane. One of the few, perhaps the only, advantages of having a relatively small air force is that it can be very picky about its manpower. In short, the selection and training processes are now such that the RAF accepts only those with the highest potential and anyone earmarked for fast jets simply has to be good enough to do it – as a first tourist. Nowadays you either make the grade first time or you are restreamed *before* you become a risk to yourself – and a cost to the budget – and the RAF can no longer afford to have large numbers of very expensive aircrew on ground tours needing to be recycled back into the system.

And it works – even without the Canberra – the problem today is not quality, it's quantity – you have to attract the Right Stuff – and then retain it – but that, I'm afraid, is a story for another day.

THE CANBERRA PR9

Gp Capt Vernon Harding



Vernon Harding graduated from Cranwell in 1962 as a navigator. Apart from a brief initial tour on a Vulcan Blue Steel squadron, all of his flying, which embraced three squadron tours and one as OC Ops at Wyton, was on the Canberra PR9. His ground appointments, all recce-related, included stints with HQ NEAF (during the Turkish invasion of Cyprus in 1974), at the MOD, as OC JARIC from 1989 to 1991 (embracing the first Gulf War) and, finally, the MOD again, looking after the interests of JARIC.

This paper will look at the luxury sports version of the Canberra, the PR9, with its powered flying controls, autopilot, bigger wing and its much more powerful Avon 206 engines – all aimed at getting the aircraft up to greater altitudes – 60,000ft plus

The need for high flying reconnaissance aircraft became apparent during WW II. Put simply, if a recce aircraft failed to return to its base, the intelligence it had collected was lost. As the performance of German fighters and static air defence systems improved, it was realised that to stay safe over their target areas reconnaissance aircraft would need to fly at greater altitudes. This appeared even more important in the early years of the Cold War because of the requirement to know what was happening within the Soviet Union and China. The PR9 was conceived as the RAF's answer to this problem. The Americans had developed the U-2, and their Canberra derivatives, the RB-57D and F. The SR-71 Blackbird and the TR-1 came along later.

The prototype PR9 first flew on 27 July 1958. The test programme went well, apart from the early loss of one aircraft (and its navigator) when the enlarged wing failed – the skin peeled back. After this, an ejection seat was fitted to the navigator's position. Twenty-three production aircraft were built by Shorts at Belfast under contract to English Electric, of which twenty-one were delivered to the RAF. It entered squadron service with No 58 Sqn at Wyton in 1960 where the

When it first entered service, the PR9 served briefly, as here, with No 58 Sqn. (MAP)

crews were trained and these aircraft and crews were transferred to No 13 Sqn in Cyprus in 1961 and No 39 Sqn in Malta in 1962.

Gary Powers, flying his U-2, was shot down deep inside the Soviet Union over Sverdlovsk in Siberia on 1 May 1960. The RAF's timing in producing its own high level reconnaissance aircraft turned out not to have been of the best.

To enable it to fly at high level the PR9 was fitted with Avon 206 engines, providing nearly double the thrust of the earlier marks, a slightly longer wingspan and an increased chord inboard of the engines. At high altitudes, the stalling speed and the speed at which the limiting Mach number is reached are very close together, so the aircraft had to be flown within a really quite narrow airspeed band. It was very 'tender' to fly and even simple manoeuvres such as a small turn to stay on a photo flight line could be a bit difficult. Although the PR9 was tender, the US aircraft, flying at even greater altitudes, were far more difficult to handle. The Americans used to call such small turns 'coffin corners'. If the aircraft stalled, the risk of flameout was high, necessitating a descent to within the range of the air defences to restart the engines. As the aircraft descended, so the speed band opened up but the controls became very heavy to manage. For these reasons, the PR9 was fitted with an autopilot and powered flying controls.

In the early days, the PR9 was well able to sustain level flight at 60,000-plus-a-bit feet but later on, probably because of increases in its weight and imperfections (dents and twists) in the airframes, this became harder to achieve and 58,000 feet was a more realistic figure.

In comparison, the RB-57, with its much larger wing could operate at around 65,000 feet.

Flying at these levels meant, not only that the aircraft was positioned further from its target (especially when taking oblique images), but also that the degradation of the image due to the effects of the atmosphere was greater. Therefore, the Mk 9 was equipped with a much developed and improved suite of cameras. For high level survey work, it was initially fitted with same F49 survey camera that the PR7 had. Later on though, the F49 Mk 4, which was gyro-stabilised and mounted in a nitrogen-filled pod, was brought into service. The pod was pressurised to a set value and the temperature was controlled, which removed some of the vagaries and changes from which the earlier version suffered as the pressure and temperature decreased in the climb. In the event, the Mk 4 version was little used, but it marked the first occasion on which a camera was pod-mounted on the PR9, a system which was to prove very successful with later sensor fits. The earlier version of the F49, as originally fitted to the aircraft, proved to be highly reliable for many years. For high level reconnaissance, the PR9 had a number of F96 cameras mounted either in a fan of two or four, providing a wide angle of cover, or, in the oblique mode, set across the aircraft at angles of 15^{O} or 18^{O} below the horizontal. These F96 cameras could be fitted with lenses of either 24- or 48-inch focal length. They were adapted for high altitude use. Although the images didn't look as good or as appealing as those taken by the earlier F52 fitted to the PR7s, they actually contained more information for the photo interpreters.

The F96 was also fitted with an image movement compensation system. As the (9 × 9 inch format) film was exposed, it was moved across the register glass to compensate for the movement of the aircraft over the ground thereby achieving an improvement to the resolution of the image.

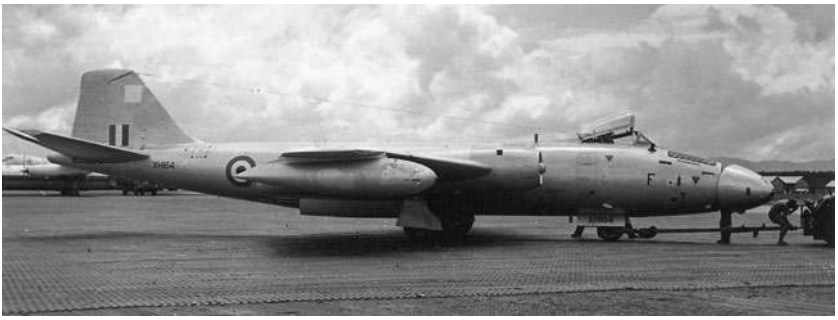
For low level operations the PR9 had three of the same F95 cameras that were fitted to the PR7. It also had a night low level camera.

The cabin air system still provided pressurisation at the standard Canberra rate of 'half the height plus two', which was fine at 60,000 feet but allowance had to be made for an unwanted depressurisation. Above 50,000 feet the partial pressure of the oxygen in the

atmosphere is insufficient to pass through the walls of the lungs. This means that oxygen has to be fed to the crew at a much increased pressure, which, in turn means that they have to 'pressure breathe' (the reverse of the normal breathing process). Pressure breathing without some sort of body restraint will cause blood vessels to burst. Hence PR9 crews, at least in the early days, were equipped with pressure jerkins, leggings, and a partial pressure helmet. If cabin pressure was lost, oxygen was automatically passed to the mask at an appropriate pressure to ensure that it would enter the lungs and, at the same time, it inflated bladders inside these three items of equipment, including the helmet, to the same pressure. It was *a lot* of pressure. Being overinflated from the inside and squeezed from the outside at the same time was quite an interesting experience, but it was manageable for long enough to make a descent to below the critical height.

A lot has been written about how the Soviets actually brought Gary Powers down on 1 May 1960, and you can still find papers on the subject being posted on the internet even today. The Americans have released quite a lot of records although, because of black felt tip deletions and poor reproduction, they are very difficult to read, and a number of papers were released in Moscow during Yeltsin's time in office. For a long time it was thought that he suffered a flameout and so was forced to descend at which time he was caught by a salvo (a phalanx) of SAM-2 missiles. However, Chris Pocock's book, *50 Years of the U-2*, puts matters straight. His research indicates that Gary Powers was brought down by a single SAM-2 exploding behind his aircraft at a height of around 70,000ft. It is fairly certain that the US lost six further U-2s in operations during subsequent years. All this is only relevant to the story of the PR9 in as much as it indicates some of the thinking which must have been weighing on the minds of the RAF Planning Staffs as the PR9 was being brought into service. No 58 Sqn was receiving the first PR9 aircraft at the very time Gary Powers was shot down. There must have been some rapid changes made to the plans for the employment of this aircraft

In the event, operations can be broken into three distinct periods. Both Nos 13 and 39 Sqns flew the PR9 in the Mediterranean until the latter returned to the UK in 1970 to be based at Wyton. It was followed by No 13 Sqn in 1978. Both squadrons remained in the UK until they were disbanded in 1982 – No 13 Sqn in January and No 39



The PR9s ranged far and wide. This is No 13 Sqn's XH164, still in the original overall silver finish, at Kuching in 1966, in the latter stages of the 'Confrontation' with Indonesia. (MAP)

Sqn in May. No 1 Photographic Reconnaissance Unit (1 PRU) was formed from the ashes with five PR9s and was kept busy with national tasking until the last operation was concluded on 23 June 2006, a date which effectively marked the end of the PR9's forty-six years of service with the RAF.

No 39 Sqn was based at Luqa throughout its Mediterranean period. No 13 Sqn flip-flopped between Cyprus and Malta as the political fortunes of those islands changed. A lot of aerial survey work was done, shared between the two units, with No 39 Sqn operating roughly to the north and west of Malta and No 13 Sqn to the south and east. No 39 Sqn was assigned to NATO's southern region in a low level role and spent much of their time in and over Italy and Greece. Thus, the PR9, designed for high level operations, began its conversion to low level at a very early stage. No 13 Sqn trained for the low level role by way of a detachment, at full squadron strength, to Brüggen in 1964. In spite of that they were still very largely used for survey and high level national reconnaissance tasking, flying operations all over what we used to refer to as the Near, Middle and Far East.

The very high level capability of the Mk 9 was used only occasionally. Until some time in the late 1960s, the crews were still issued with and trained in the use of the high level pressure breathing kit. By 1971 however, it had all been withdrawn and the oxygen regulator had been changed for a version more suitable for flight at or below 50,000 feet.

That didn't mean that the squadrons weren't kept busy. No 13 Sqn

No 39 Sqn's XH176 photographed in 1974 sporting the camouflage scheme appropriate to its low-level role over Northern Europe. (MAP)

had work to do in Cyprus in the aftermath of the EOKA problems but much of their time was spent detached. There were near permanent detachments maintained in Bahrain and Aden for high level reconnaissance tasks and in Kenya for the completion of a survey of that country. Crews were also sent to Singapore to support the PR7s stationed out there in their tasking which mainly involved a survey of Borneo and support for 'Confrontation' operations. There was also a fair amount of tasking in North Africa and the occasional trip to Hong Kong. Make no mistake – the living was good!

The living was equally good on No 39 Sqn. As well as maintaining their NATO commitments, they mounted detachments in Africa, Italy, Germany, Greece, and the Far East during this period although, generally, they were rather more static than was No 13 Sqn.

On its return to the UK in 1970, No 39 Sqn was assigned to support NATO's Northern Flank in the low level recce role. Their forward operating base was at Ørland near the mouth of the Trondheim Fjord. They also flew national recce tasks but there weren't many of these – shipping surveillance, support for police operations, sorties for Customs and Excise and for the immigration authorities. A number of three- or four-aircraft detachments were mounted to the Far East and there was some tasking flown out of Hong Kong. The larger survey tasks included Denmark which had to be re-flown for updating every three years and The New Hebrides, Fiji, Jamaica and some work in Africa.

No 13 Sqn was brought back to RAF Wyton in 1978. By this time, they were operating a mixed fleet of PR7s and 9s. This mix was put in place to allow some of the Mk 9s to be put into storage to preserve their fatigue life. By the time they disbanded in January 1982, the squadron was operating PR7s only. Assigned to AFSOUTH, they spent a lot of time at their forward operating base which was Villafranca near Verona. Once again, the living was good on both squadrons. No 39 Sqn was now the only RAF unit flying the PR9. They were disbanded in May 1982 and, as already mentioned, five of their aircraft were used to reform No 1 PRU.

No 1 PRU, initially based at Wyton and later at Marham, continued the work of No 39 Sqn, except that, in order to extend the fatigue life of the aircraft, low level flying virtually ceased, so the aircraft were effectively limited to high and medium level operations. The fatigue life of the airframe had been a worry all its life but it became a major issue as soon as the aircraft started low level flying. It had long been recognised that the weakest point was the pressure bulkhead at the back of the cockpit. Thereafter, as one of the PRU's aircraft reached the end of its fatigue life, it was replaced by another aircraft taken out of storage. With only very little low flying, the rate of fatigue life consumption was very low.

The unit was renamed No 39 (1PRU) Sqn in July 1992. Extensive surveys were flown over Zimbabwe and Kenya. The amount of national tasking steadily increased and, on behalf of both the UN and NATO, very early operations were flown over the former republic of Yugoslavia. They also mounted operations over Afghanistan, Bosnia, Iraq, and Somalia. The last operational detachment flown by the unit, and indeed the PR9, came to an end on 23 June 2006, when two aircraft landed at Marham at the end of a four-month detachment to Afghanistan – perhaps showing the value of the PR9 in the recce role right up to the very end. The only other PR9 flights after that were a few displays and delivery flights. The unit was disbanded, just one month later, on 28 July 2006 – the very end.

Throughout its life a number of upgrades and improvements had been carried out. A major upgrade of the navigation equipment occurred between 1978 and 1980 when twelve of the then surviving sixteen aircraft were given the Sperry Master Reference Gyro to improve heading information and an improved Doppler along with

Decca TANS (Tactical Air Navigation System) to improve the track keeping capability. At the same time an improved Radar Warning System was fitted in fairings mounted on the tail. Much later, the aircraft were re-equipped with a Trimble GPS System which was linked to the TANS and later still, this system was replaced with a very accurate GPS/INS system. The later PR9s had a nav fit which would have been very hard to better – which is, of course, exactly what is needed for reconnaissance operations in remote parts.

There were also improvements and upgrades made to the sensor fit. The System III camera, provided very high resolution images of a wide swathe of ground under the aircraft. This was still a wet film camera but the fact that it was mounted in a pod in the flare bay meant that the film itself could be custom-made to provide optimum performance in the carefully controlled atmosphere within the pod. The mirror lens was articulated so that it could move to a number of positions during flight. The whole system was optimised for best performance at 50,000 feet or above. Pin sharp images could be obtained. It was, however, a difficult system to operate mainly because, although it was possible to get the large and heavy pod into the flare bay by lifting the aircraft on jacks, it was much better and quicker to do it over a pit. A small number of suitable pits were dug, the best of them being in purpose built hangarettes. Another sensor upgrade dating from the 1970s was the fitting of the ex-Phantom IRLS (Infra-Red Line Scan) in a pod which could also be fitted in the flare bay.

A much later sensor upgrade involved yet another pod to be fitted in the flare bay. This one was used for an EO (Electro-Optical) system called RADEOS – the first three letters standing for ‘rapid deployment’. The information gained could either be sent down to a ground station or stored on board for interpretation after landing. The image gained was of very high quality even at quite long oblique range. However, the area covered was small. To help offset this, a new panoramic camera, the Recon/Optical KA-93 with a 24-inch lens, working from horizon to horizon and providing very high resolution images, was fitted. The overall system was both successful and popular, and was the reason why, during the aircraft’s later operations, many UK and US commanders were putting ‘Preferred Sensor Canberra PR9’ on their recce request forms.

XH134, one of the handful of PR9s still serving with No 39 Sqn in February 2006. (Mike Jorgenson)

The final PR9 flight landed at Kemble on 31 July 2006. The aircraft had provided the RAF with a very stable recce platform, with a range of nearly 2,000 nms, large enough to carry a suite of highly capable sensors and able to operate from medium level up to around 50,000 feet (and *in extremis* at low level too). This highly capable suite included the ability to get recce data onto the ground in near real time. In the year 2000/2001, the total cost of operating No 39 Sqn was very close to £15M. It is easy to assume from that figure that it was not scrapped on cost grounds. Money was never going to be found to overcome the fatigue issues – replacing the pressure bulkhead at the back of the crew compartment. Any remedy was always going to be so expensive as to put it beyond consideration. Project DABINETT was set up to consider a replacement. A line was put in the estimates to allow some of the sensors to be mounted in the ASTOR aircraft but it failed to survive.

So, in conclusion, what is the loss caused by the demise of the PR9? From the national standpoint, there is no other aircraft available that carries that very wide range of sensors over the same range, as did the Mk 9. The navigator had control of the Zeiss RMK survey camera, the RADEOS, and the KA-93 panoramic camera. The pilot controlled the suite of three F95 low level cameras – all of this over a range of 2,000 miles. There were very few target categories it couldn't take on. But how often have UK forces gone into action on a national basis as

The end of an era – half-a-century of RAF Canberra operations. XH131 touches down at Kemble on 31 July 2006. (Stephen Kilvington)

we did in the Falkland Islands and what is the likelihood of our doing so, or indeed of being capable of doing so in the future? Were we to enter a conflict on a similar basis now, then we might well feel the lack of a such a recce vehicle, especially in the pre-hostilities stage, because of the very wide range of sensors that would *not* be available. From an international perspective, however, the situation is a little different. If we look at operating within any grouping of nations which included the US, then surely the gap could be filled. Without US participation though, we might well find ourselves committing forces to hostilities knowing that we had some blind spots in our plans. If we in the UK have a special relationship with the US, then surely we have to look at exactly what we contribute to that relationship as well as what we gain from it. We know that US commanders in the field valued the product they received from the PR9 imagery. That, however, is hardly likely to influence our politicians. They would perhaps prefer to look at the wider picture and to consider the totality of the UK's contribution, including the frequency with which we have deployed forces alongside theirs. In my view the Canberra PR9 had served us well, but its time was up and we needed to move on.

AFTERNOON DISCUSSION PERIOD

Air Mshl Sir Frederick Sowrey. Aside from the PR9's purely military activities, I believe that it did a great deal of civilian survey/mapping work which, apart from JARIC, will have been of considerable value to others, various Commonwealth and United Nations agencies, for instance. Could Vernon Harding tell us something about that?

Gp Capt Vernon Harding. Our survey work was an extremely important element of PR9 operations and we participated in a variety of joint programmes. You specifically asked about 'civilian' mapping, but much of it was carried out for the benefit of the military – who could impose appropriate overlays on the basic terrain information. This is all a bit passé, of course – today there are other ways of making maps – and, with the retirement of the PR9, the RAF no longer has any survey cameras. The obvious solution is to use satellites. I am no expert in this field, but I do know that there are some aspects of survey work that satellite imagery does not address. Another problem with satellites is the availability of imagery – the Americans have them, of course, and I believe that some are operated by civilian companies and anyone can buy satellite imagery fairly readily via the internet, although I'm not sure about the degree of resolution that can obtained commercially. To be honest, I am no longer up to speed with the current state of play regarding survey work but I would guess that it is an issue, not so much for the military, because alternative sources are available, but for the Government because UK Ltd is no longer able to support joint or co-operative programmes to which we used to make a major contribution.

Air Mshl Sir Michael Simmons. I just wanted to amplify something that Chris Pocock said. I had the privilege of flying Canberras with No 51 Sqn for two years in the mid-1960s. We operated both by day and by night and when we were flying close to the Warsaw Pact's borders we were not just trying to stimulate the radars on the ground; we were also hoping to provoke Warsaw Pact fighters into using their airborne radars in order to come and have a look at us – which they frequently did, and it was quite an exciting moment when one of them went flashing past. One final point – our Canberras had the BLUE

A Canberra B6(Mod) of No 51 Sqn passing through Luqa in 1966. Note the BLUE SHADOW aerial on the side of the forward fuselage. Its location on the starboard side meant that, to be of much use, one had to fly around the Mediterranean anti-clockwise or 'left hand down'. (MAP)

SHADOW sideways looking radar that was mentioned this morning, but it only looked to starboard, so, if you flew around the Mediterranean, for instance, it only worked if you did it anticlockwise.

David Bale. I was at Labuan in 1958 when Canberras regularly staged through on their way to Australia. Were they going to be converted into drones once they got there?

Fairclough. No. All the conversions were done in the UK – by Shorts.

Jefford. I think that the Canberras passing through Labuan may well have been drones that had already been converted by Shorts and were being ferried down to Australia. The fact that they could be flown without a pilot, didn't mean that they couldn't still be flown with one, of course, so I'm guessing ferries. The timing is about right – late 1950s.

John Stubbington. I have spent most of the last ten years or so working on what could be called 'the future C4ISTAR requirement', but I have a background in intelligence, including No 51 Sqn. With reference to Vernon Harding's observations, I agree there are indeed many alternative sources that can provide information. The problem with not having a capability of your own, however, is that one lacks executive authority over those other sources. When you have a

pressing need to see something, this can be difficult and I have to say that the Americans in particular – and it is the Americans, of course, who control many of the available systems – have their own priorities and, unfortunately, these do not necessarily always coincide with ours.

Ian Strachan. I was a test pilot at Boscombe Down for many years and I can offer a few thoughts on the PR9. I was concerned with handling issues, rather than the equipment fit, of course, but I do remember flying a PR9 trial that reached 65,000 feet. It was all to do with some classified black box – probably one of the pieces of kit that Chris Pocock spoke of – but I knew nothing of that; I was merely the chauffeur.

Because of the uprated engines, there was obviously an aggravated potential asymmetric problem with the PR9 and the answer to that one was simple – you took off with 90% power and only wound it up to 100% when you got to safety speed which was, I think, 180 knots. That may sound a little odd on a military aircraft, but it is actually what happens routinely in civil aviation on just about every take off.

As to the tailplane runaways, I think that Boscombe's view on this was fairly simple. Some of you may have heard of Flt Lt Ron Ledwidge AFC. He got his AFC for ejecting from a Canberra that had a nose-up runaway – not for the ejection, of course, so much as for his efforts in pushing his navigator out of the door with his foot while the aeroplane was pulling about 4G! The solution, as I understand it from the Boscombe people, was to introduce double-pole wiring to the tailplane actuator in place of the previous single-pole wiring, so that a single fault could no longer cause a runaway. But, as was said this morning, the speed of the actuator was also reduced, as was the range of travel, because the original Canberras had an excessive amount of tailplane movement available. Does anyone remember the occasional trim check flights that we used to do? The object of that exercise was to ensure that the tailplane limits did not exceed the flight limits.

Jefford. I recall an occasional exercise that I used to log as a '2125 air test'. They were very short trips involving, as I remember it, accelerating to about 450 knots and then winding on as much nose-up, (or was it -down?) trim as you could hold at that speed and then flying it back and landing with the trim left at that setting. Having thus established what the pilot could cope with in the event of a runaway,

the groundcrew then did what was necessary to adjust the mechanical stop that prevented the tailplane moving beyond that point.

> (For the record, the '2125' referred to Canberra Mod 2125 from which the following is extracted: 'This modification is introduced to overcome the results of tailplane actuator overrun or runaways. A modified tailplane actuator with restricted travel is fitted, the elevator spring tab is given an initial setting of 12½° 'up' and the elevator trailing edge strips are adjusted to 'trim out' the elevator stick force at 450 knots. This enables the pilot to maintain control of the aircraft, under any flight condition within service limits, should the actuator have reached the full aircraft 'nose down' position – that is, with the actuator against its mechanical stop and the tailplane leading edge 'up'. In the course of embodiment, an average of three short flights by an experienced service pilot, will be necessary to establish the trimmed condition at 450 knots.' **Ed**)

Gp Capt Jock Heron. The classic Canberra's cockpit was criticised until we got the Mk 8 and yet the American Martin company introduced the tandem-seat clamshell-opening canopy on the B-57B way ahead of the B(I)8 coming into service. Was there any co-operation between the Warton team and Martins in an attempt to harmonise their efforts regarding crew accommodation?

Fairclough. In point of fact, the Americans were actually exploiting work done by English Electric in an earlier design exercise that we had carried out with a view to improving the British Canberra. We called it the P4 project. By then, however, the Ministry had already paid for the basic design (which, of course, had been based on the use of a large radar) and they weren't going to pay again. It was as simple as that. That's why it wasn't taken up. By this time, of course, we had already built and flown a lot of Canberras – to a degree, the Americans were able to take a fresh look and they incorporated a number of minor changes and, of course, the major one of the tandem two-seat cockpit. If English Electric had done the aircraft again, they would certainly have done the same thing but the Ministry just wasn't interested.

Jefford. I had a ride in the tandem cockpit of a B-57B during a

squadron exchange. We had not long been airborne before I smelled smoke in the cockpit. I alerted the driver, who initially showed an appropriately reassuring degree of concern – but then he said 'Do you suppose it's this?' and held up a big fat cigar! A quite different air force, you see.

Knight. There must be some QFIs in the room. I have a question for them. Andrew Brookes referred to the sad loss of a Station Commander at Wyton while doing asymmetric training. It was a question that cropped up repeatedly in crew rooms – do you lose more people practising asymmetric than you save following real engine failures?

Air Cdre Phil Wilkinson. I would agree that that the assumption is that we probably have caused rather more accidents than we needed to. But, as the QFI on No 85 Sqn, and as Andy Brookes was saying, we did have a number of young chaps who were needing a bit of maturing. They weren't necessarily very good, therefore, and they did need quite careful management. We did do asymmetric training, and it was done with great care, and I probably did rather more 'engine failures on take off' than was good for anybody. It was with some joy, therefore, that when I eventually had a real engine failure on take off – off the short runway (although they are all short at West Raynham) – with a full fuel load including, unusually, a bomb bay tank, it happened right in that gap before safety speed. I think that it was only by virtue of my having had endless practice that we got away with it. It was actually an explosion followed by fire, not just an engine running down, so the asymmetric problem was aggravated by the drag caused by bits of damaged wing. The only reason that I, and the nav, didn't abandon the aeroplane, which we would have been fully justified in doing, was that we had a corporal armourer in the right hand seat. At one stage, as we were approaching the coast – so we were twelve or thirteen miles from the runway and still only at 800 feet – I glanced over my shoulder and saw our corporal's huge eyes staring out between the top of his oxygen mask and his visor, and I just knew that he wouldn't get out. So we stuck with it and eventually landed safely at Marham. So – for me, at least – practice saved an aeroplane. It does need to be done carefully, however – I remember that the exercise as originally taught at Bassingbourn involved actually

closing the HP cock, which effectively converted a practice engine failure into a real one! Thankfully, they soon put a stop to that. But, in my view, asymmetric practice was worth doing.

Roland White. Could I ask Chris Pocock and Group Captain Harding why American commanders expressed a preference for the PR9? What did the PR9 offer that they couldn't provide for themselves?

Harding. I think our exploitation of the 'take' was very good, as it has been for many years, and they appreciated that. But it was probably the wide variety of sensors that we had on board, which meant that there were very few targets that we couldn't take on. In addition, the quality of the later sensor fit really was excellent. The PR9 was simply very good.

Chris Pocock. Assuming that we are talking about Iraq and Afghanistan, for imaging, a U-2 can carry either an electro-optical (EO) sensor, or a radar imaging sensor. But it's an either/or situation; you can't do both, because it involves interchangeable noses – and if you opt for the radar nose, it still requires a number of electronic boxes that are housed in a bay behind the pilot, which precludes carrying the synoptic panoramic camera. The Canberra could carry, as standard, a wider variety of imaging sensors.

Who? Where? When?

SUEZ – A SQUADRON COMMANDER'S VIEWPOINT

Air Vice-Marshal Paul Mallorie
(OC 139 Sqn at the time}

This is, essentially, a personal, narrow view of events, from one who was at the time at the bottom of the ant-heap. I was blissfully unaware of what most of you have heard so far.[1] In that I was apparently at one with my commanders, but I can claim a significantly greater depth of ignorance!

Events leading up to the Suez affair for No 139 Sqn began in October 1955, some ten-and-a-half months before the event. In that month, the Canberra B6 was cleared for the first time to drop 4.5" parachute flares. The aircraft was already cleared to drop 250 lb target indicators, and the role of the squadron at Suez was to be target marking – providing the aiming point for main force Canberra and Valiant crews and, in the event, indicating the dropping zone for parachute forces near Port Said.

In December 1955, the squadron was a main force Canberra unit. In the face of the current threat at that time we were trained for high-level bombing using G-H as a navigating and aiming system. Unlike the rest of the Canberra force, except for No 109 Sqn, we had no visual bombing capability; the bomb-aimer's position had been taken out and replaced by a sideways-looking radar called BLUE SHADOW, which gave the navigator a print-out of radar returns at 90^{O} to the right of the aircraft up to a distance, I think, of about 60 miles, depending on the height. We had no operational directives on the use of this equipment, but presumed that all would be revealed when necessary, and we used the equipment partly because we had ground crew who were trained to service it and partly because it was quite fun to use.

No 139 Sqn had inherited, from its wartime Mosquito forebears, a low-level, shallow-dive target-marking role. That had regressed over the years since the war to occasional visits to the range at Wainfleet by day, and occasionally by night. At night it was well lit and we dropped details of practice bombs from the theoretical 30^{o} dive. In practice we found that the steeper you went, the better the results and we had no bombsights and were just fortunate there were no casualties. The navigation problem was one of distinguishing between the lights of

WT369, one of the Canberra B6s of No 139 Sqn which flew on Op MUSKETEER; note the prominent BLUE SHADOW aerial. (MAP)

the range, and those of *The Prussian Queen*, which was a nearby pub which had unwisely invested in a set of floodlights!

In the first months of 1956, the main task for the squadron was to improve its G-H results and to qualify crews at increasing altitude. In March, 1956, a detachment was flown to Libya to devise a low-level target-illumination and marking technique. On our own initiative we tried out low-level BLUE SHADOW navigation as a means of reaching targets and, as I recall, we had no operational or intelligence staff guidance and were left entirely to our own devices. Fortunately, we had a supernumerary squadron leader, Terry Kearns, who had wartime marking experience. But years had passed since the end of the war, and I don't think it was realised how operationally naïve we were. For the short trial we had, we were more concerned with the technical problems of lighting a target in sufficient time to lay down markers, than with problems of our own vulnerability. Our trials were curtailed (they unfortunately interrupted the Easter weekend) but we did develop a procedure for a technique involving two illuminating and two marking aircraft, and that technique was modified in August when mixed loads of flares and target indicators were approved and four aircraft in the marking team then each carried eight flares and two target indicators.

Navigation was a problem, and it was decided by higher authority to add a third crew member to assist with low-level navigation – essentially map-reading – and to improve our flexibility the bombsight

was reinstalled and some training was done in visual bombing at medium altitude. The third crew member had to sit on the jump seat alongside the pilot, wearing one of those harnesses and, somewhere down in the rubbish, there was a parachute that he was supposed to clip on. In the meantime, life on the squadron continued. In April we took part in a massed fly-past for the benefit of Messrs Bulganin and Khrushchev, and in July a similar exercise on the occasion of Her Majesty the Queen's visit to the Royal Air Force at Marham. In August, there was a full-scale exercise when we acted as markers for the main force, hence the complaints that we were disturbing the ducks. We were assisted by a single marker, dropped from high altitude by a Valiant using its 'highly sophisticated equipment', but found that the lack of this equipment made this more of a distraction than an assistance.

About this time, we provided training for No 18 Sqn, which was then under Squadron Leader Alan Chamberlain, which converted to the marker role for the Suez operation. In October, as the political tension was building up, half of the squadron and all of its ground crew were in Malta on exercises which included taking-off with full bomb loads and fuel, as training as a main force squadron. At the end of this detachment we were on our way home when we were ordered to Cyprus. At Cyprus, we were finally brought up to full strength with twelve-aircraft and fourteen three-man crews, compared to the nine aircraft and a dozen two-man crews that we had been a year before. In Cyprus, during the twelve days before operations began, the last aircrew members joined the squadron and the ground crew was brought up from our normal sixty to 145. So we had a 75% increase in aircrew and 140% increase in groundcrew. We then had aircrews who had been drafted in from five squadrons and a supporting groundcrew hurriedly assembled from four different stations. As Squadron Commander, I was concerned about the lack of training for the newly-formed aircrews and the unknown capability of many of the groundcrew.

On 29 or 30 October we received our first intelligence briefing. I would like to emphasise that we had no briefing or consideration of defences when we were developing the marking technique which was about to be put to the test. Intelligence material, certainly at our level, was surprisingly sparse; we had very dim, rather foggy, pictures of

airfields. The initial operations were planned, and then delayed one day. The following night, as the lead aircraft (and for that particular target it was Flight Lieutenant John Slater) was about to leave dispersal when there was a hammering on his aircraft door, which was opened and he was informed that his target had been changed, as you've already heard.[1] He was told then to attack Almaza, rather than Cairo West. It was just fortunate that Almaza was marked on his map, as the main force was already en route from Malta to Cyprus. Curiously, the markers would take off from Cyprus after the main force had gone, partly because we were flying low level and we didn't have to climb up and form up; hence the motto, 'I must hurry and catch up with them, for I am their leader!' On that occasion, the revised target was attacked successfully and, fortunately, air-to-air communications worked well – and there was no opposition.

The squadron operated between 31 October and 5 November. A number of airfields were marked for night attack, and on one occasion, the second attack on Luxor, at last light. On that occasion the marker aircraft carried a mixed load of target indicators and 1,000 lb bombs which were proximity fused. I'm sure that Boscombe knew nothing about that. Having dive-bombed with Target Indicators (TI) in the last light, we were supposed then to see the raid through and add our contribution of straight and level attacks with the thousand pounders. By that time, the gyros were completely toppled, the navigators confused and the bombsights useless. So we made dive-bombing attacks on the parked 'Beagle' aircraft (ie Il-28s) which were there, with high-explosives.

There had been some over-provision of marker capability so the squadron provided crews and aircraft from time to time to augment the main force. The last squadron operation was marking the Suez dropping zone near Port Said on 5 November. Thereafter we flew on local training at low intensity until we returned to base on 23 December, just in time for Christmas. During this period one aircraft, which had collected a bullet hole during the operation, was to be flown home by a ferry crew. Shortly after taking off it returned to Nicosia on one engine and crashed on landing; regrettably there were no survivors.

By way of comment. The experience that I relate, of No 139 Sqn, was far from typical. Most squadrons maintained their personnel and

performed, more or less, in the role for which they had been trained, apart from No 18 Sqn which retained its personnel but learnt the new technique of marking in a fairly short time. At the time I was, and in retrospect I remain, astonished at the rather casual way we were left to develop the marking system which was suitable for Canberra aircraft but without any high-level guidance which I can recall, apart from clearance to drop armaments. I remain surprised at the way in which the squadron was able to absorb, without serious difficulty, new crew members and groundcrew to within a few days of flying operational sorties. Indeed the development of the technique and the re-organisation of the squadron appeared to me then as slightly haphazard. Yet there must have been sound long-range contingency planning to clear the aircraft to drop flares in the first place ten-and-a-half months *before* Suez, and to ship the flares and markers needed for the trial experiments in North Africa nine months before the event.

A note on morale. Morale rose with the pace of work and the opportunity which came to exercise initiative. It then fell with the uncertainty and apparent pointlessness of the long delay between the end of operations and the return home. To a few, certainly, and perhaps to many more within the squadron, the Suez affair appeared at the time as being politically questionable, but this was not generally discussed, not often mentioned in the normal way, as we had the deeply ingrained tradition that we were part of an apolitical Service. It was assumed that there were intelligent and national considerations of which we were not aware. The sight of the Soviet military aircraft and the other equipment which was to be seen in Egypt once the operation began seemed to confirm that view. That, then, was the Suez operation from this Squadron Commander's point of view.

[1] The reference is to earlier papers read at a seminar devoted to the Suez campaign – see *Proceedings 3* and *Journal 39.* **Ed**.

RAF GERMANY – OFFENSIVE OPERATIONS – STRIKE

Air Commodore P J Wilkinson

After National Service as a RAF officer, Phil Wilkinson graduated from Oxford and rejoined the Service in 1961. He flew the Canberra with No 14 Sqn in Germany and again with No 85 Sqn, later commanding No 237 OCU (Buccaneers), and is a graduate of the French and US Air Force War Colleges. He has served at the MOD and at SHAPE and commanded RAF Gatow in Berlin; his final appointment being Defence and Air Attaché in Moscow.

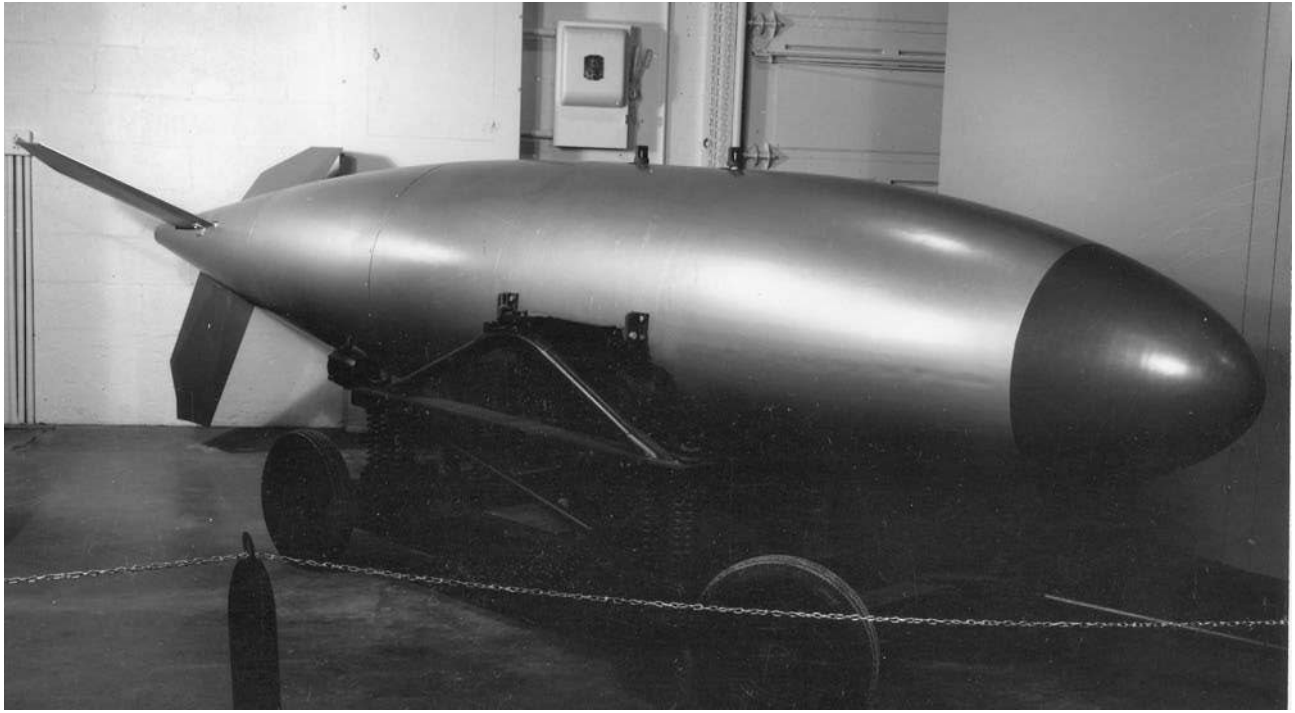
On 1 January 1958, No 88 Squadron's Wildenrath-based Canberra B(I)8s and their two-man crews were formally committed to the nuclear strike role, using a 'low altitude bombing system' (LABS) for the toss delivery of their US-provided Mk 7 1,650 lb weapon.

The Memorandum accompanying the 1958-1959 Air Estimates noted that:

> 'Canberras of 2nd Tactical Air Force and Bomber Command are being given nuclear capability.'

With the assumption of the nuclear role, the squadron gave up its previously assigned tasks of reconnaissance, army co-operation and close air support. It will come as no real surprise to today's generation, brought up on the 'management of change', to hear that as early as July 1958, the squadron had already been re-roled for conventional shallow dive bombing. Still less a surprise will be to hear that this was all in aid of a Middle East crisis, this time following the assassination of King Faisal of Iraq. But the moment passed, and the squadron settled to a routine of training and practice attacks that characterised the next forty years, until, on 1 April 1998, the Operational Record Book of No 88 Squadron's successor (No 14 Squadron) notes in a single sentence that '..the WE177 weapon has been withdrawn from service and the squadron is no longer declared in the strike role.'

I can only give a brief survey of the operational and domestic content of those forty years of service in Germany. Much of what was



The US Mk 7 (Project E) Weapon

established in the first years of the nuclear role, however, was continued in many ways almost unchanged until the completion, and I therefore feel it possible to concentrate much of my presentation on the period when I was involved – at a very junior level – in all the activities of a nuclear strike squadron with Canberras as the delivery vehicle.

In that context, I shall first cover in outline the reason for a build-up of Canberras in Germany in the mid-1950s. The fundamental reason was the build-up of Canberras in the UK, where the rapid rise to 24 bomber squadrons with 10 aircraft each was causing headaches over where to put them, especially since the parallel programme of airfield upgrades to accommodate the, also expanding, V-Force had taken away most of the remaining options. There was a brief look at bringing up to what was known as Class 2 standard (that is to say, with a 9,500-foot runway) one or other of a couple of Training Command airfields – Worksop or Full Sutton – but at the end of a very short period of briefing and Air Force Board consideration, a completely different option was offered by AMSO to CAS in March 1954, which reassured him, as the Minute of the day records, that:

> '...since the runways and taxy-tracks are of the requisite LCN, we see no reason why four Canberra squadrons should not form at, say, Ahlhorn, beginning 1 April of this year.'

CAS approved this interestingly flexible recommendation on 29 March; PUS gave his seal of approval on 30 March; AMSO was told to get on and fix it. CAS rounded off a good week's work by directing that CinCs Bomber Command and 2nd TAF should have their Directives reviewed to make it clear that these four squadrons were still part of Bomber Command, under operational control, with HQ 2nd TAF their administrative masters. The squadrons thus remained allocated to SACEUR as part of the UK's declared light bomber force. Despite the notable speed of decision-making, the 1 April target was not quite met. The first unit to arrive was No 149 Sqn, drawn fully-formed from the Cottesmore Wing, and planned to arrive at Gütersloh. Again, no surprise to hear that runway repairs meant that the squadron actually arrived at the originally suggested aiming point – Ahlhorn – on 25 August 1954. They moved on to Gütersloh a couple of weeks later. The remainder of the force –

formed as No 551 Wing – assembled quickly after that, with the squadrons forming *in situ*: No 102 on 30 October, No 103 on 30 November, and No 104 on 15 March 1955. Their subsequent existence was in the classical Bomber Command mode, with concentration on academic medium and high-level bombing using UK and Germany ranges leading to crew classification in the various visual and blind bombing modes, together with exercises and competitions. This pattern continued until the squadrons' disbandment and withdrawal in August 1956.

By then the original plan for the deployment to Germany of Canberra PR and NI (night intruder) squadrons had come to fruition. The PR echelon had in fact already come into being (originally with four squadrons) before No 551 Wing disappeared. The bomber/intruder squadrons were a little further back, and their designation was changing en-route – from night intruder, through intruder, to simply interdictor. Thus the nomenclature of the aircraft, the B(I)6 of No 213 Squadron and the B(I)8 of the other three.

No 213 Sqn was the first to form – at Ahlhorn in July 1955 – but it was not until March 1956 that they received their B(I)6s. By then, No 88 Sqn was up and running at Wildenrath, and a year later – in February 1957 – its aircraft were being fed into the modification programme to install the Honeywell equipments that were the core of the LABS attack system. Political and technical problems complicated the progress to full operational status (despite the February 1958 statement noting the Canberras' capability), not least the arrangements that had to be made for storage of the US weapon, and for separate accommodation for its technical support team, and for the security force who guarded it. But by September 1959, all four squadrons were each maintaining a single aircraft on QRA (increasing to two in 1962), with a requirement to be airborne within 15 minutes of the alert. The two crews were accompanied in the wired-off compound by a USAF Alert Duty Officer (usually a lieutenant) who provided half of the two-man concept that governed all access to and handling of the weapon. The USAF air policemen similarly provided half of the security cordon, sharing the task with RAF Police, both armed.

The concept of operations was straightforward: the QRA aircraft would provide immediate response to SACEUR's call for strikes, and would be able to do that either individually or as the vanguard of a

Aircraft and equipment inside No 14 Sqn's hangar at Wildenrath in 1965, showing the training ballistic 1,650 lb 'shape' store on a trolley in front of the middle aircraft

fully-generated force that had benefited from a period of alert state development allowing time for the weapon loading and crew preparation to make the whole squadron available for selective release against targets on SACEUR's strike programme. Given the Canberra's low-level radius of action – with 24,000 lbs of fuel, the B(I)8 could cover 600 nautical miles out and back in a straight line at 420 knots (365 till the wing-tip tanks were jettisoned, or at least that is what the Pilot's Notes said) to dry tanks – the targets were almost all confined to tactical airfields in one or other of the Warsaw Pact satellite countries. The primary QRA target was the one exhaustively studied by crews in regular sessions in the Operations Wing vault – the day before a QRA duty started was a mandatory study day; other sessions were programmed in with all the other routine training requirements. The visit of the Weapons Standardisation Team from the Armament Support Unit at Wittering was a regular challenge to the memory glands. So it remained until the end of the strike role earlier this year (*ie 1998.* **Ed**). And of course TACEVAL, and all the lower level alert and readiness tests, kept the edge permanently sharpened. With half the squadron assigned to each of the two QRA targets, it was never less than once a fortnight that a crew had a 24-hour shift in the compound. The weekend duty, covering 48 hours, came up six or seven times a year. The junior combat-ready crews could, of course, expect to have the several days of the Christmas break for their personal enjoyment! But that was the ground based theory. What of the flying training for the role?

In three years on 14 Squadron I fell just nine short of 1,000 hours. The role of the squadron was totally focused on low-level operation. Hence the vast majority of sorties were two-hour excursions around a relatively-unrestricted German airspace, including first-run attacks at the main ranges and academic practice-bomb sessions, almost invariably at Nordhorn. The other continental ranges were used – in Belgium, the Netherlands, and (occasionally) France – and regular runs were made to all the UK targets, but it will be the features and time checks along the LABS run to Nordhorn target that are probably still etched on the memories of anyone who served on one of the Germany squadrons of the period. The attack was a trifle mechanical, and involved pre-computing release parameters prior to take-off, which were set by the navigator on the release computer at the rear of

the aircraft before clambering aboard. In-flight adjustments were possible but only by over-riding the cues that the pilot followed to initiate the pull-up. For both the standard forward toss and the reversionary ‘over-the-shoulder’ attacks, the approach speed was calculated (from Met data) to give an Equivalent Air Speed of 434 knots; the pull-up was triggered by pickling the bomb release button at the final IP and waiting until the computer-driven timer ran down and gave the cue. On a manual ILS-type instrument the driver then gathered the horizontal needle back up to the centre and maintained the vertical needle vertical (hence the Hornchurch/Biggin Hill aptitude tests!) which meant a modest application of +3.4g. Bomb release was also signalled to the driver and the mildly aerobatic escape recovery from 4,000+ feet back to the 250 feet approach height was carried out ready for another run in the academic pattern.

Proficiency in this manoeuvre was of fundamental importance, both for consistent weapon accuracy and for survival. Hence the regular detachments to better weather areas with range facilities on the doorstep, for intensive work-up of new crews and consolidation for the more experienced. Thus, in my second month in the squadron, three crews and two aircraft left the murk of North Germany in December and worked for a five-day period at RAF Idris, 20 miles south of Tripoli, and with Tarhuna range just minutes off the end of the runway. Flying started at 0600 or asap after sunrise and was as intensive as the ramp heat and the cockpit air conditioning would allow the ground and air crew to achieve. A typical day’s flying was, therefore, a four-bomb detail, with the first being an FRA, returning to Idris after perhaps only 25 minutes for an engines-running re-arm with four more 25 lb practice bombs on the wing pylons ready for the same again. That would be repeated twice more before lunchtime. Each crew would thus drop 24 bombs a day; 70+ per crew per detachment. The third crew split; one man to the range as RSO (Range Safety Officer), the other to manage the ground activities at Idris and keep the orange juice cool for the quick turn-rounds.

Range work was usually built-in to the exercise sorties flown within the overall pattern of NATO training: major ATAF-wide air defence events such as BLUE MOON or COLD FIRE; smaller-scale air defence exercises such as BROWN FALCON over Denmark; HIGHWOOD, and the smaller-scale PRIORY, versus the UK Air

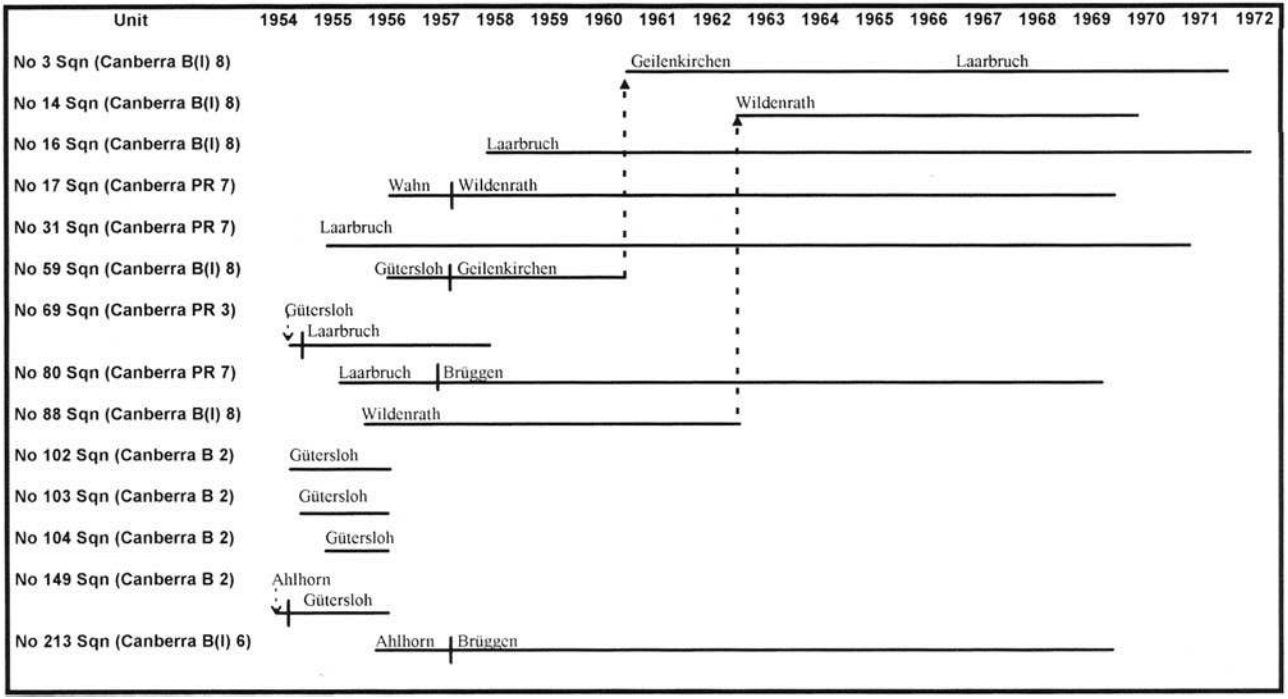
Canberra B(I)8 in the conventional role fit

Defence Region; ROUND ROBIN, later AMPLE GAIN, to check cross-servicing facilities at other NATO bases; even DATEX – for the benefit of the French; and, with due political correctness, CLOGGY EMOTION to exercise the Dutch Forward Air Controllers. These, and many others, remained fixed points in authorisation sheets and log books until this year for the strike squadrons, and will last into the foreseeable future.

The versatility of the Canberra, and its replacements – Phantom, Jaguar, Buccaneer, and Tornado – meant, inevitably, that it would be asked to do more than hold alert for nuclear response and the associated training. Thus the regular reversion to conventional fit – with the 4 × 20mm gun pack fitted in the bomb bay and all conventional weapon options available from wing pylons and the remaining forward sector of the bomb bay. Operational actuality was regularly the cause: No 59 Sqn went to British Honduras (Belize) in 1958 to discourage Guatemalan advances; Nos 213 and 88 Sqns deployed to the Gulf in mid-1961 for an early version of the Kuwait crisis; in 1963 all RAF Germany Canberra squadrons were rotating through Kuantan in Malaya to reinforce the UK response to the Indonesian Confrontation.

To remain at least semi-prepared for these short-notice excursions, all Canberra squadrons had at least one three-week detachment to (usually) Cyprus, in the conventional fit – Exercise CITRUS GROVE. Dive bombing was against the raft targets in Episkopi Bay; strafe was at Larnaca, against targets on the salt marsh that now supports the international airport.

The highly agreeable solution to the need for readiness for these exotic deployments was simply to practise exotic deployments: this was Exercise LONE RANGER. There was hardly a day on any of the squadrons when there was not a singleton aircraft and crew somewhere down the Southern or Extended Southern Ranger route; via Cyprus, the Gulf (Sharjah, Bahrain, Masirah, or even Djibouti), through Aden and on to Nairobi and (then) Salisbury. Return routes often staged via Tehran and then had extended low-level sectors across Iran before climbing out to overfly Turkey back into Cyprus. Sometimes, too, the last homeward stage would take in some Libyan desert low-level flying, using El Adem as a refuel/re-arming point, prior to some range runs or an attempt to find the wreck of the 'Lady



Deployment of RAF Canberras (all roles) in Germany, 1954-72

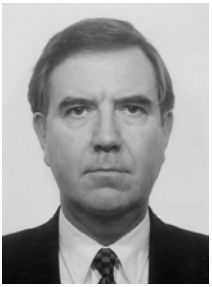
be Good' B-24 before climbing out on fuel minima.

In mid-1966 there had been a change of strike profile, the Mk 7 LABS weapon delivery being replaced by lay-down with a US Mk 43 2,100 1b weapon. Work-up had gone well and the CEP for strike had been radically improved from LABS scores of around 200 yards to lay down scores of 60 to 80 feet. After a short pause from QRA while ground procedures and practice weapon loading had been exercised, the squadron resumed QRA with the new weapon on 4 November. Just to prove the point, HQ RAF Germany and the Station Commander called us out for three alert and generation exercises in the next ten days. Very percipient, since the NATO TACEVAL team arrived on 14 November. The squadron received an across-the-board rating of '1' – the first for a strike unit in RAF Germany. In June 1967 the AFCENT Tactical Weapons Meet saw the squadron just beaten by a Canadian F-104 team; the USAFE F-4Es were a long way behind. A 14 Squadron crew won the night strike competition by a wide margin. Given that the navigation equipment fit still consisted of just a steam-driven Doppler (BLUE SILK) and the Decca Mk 8 (conceived as a navigation system for shipping, and quite good at that sort of speed!), the abilities of the navigator fraternity were remarkable. Their working environment – in the B(I)8 – was testing to say the least: 90% of the time stretched out in the nose map-reading, contorting back at regular intervals to update the navigation equipment from the most recent visual fix. There was no ejection seat for him, just the normal entry/exit hatch and a chest parachute. My own partner was 6'1" tall and as solid as you could wish (very Irish, too). The Aviation Medicine people were concerned! But – especially if you were very small – escape was possible. On 11 June 1968 Flt Lt Stu Stringer decided to leave after his driver had had an airborne coming-together with another of the squadron's aircraft. The driver ejected successfully at just 200 feet, no doubt still astonished at seeing Stu roll up and dive for the ground some 800 feet earlier. All good things come to an end and – for the 18 crews still keeping 14 Squadron at full strength until the last moment – on 31 May 1970 14 Squadron came off state as a Canberra strike squadron.

Note: The original article (see *The RAF in Germany*) continues the tale until the eventual withdrawal of the WE177, but that section has not been reproduced here as it post-dates the Canberra era. **Ed**

CYPRUS – CANBERRAS

Wg Cdr Barry Dove



Barry Dove joined the RAF in 1961 and trained as a navigator. His flying experience involved Canberras in Cyprus, FAA and RAF Buccaneers and, as OC 15 Sqn, Tornados. Ground tours included HQ 1 Gp, HQ RAF Germany, HQ AAFCE, MOD, the Cabinet Office and with the DS at Bracknell; his final appointment before leaving the Service in 1997 was with the Defence Export Services Organisation.

The basing of Canberras in Cyprus started in 1956 when No 13 Sqn, having moved from Egypt in January, re-equipped with the PR7 in May of that year. The squadron had little time to settle in before it was back in action over the skies of its former home during the Suez campaign. Several aircraft sustained damage due to enemy fire and one was lost. On 6 November 1956, the last day of the Suez campaign, Canberra WH799 took off from Akrotiri for a photo-recce sortie. The purpose of the mission was to monitor a reported build up of Soviet supplied combat aircraft in Syria. Unfortunately WH799 was shot down by a Syrian Air Force Meteor F8 supplied by Britain. The surviving crew members were repatriated after treatment in Beirut Military Hospital. No 13 Sqn replaced its PR7s with PR9s in 1961 and in 1965 took its aircraft to Malta.

Although No 13 Sqn had been the first Canberra unit to be based on Cyprus, I shall focus on those that flew the bomber version from the island between 1957 and 1969. My personal experience is of the period 1963-66 when, on my first tour, I was a navigator on No 249 (Gold Coast) Sqn. My presentation will discuss: the build up of the Canberra Wing; the aircraft's roles, equipment, weapons, training and operations; some significant occurrences; and the final years leading to disbandment in 1969.

In 1955 it fell to Britain, and in particular the Royal Air Force, to provide a form of armed insurance against any aggression aimed at the Baghdad Pact nations. The area to be defended in an emergency was quite beyond the operational scope of the Venom, the RAF's principal

attack aircraft in the Middle East at the time. It was therefore decided in 1956 to re-equip four Venom squadrons with the Canberra and to base them on Cyprus under the operational control of Air Headquarters Levant. After a delay, due to the Suez campaign, when seven UK-based Canberra squadrons operated from Cyprus, the re-equipment got underway. No 32 Sqn's Canberra B2s arrived in January 1957 to be followed by No 73 Sqn's in May and, by the end of the year, the other two units, Nos 6 and 249 Sqns, had also traded-in their Venoms for Canberras, in June and September, respectively.

Unlike previous re-equipment exercises, when the pilots and groundcrew had simply converted to a new type, this time the process involved complete replacement of all aircrews and many of the groundcrew as well. Each squadron had an establishment of eight aircraft and ten crews. The technical personnel had a variable amount of experience; on No 249 Sqn, for example, one-third were from the original unit; one-third came from other Canberra units on Cyprus, with the rest being posted-in direct from the UK. Of the total, only half were specifically Canberra-trained.

Life was fairly rugged in those early days as Akrotiri still lacked permanent buildings and most personnel were accommodated under canvas. No 249 Sqn was particularly unlucky and had been given a piece of rocky ground on which to erect its tents, borrowing a pneumatic drill from the Royal Engineers to help in the task. It was not until 1959-60 that permanent air traffic control and air operations facilities for the multi-squadron Flying Wing were ready for occupation, permitting the tents, caravans and huts to be abandoned.

For the newly arrived squadrons there was a considerable gap to bridge between low-level ground attack and medium and high-level bombing and they trained hard to achieve the necessary combat-ready status. There were frequent practice bombing sorties and navexes over Libya, deployments to RAF Stations in the Persian Gulf and to air bases in Turkey and Iran, along with detachments to the staging posts at Habbaniya and Basrah in Iraq. One of No 249 Sqn's first tasks was to send a Canberra to Nairobi to collect the squadron's silver and other property. Staging via El Adem and Khartoum, the aircraft returned with the hoard four days later, having been liberally decorated with mini-elephants – the squadron badge is a running elephant – courtesy of the ground staff at Eastleigh.

A Canberra B6 of No 6 Sqn. (MAP)

In the last weeks of 1959 Nos 6 and 249 Sqns were re-equipped with ex-Bomber Command Canberra B6s; the other two squadrons retaining their Mk 2s for the time being. Training continued, the Canberras carrying out frequent 'bombexes' in which they attacked Cyprus from all altitudes to provide interception practice for the visiting Hunter, Javelin and, later, Lightning squadrons from the UK. During long-range navigation training the emphasis was on locating pinpoint targets from medium and low level.

Locally, the years between 1958 and 1960 were dominated by the EOKA campaign for union of Cyprus with Greece. This led to a heightened ground defence posture at Akrotiri due to the terrorist threat. This situation was resolved on 21 September 1960 when Cyprus became an independent republic which, six months later, joined the Commonwealth. Britain, however, retained title to two tracts of land, one encompassing Akrotiri and the other the Army base at Dhekelia, these being designated as Sovereign Base Areas (SBA). Internationally, a chilling reminder of the potential of the Cold War was given in a MEAF memorandum, which suggested that Cyprus would be a prime target in time of war. It read:

> 'In the event of war it is expected that the enemy will have a large, efficient and balanced force capable of striking at RAF Akrotiri by air, land and sea. The station would be a target for the employment of all types of modern weapons, including nuclear missiles. Paratroops could be dropped on or near the airfield by day or night. In the event of local uprisings and internal strife, sabotage and attacks by armed bands, with little or no warning, is to be expected.'

On 1 March 1961 the Near East Air Force (NEAF) was formed with its HQ at Episkopi. It was soon faced with a crisis when, in July, Iraqi troops began making hostile movements towards Kuwait. In response elements drawn from two squadrons of interdictor Canberras (Nos 88 and 213 Sqns) were deployed briefly from Germany to Sharjah in the United Arab Emirates. Meanwhile, in the event of hostilities breaking out, the Akrotiri-based Canberras had also been assigned targets in Iraq. The Kuwait crisis never escalated, however, and the two deployed squadrons soon returned to Germany, although, for a time, No 6 Sqn was held at readiness to reinforce the remaining forces in the Gulf in case the need arose.

Having mentioned the Cold War and treaty obligations it is appropriate to introduce the nuclear weapons issue at this point. In 1956, when plans were being laid to develop Akrotiri as a forward base for V-bomber detachments and a permanent home for Canberras, they included provision for nuclear weapons storage. However, it was the early 1960s before Britain's commitments to the Baghdad Pact led to the permanent deployment of nuclear weapons at Akrotiri, a development which implied a significant change of role for the resident Canberra squadrons. As in the Far East, British planners saw nuclear weapons as the most cost-effective way of contributing to allied defence of the region. However, it was thought that the weapons would be used only in a global war between the Soviet Union and the Western allies. The risk of escalation, if limited nuclear war were to break out in the Middle East, would be far too great to plan for any such conflict. It is worth noting that the British Chiefs of Staff rejected advice in a 1956 report, not long before the Suez crisis, that nuclear weapons should be employed in a limited war against Egypt.

By 1960, facilities were available for sixteen RED BEARDS to be brought to Akrotiri in a crisis and stored temporarily. On 28 November 1961, a permanent facility, the Supplementary Storage Area (SSA) at nearby Cape Gata, became available to hold thirty-two RED BEARDS. These 15KT weapons weighed 1,950 lb apiece and each Canberra could carry one in the bomb bay. Two RAF Regiment squadrons defended the Cape Gata installation as part of their protection of the base. Because of the post-independence SBAs, Akrotiri and Cape Gata were technically on British soil, however, this did not eliminate political sensitivities, as the Cypriot government

under Archbishop Makarios was neither especially pro-British nor a member of CENTO. A British Air Ministry official wrote in 1960 ‘all possible measures should be taken in Cyprus to conceal the arrival and storage of nuclear bombs …. whether they be inert, drill or the real McCoy.’ A few years later a plan of Akrotiri was published in a local newspaper; luckily the SSA was identified as ‘Soldiers and Sailors Accommodation’.

The arrival of Canberra B15s and 16s in 1961 gave the Akrotiri squadrons a nuclear role, which was implicit in their new collective title of the Akrotiri Strike Wing. The B15s were allocated to Nos 32 and 73 Sqns whilst Nos 6 and 249 Sqns received the B16s. Both versions were modified B6 airframes strengthened for low-level operations in general but particularly for the nuclear delivery manoeuvre associated with the Low Altitude Bombing System (LABS). Both aircraft had a crew of three: a pilot, a navigator/plotter and a navigator/observer. The nav/plotter sat behind the pilot in the ‘Black Hole of Calcutta’ with a BLUE SILK Doppler, a Ground Position Indicator (GPI Mk 4A), Rebecca/Eureka range and bearing equipment, a Marconi radio compass, an STR18 HF radio and an ORANGE PUTTER tail warning radar for company. The navigator/observer’s role, lying prone in the nose of the aircraft, was map reading at low-level and operating the bombsight for medium level bombing.

The Mk 15 could carry its crew of three plus one, as it had three ejection seats and an occasional fold-down seat alongside the pilot. The Mk 16 had ejection seats only for the pilot and the nav/plotter, the nav/observer having to make do with the fold-down seat. With no ejection seat the observer relied on a flying suit, which had an integral parachute harness, and a chest parachute that clipped onto two hooks. His escape from the aircraft was via the entrance door which could be opened from the inside by turning a handle at least three and a half turns clockwise.

The third ejection seat had been removed from the Mk 16 to make way for the BLUE SHADOW sideways-looking radar. This new device was not popular with the navigators for several reasons. First, the navigation table had to be folded up to check that the system was working. This obscured the BLUE SILK display and, inevitably, the Doppler would choose that moment to unlock, and thus drive the GPI

One of No 249 Sqn's Canberra B16s displaying its BLUE SHADOW aerial on the starboard side of the forward fuselage, the only external feature that distinguished it from a B 15. (MAP)

read-out off the edge of the chart. Secondly, the radar output was burnt onto specially impregnated paper that had a nasty habit of producing clouds of smoke when it went wrong. Finally, it only looked to starboard, to a range of about 60 miles – consequently, to be of any use, the aircraft had to fly anti-clockwise around the Mediterranean, which meant that we became very familiar with the outline of the southern coast of Crete.

The re-equipment of all four squadrons with B15s and 16s was completed in early 1963 and marked the start of the period during which the Cyprus Wing possessed its greatest potential. The Canberra had a credible low-level strike (ie nuclear) capability, with the LABS delivered RED BEARD, and a wide range of attack (ie conventional) options, employing medium level 1,000 lb bombing, shallow dive bombing and low level rocketing; in addition No 249 Sqn had a target marking role using 4.5-inch parachute flares and target indicators.

Allied to routine weapons training were regular squadron detachments and solo training exercises (known as Lone Rangers) to all points of the compass: west to Malta and Gibraltar, and occasionally the UK; north and east to Turkey, Iran (Tehran), Pakistan, Bahrain (Muharraq), the UAE (Sharjah), Oman (Masirah) and Aden; south and west to El Adem and Idris in Libya or on to Khartoum and Nairobi via the bottom left hand corner of Egypt, known as 'Nasser's Corner'. It is not surprising that at the end of his tour in 1963 a Squadron Commander reported that 'the variety of flying opportunities combined with the holiday atmosphere of Cyprus

at peace added to the enjoyment for all Squadron members and their families.' This is when I actually appeared on the scene, in August 1963, but that had not been the original plan for my future.

Although originally earmarked for the single-navigator Canberra B(I)8 in Germany, my course on No 231 OCU at Bassingbourn was reshuffled to meet the need for a three-man crew for Cyprus. I drew what I thought was the short straw and was posted to No 249 Sqn as a navigator/observer. The nuclear weapons course at the Bomber Command Bombing School (BCBS) at Wittering followed the OCU and, as the observer, I had to learn how to carry out the 'last minute loading' of the RED BEARD. This involved a large flask that contained the central core of the weapon, discreetly referred to as 'the physics package'. The whole thing was not dissimilar to the shape of the Jules Rimet Football World Cup, ie a ball on the end of a pole with a flat bit at the bottom! To get this core from the flask into the weapon, a handle was attached to the base plate; the device was then lifted with great care out of the flask and offered up to the weapon. It was then locked into place and the handle removed. A tricky operation at the best of times but with the well-used equipment at BCBS the odd dummy physics package did occasionally end up on the hangar floor. The procedure was affectionately known as 'playing gynaecologist to an elephant'.

Armed with this invaluable knowledge, I arrived at Nicosia in a British Eagle Britannia early one hot summer morning and thence by RAF 39-seater Bedford coach to Akrotiri ready to enjoy this seemingly idyllic location. However, the peace did not last long and hostilities between Greek and Turkish Cypriots erupted in late December 1963. The UN presence in Cyprus dates from that time, although it was the 1974 troubles that cemented the island's division into a Turkish North and a Greek Cypriot South. The aftermath of December '63 meant that there was a dusk-to-dawn curfew for most of the following year. For us, that was an inconvenience, rather than a real problem. We could, for instance, still travel to the north of the island and enjoy the delights of Kyrenia by day. Despite the continuing UN presence, the curfew had been lifted by 1965 and most of the previous freedoms had been restored. Generally speaking the situation remained that way for the rest of the Canberra era.

Back to 1963 and, with the B15/16 re-equipment complete, the

wing settled into a training and exercise routine that was broadly similar on all four squadrons. The station worked six days a week, mornings only, from 7 am to 1 pm. We flew Monday to Friday, with Saturday mornings devoted to target study, 'last minute loading' practice and lectures on the weapon in preparation for the annual visit by the Weapons Standardisation Team. Crews had targets in the so-called 'soft underbelly' of the Soviet Union but, unlike the Canberras stationed in Germany, there was no QRA. My crew had a target near Tashkent, in Uzbekistan, which would have involved a hi-lo sortie of about 1,500 miles; the planned recovery base was Peshawar, about 600 miles away in Pakistan's North West Frontier Province.

Night flying took place on a fairly regular basis and the crews working day was adjusted accordingly. Most of the local area flying used the weapons ranges at Episkopi Bay and Larnaca. LABS by day, medium level bombing and shallow dive bombing (SDB) by both day and night took place at Episkopi using 25 lb practice bombs. LABS involved pre-computing the release parameters before take-off, these being set by the navigator on the release computer at the rear of the aircraft. Approaching the target at 250 feet, at a pre-determined point the pilot began a 3g pull-up until the bomb was released automatically to be thrown forward by about two miles. To gain maximum possible separation from the weapon before it detonated, the aircraft continued its looping manoeuvre before rolling off the top to recover to low-level heading away from the target. Should the automatics fail, the technique was to proceed to the actual target before starting the manoeuvre, releasing the weapon about 120^{o} into the loop in the so-called 'over-the-shoulder' mode before escaping.

Medium level bombing differed little from the techniques used during WW II; although the bombsight had improved, the same 1,000 lb bombs were in the inventory. Shallow dive-bombing started from a circuit height of 5,000 ft before diving towards the target at 30^{o}. The navigator/plotter called out the heights in the dive down to the release point when the aircraft was recovered for another pass – quite exciting at night.

Low level rocketing was practised on the Larnaca Range and was also an exciting event. From a circuit height of 1,000 ft the aircraft made a descending turn to 100 ft or less and accelerated to 350 kt for the run in. The fixed aiming point was lined up to track over the

ground up to the target and when they coincided the firing button was pressed. Only single rockets were fired on the range but the operational load was two pods with frangible noses, one on each wing weapons station, each carrying thirty-seven 2-inch rockets. Firing a full salvo of seventy-four rockets in this attack profile produced an elliptical pattern of about 1,000 ft by 40 ft and was ideal for attacking lines of unprotected aircraft or vehicles. Following firing the aircraft turned away sharply to avoid ricochet damage as the rockets impacted.

Bombing practice with thousand pounders was carried out on El Adem range in the Libyan Desert. This could be a single aircraft operating from El Adem or a bomber stream from Akrotiri led by No 249 Sqn crews dropping 4.5-inch parachute flares at medium level followed by coloured target indicators in true Pathfinder tradition. Weapons training locally was complemented by regular detachments to El Adem, Idris (for Tarhuna range) and Sharjah (Exercise POTAGE), using Rashid down the coast south of Dubai.

There was involvement with CENTO nations, Iran and Pakistan, through Exercises SHAHBAZ and SHAHIN, and detachments to Tehran and Karachi (Mauripur) provided target practice for the local air defenders. Combined exercises were held to test the squadrons' efficiency in the nuclear and conventional roles. An example of this was Exercise TOTEM, a global alert exercise held in February 1965. Elements of the Akrotiri Wing were required to assume the nuclear role for the first 48 hours of the exercise, with aircrew being brought to various states of readiness until Phase One was completed. During Phase Two the aircraft were dispersed. My own log book shows that on 25 February I flew to Masirah with OC 249 Sqn, Sqn Ldr John Sutton; we returned to Akrotiri, via Tehran, on the 27th.

The Lone Ranger programme provided invaluable experience and taught the crews a great deal about operating alone away from home in some fairly remote parts of the world. Well before satellites and mobile phones allowed communication from almost anywhere, crews simply submitted their flight plans and set off to make use of the many RAF stations and international airports east of Suez. Where possible we took full advantage of what the location had to offer. For example, Malta had smoked hams, Aden duty free electrical goods and cameras, Masirah crayfish tails and swordfish steaks, and Nairobi carved wooden animals. Things did not always go according to plan,

Canberras of No 249 Sqn over Malaya in 1965.

however, and No 6 Sqn lost an aircraft and crew returning from Nairobi. The aircraft suffered a major structural failure and crashed when it flew through an embedded cumulonimbus cloud while descending into Khartoum. Lone Rangers to Nairobi were sensibly suspended for a while, the only downside being that it was my crew's turn next, so I never did sample the delights of that part of the world.

As will have become clear by now, life for the Cyprus Canberra community was never dull, such was the scope of our normal activities and the variety of additional tasks, large and small, that regularly came our way. One of the biggest was in 1964-65 when the Cyprus squadrons replaced the Canberra B(I)8s from Germany that had been rotating through Kuantan for two months at a time as part of the UK's response to the Indonesian Confrontation. Operating from a tented camp on the east coast of Malaya was an entirely new experience for everyone. Apart from the Kuwait crisis of 1961, the Malaysian experience was the closest the Cyprus Canberra Wing ever came to going to war. Aircraft were loaded with 1,000 lb bombs, crews were briefed, issued with pistols and Maria Theresa dollars and put on stand by – but they were never used.

There were several other significant occurrences on the wing during the mid- to late-1960s. No 249 Sqn carried out trials with the

With the imposition of centralised servicing, individual unit markings were replaced by a Strike Wing emblem featuring one of Akrotiri's trademark pink Flamingoes standing in a representation of the local lake while being struck by lightning but, as this picture shows, you can't keep a good squadron down and No 249 Sqn's elephant had reappeared on the fin of this aeroplane, and probably on others too. (MAP)

new Lepus flare at El Adem in September 1964 and it eventually replaced the 4.5-inch flare in 1967. Ground environmental and flying trials with the new nuclear weapon, the WE177, took place in 1964-65 when weapons were loaded and the aircraft taxied around the airfield to monitor temperature and vibration. Instrumented rounds, minus the 'physics package', were flown on a series of sorties nicknamed 'CONFECTIONARY'.

At much the same time, the French AS30 radio-guided air-to-ground missile was added to the B15's weapons inventory. The first squadron firing took place on 20 October 1965 when Fg Off Brian Cable of No 32 Sqn guided a missile to the target at El Adem range. Other innovations included 'pop-up' bombing and trials with the SFOM gun sight and, finally, the dogma of centralised servicing for the wing was introduced at the end of 1966 – but it did not last long. In mid-1968 the runway at Akrotiri was closed for repair and the central servicing force was split into four with each squadron being allocated its own personnel. Morale and serviceability soared and very few sorties were lost over the next four months or so, even though the squadrons spent much time away from Cyprus at a variety of places including Malta, Sharjah and Nicosia.

These were Indian summer times for Akrotiri's Canberras but the end was in sight. It had been the intention to re-equip two of the squadrons with the TSR2 but that project was cancelled in 1965 and the US F-111 was ordered instead. That order was also cancelled, in January 1968, when the Labour Government decided to buy Phantoms and Buccaneers. In the event Akrotiri's Strike Wing was replaced by two squadrons of Vulcans from the UK. The beginning of the end for the Canberra came on 10 January 1969 when a disbandment flypast was held. Shortly afterwards No 6 Sqn left to be re-established at Coningsby with Phantoms. No 32 Sqn was next to go, disbanding on 3 February, followed by No 249 Sqn on the 24th and No 73 Sqn on 3 March.

Sources:

Cull, Brian. *249 At War* (London: Grub Street, 1997).
Jackson, Robert. *Canberra: The Operational Record* (Shrewsbury: Airlife, 1988)
RAF Historical Society Journal 26

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RAF EW TRAINING 1966-94

Wing Commander Dick Turpin

Richard 'Dick' Turpin joined the RAF in 1953, trained as an air signaller in 1963 and flew in Beverleys. Commissioned as an AEO in 1967, he subsequently flew with four Vulcan squadrons; ground appointments included tours at Lyneham, Rheindahlen, Wyton and High Wycombe. After a stint with No 51 Sqn he served at MOD before leaving the Service in 1994. His subsequent involvement in local politics, culminated with six years as Leader of Huntingdonshire District Council.

Since I was an instructor at the Vulcan OCU, I should perhaps confess that I was probably one of those AEOs who caused Rod Powell to concentrate on the wrong aspects of his job (*this reference is to a paper presented by a previous speaker – see Journal 28.* **Ed**). As he rightly said, we were far more interested in the aeroplane's electrical circuits than in electronic warfare. If I knew then what I know now things might have been different. But I didn't, of course. Having got that off my chest, what of the later stages of EW training?

In September 1966, following the demise of No 18 Sqn and the CSE, No 360 Sqn was set up at Watton, absorbing much of the resources of No 831 NAS in the process. To be pedantic, it had originally been intended to establish two joint units and No 361 Sqn was actually formed in January 1967. The second unit was pencilled in for deployment to FEAF but this plan stalled and it disbanded after only six months of rather insubstantial existence at Watton.

No 360 Sqn was to be equipped with Canberras. The Canberra had first become associated with the EW community as early as 1953 when Watton's No 192 Sqn had been provided with a couple of B2s. Interestingly, these aeroplanes, which were intended for ELINT duties, were the first Canberras to be fitted with a Doppler radar – GREEN SATIN. They were succeeded by quite extensively modified B6s from 1954 onwards, these aircraft operating around the Baltic and elsewhere monitoring and recording electronic emissions. There was a marginal training aspect associated with this activity, as it was

Seen here after its final update to T17A standard, WD955 kept going until well into the 1990s. Since it had first flown as a B2 in 1951, it must surely have been one of the longest lived of RAF Canberras.

possible to make duplicate tapes from which aircrew could be taught to recognise the audio signatures of specific equipments and thus to evaluate the level of threat that they represented. It has to be said, however, that I do not think that there was very much of this sort of applied training going on in the late 1950s. Meanwhile, Canberras began to be issued to other units within No 90 Gp. Most of these were concerned with the calibration of early warning, GCI and missile fire control radars, IFF and so on but in the early 1960s No 97 Sqn acquired a limited jamming capability which permitted it to offer a degree of practical EW training.

So, having established the Canberra's pedigree in the signals world, what of No 360 Sqn? Beginning in 1964 twenty-four surplus Canberra B2s began to be fed through Samlesbury where they were turned into T Mk 17s. The conversion involved the installation of a range of equipment in the bomb bay and the provision of sundry aerials, resulting in the distinctive bulbous and 'warty' nose that was so characteristic of the breed. Twelve of these aircraft were assigned to No 360 Sqn, to provide a realistic ECM training capability for both the RAF and the RN. The squadron moved to Cottesmore in 1969 and in 1975 to Wyton where it remained for the next twenty years.

The T17 had a comms noise jammer, covering the VHF/UHF bands, and two E/F-Band or, alternatively, one D-Band and one E/F-Band jammers, and an I-Band jammer; the latter could transmit from either front or rear aerials but not both. There was also an I-Band CW Pulse Doppler repeater jammer. It could sometimes be difficult to be

certain that the jammers were tuned to the appropriate frequencies because the operator was obliged to work with an APR-9 of some considerable vintage, this having a 'window' covering only 20 MHz.

The annual task set by the MOD amounted to some 3,600 sorties per year, allocated variously to NATO and UK forces. The squadron's success in achieving this task varied over the years. It was probably always too demanding and I doubt that it was ever met in full, even in the early days, and many sorties were being lost towards the end due to equipment problems and aircraft serviceability. This highlights a problem with integral EW equipment in that it complicates the serviceability equation. With built-in kit, both it and the airframe have to be in working order if the sortie is to succeed; with a defective EW pod you may be able to solve the problem by dropping one and fitting another. Either way, serviceability became something of an issue in later years, mostly due to the age of the aircraft.

The squadron flew a variety of sortie profiles according to a weekly programme which was prepared by the Electronic Warfare Training Cell (EWTC), a part of Wyton's Ops Wg and where I first became personally involved in this business in 1980-82. The squadron's principle bread and butter missions ranged from so-called COFFEE DELTAs, which exercised the radars of the UK's Air Defence Ground Environment, PROFITs, against either singletons or pairs of fighters, and Flag Officer Sea Training's (FOST) weekly 'war' off the south coast. Larger scale exercises often entailed multi-aircraft detachments to Scotland for Joint Maritime Courses (JMC), or to a variety of airfields in Germany, Belgium, Holland, Italy, Norway, Portugal and France to participate in NATO or bi-national events. Another range of major tasks involved Mediterranean Fleet exercises flown from Gibraltar and naval exercises sponsored by NATO. Although, as part of the EWTC's staff, I was not actually filling a flying appointment, I did manage to participate in one of these naval affairs which involved a trip to Landivisiau in north west France.

Over the years I am sure that No 360 Sqn accomplished a great deal in providing RN and RAF personnel with an insight into the problems that ECM could cause them in their operational roles, whether on land, at sea or in the air. By the mid-1980s, however, in order to reflect changes in the Warsaw Pact's electronic ORBAT, it was becoming increasingly necessary to update the Canberra's EW fit

and there was a corresponding need to modernise the original navaids. In 1985, therefore, WD955, was flown back to Samlesbury to act as a trials aircraft for a new electronics suite. This time we could afford to update only half-a-dozen aeroplanes to the new T Mk 17A standard but, with their much enhanced capability, they served the squadron well for the rest of its life.

The T17A had a wide-band spectrum analyser, its 20 GHz window, permitting the operators to cope with the frequency agile radars which used to be able to 'hop' outside the mere 20 MHz covered by the old APR-9s. The new active equipment included a 1 Kw communications jammer, a 3 Kw frequency-controlled I-Band jammer (which actually went just into J-Band) and an enhanced noise/repeater jammer. The installation involved the replacement of all of the original wave guides and the provision of new aerials. The new E/F antenna in the nose, for instance, produced a more sharply focussed 17.5^{o} beam giving a much higher Effective Radiated Power (ERP) while a new omni-directional D-Band aerial beneath the aircraft gave a respectable 15db gain.

Despite its limitations, the T17's kit permitted us to play some relatively sophisticated tricks. I recall, for instance, visiting UK radar sites to show the operators that, even with their ECCM features operating, they could be deceived into believing that they were not actually being jammed. Probably one of the more valuable lessons that we were able to teach the AD operators was not just that it was possible to work through jamming, but that, unless they were vigilant, it was possible to persuade them that they did not have a problem and that there simply were no targets out there.

It was, perhaps, a pity that No 360 Sqn never had a formal war role. I am sure that it could have made a useful contribution to an offensive and, had it been seen in that light, the funding of updates might have been easier. Had the chips really gone down I suppose that they might well have been pressed into service, even if only as command and control relay aircraft, and the squadron certainly became involved in some urgent trials work in connection with attempting to counter the Exocet threat during Operation CORPORATE. As it was, the squadron did not long survive the end of the Cold War and it was disbanded in 1994. Like so many other military functions, the EW training role has now been put out to civilian contract. Sad, but true.

ROYAL AIR FORCE HISTORICAL SOCIETY

The Royal Air Force has been in existence for over 80 years; the study of its history is deepening, and continues to be the subject of published works of consequence. Fresh attention is being given to the strategic assumptions under which military air power was first created and which largely determined policy and operations in both World Wars, the inter-war period, and in the era of Cold War tension. Material dealing with post-war history is now becoming available under the 30-year rule. These studies are important to academic historians and to the present and future members of the RAF.

The RAF Historical Society was formed in 1986 to provide a focus for interest in the history of the RAF. It does so by providing a setting for lectures and seminars in which those interested in the history of the Service have the opportunity to meet those who participated in the evolution and implementation of policy. The Society believes that these events make an important contribution to the permanent record.

The Society normally holds three lectures or seminars a year in London, with occasional events in other parts of the country. Transcripts of lectures and seminars are published in the Journal of the RAF Historical Society, which is distributed free of charge to members. Individual membership is open to all with an interest in RAF history, whether or not they were in the Service. Although the Society has the approval of the Air Force Board, it is entirely self-financing.

Membership of the Society costs £18 per annum and further details may be obtained from the Membership Secretary, Dr Jack Dunham, Silverhill House, Coombe, Wotton-under-Edge, Gloucestershire. GLI2 7ND. (Tel 01453-843362)

THE TWO AIR FORCES AWARD

In 1996 the Royal Air Force Historical Society established, in collaboration with its American sister organisation, the Air Force Historical Foundation, the *Two Air Forces Award*, which was to be presented annually on each side of the Atlantic in recognition of outstanding academic work by a serving officer or airman. The RAF winners have been:

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THE AIR LEAGUE GOLD MEDAL

On 11 February 1998 the Air League presented the Royal Air Force Historical Society with a Gold Medal in recognition of the Society's achievements in recording aspects of the evolution of British air power and thus realising one of the aims of the League. The Executive Committee decided that the medal should be awarded periodically to a nominal holder (it actually resides at the Royal Air Force Club, where it is on display) who was to be an individual who had made a particularly significant contribution to the conduct of the Society's affairs. Holders to date have been:

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