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THE RAF IN THE POSTWAR YEARS

# THE BOMBER ROLE 1945 - 1970

Humphrey Wynn



Ministry of Defence

**AIR HISTORICAL BRANCH (RAF)**  
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**THE BOMBER ROLE  
1945 – 1970**

by

**HUMPHREY WYNN**

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Air Historical Branch (RAF)  
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## FOREWORD

When, in 1980, I was invited to deliver the Chadwick Memorial Lecture on the subject of the Vulcan, I was advised to consult Mr Humphrey Wynn, one of the historians of the Air Historical Branch, and he allowed me to read the first draft of his study of the Bomber Role in the post-war RAF. I found it not only a mine of information but also an excellent guide to the politics surrounding the development and role of the bomber force, and I am therefore very pleased that it has now reached the point of publication and to be able to commend it to its readers.

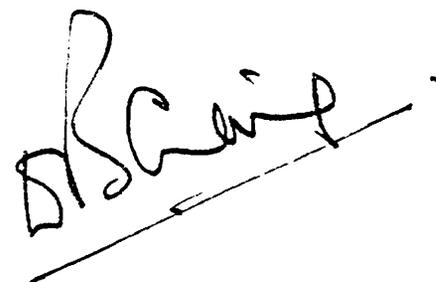
This history covers the creation and development of the jet bomber force which until mid-1969 provided the strategic nuclear deterrent capability of the United Kingdom – surely one of the most important roles ever entrusted to the RAF. The development of this force involved many strands of technology – the aircraft themselves, their engines, weapons, electronic systems, airborne and ground aids – and many thousands of people in the RAF, the Ministries of Supply and Aviation and the aerospace and associated industries. Thanks to their combined skills and enormous effort, the wartime bomber arm of piston-engined machines was transformed into what became known as the V-force, whose aircraft were able to operate at almost the speed of sound, at altitudes of around 50,000ft and carrying megaton-range nuclear weapons of awesome destructive power.

Mr Wynn's account traces the stages by which this change came about, starting with the immediate post-war years when Lincolns formed the front line and when Operational Requirements were laid down for four-jet bombers, for the Canberra and for an atomic bomb – which it was assumed would be delivered by aircraft, since missile technology was then confined to the V2. It covers the way in which Bomber Command progressed towards its QRA capability: the last use of its piston-engined bombers, the Lincolns and B-29 Washingtons; the introduction of the Canberras followed by the Valiants, Vulcans and Victors; and the deployment and dispersal of this force, which wielded a greater concentration of destructive power than ever previously possessed by any of the British Services. It shows, too, against a background of worldwide UK treaty commitments, how the Canberras and V-bombers operated in a peace-keeping role in the Middle and Far East, where deployments were often undertaken at short notice and supported by the jet tanker force, and how in Europe elements of the V-force were directly assigned to SACEUR.

Other major features of the period are the development of British nuclear weapons into the megaton range, culminating in the successful air-drops from Valiants in the 1957–1958 Christmas Island tests, and the close co-operation between Bomber Command and Strategic Air Command of the United States Air Force from 1957 onwards.

As these pages make clear, the RAF became the only air force in the world to deploy Thor IRBMs; from 1963 to 1969 its V-force carried a British stand-off bomb, Blue Steel; and – but for its cancellation at the end of 1962 – the Vulcans would have been armed with the thousand-mile-range Skybolt ALBM. However, the ending of that project and the Government's acceptance of the submarine-launched Polaris in its stead meant that the strategic nuclear deterrent role would be transferred to the Royal Navy from mid-1969. Meanwhile in order to penetrate increasingly sophisticated enemy defences the V-force would have to operate at low level.

The modification of the V-bombers and their weapons for this role, and the training of crews in it, are described in the final chapters of Mr Wynn's study. The change marked a culmination of strategic bombing technique by a force which, because its full capability never had to be used, provided Great Britain with an effective strategic nuclear deterrent for all of fifteen years.



Air Chief Marshal  
Air Officer Commanding-in-Chief  
Strike Command

## THE AUTHOR

Humphrey Wynn joined the Air Historical Branch in 1971 as a historian, having previously been assistant editor of *Flight International*, the aviation magazine, and also its defence correspondent. He served in the RAF from 1940 to 1946 as a pilot and in the RAFVR from 1948 to 1980, initially in a UAS and then in the public relations branch, having entered journalism in 1949 and worked on newspapers in Manchester and London. He joined *Flight* in 1956, went to the SBAC in 1963 and to the Air League in 1965 in PR appointments then rejoined the magazine in 1967. He is a graduate of Manchester University.

In his research for this volume, which is one of AHB's series of post-war RAF histories, Mr Wynn has had full access to the official documents.

## THE BOMBER ROLE, 1945-1970

### Introduction

This period in the history of the Royal Air Force saw the culmination of its use of bombers – in a strategic nuclear deterrent force, the final expression of a bombing philosophy first put into practice in 1918 with the establishment of the Independent Force in France and then, in a highly intensified form, with the operations of Bomber Command from 1939 to 1945.

By the 1970s the emphasis had changed to low-level operations by Vulcans and smaller (one- or two-man crew) bombers, the days of high-level strategic bombing by five-men crew aircraft having gone for good, as far as the RAF was concerned, apart from their brief revival over Port Stanley in the Black Buck sorties of 1982. Indeed, they effectively came to an end in mid-1969 with the handover of the medium-bomber Quick Reaction Alert role to the Royal Navy's nuclear-powered, Polaris A3-armed submarines.

It is the purpose of this study to describe what happened in the 1945-1970 period: how new types of bomber were developed to replace those of the Second World War; how British nuclear weapons, designed to be carried by the new jet bombers, provided the means to create an independent British nuclear deterrent force; how this force was principally deployed on bases in the United Kingdom but ranged world-wide; how the United States supplied stop-gap bombers to Britain during a critical period, agreed to co-ordinate USAF-RAF atomic strike plans and deployed IRBMs (intermediate-range ballistic missiles) in the UK with RAF crews; how developments in Soviet air defences, and cancellation of the American Skybolt air-launched ballistic missile, brought about a major change in RAF bomber tactics during the 1960s; and how an alternative US offer of submarine-launched strategic missiles signalled the end of strategic bombers as the RAF had known them for 50 years.

## CHAPTER 1

**The Final Front-line Use of Piston-engined Bombers (1945-1955)**

During the Second World War a mighty force of Lancasters, Halifaxes and Mosquitoes, capable of putting up a thousand aircraft for a night's operations, had been developed in Bomber Command. Its Order of Battle for 9 May 1945, the day after hostilities ended in Europe, showed a UE (unit establishment) of 1,340 heavy bombers (Lancasters and Halifaxes), with an actual number of 1,463 on unit charge, and a UE of 240 light bombers (Mosquitoes) with 280 on unit charge. Thus the total bomber UE was 1,580 with 1,743 actually on stations.

When the war ended, this force melted away: aircrew and groundcrew were demobilised, squadrons disbanded and aircraft sold for scrap – swords beaten into ploughshares. More than half the squadrons which remained were units in name only, their strengths well under establishment. Thus at mid-1947 there were 14 Lincoln, eight Lancaster and two Mosquito bomber squadrons, with a total UE of 157 aircraft; but this was equivalent to only nine Lincoln/Lancaster squadrons and one of Mosquitoes at the standard UE (16 aircraft per squadron). When No 617 Squadron visited Canada and the USA during that year (Operation Goodwill, 22 July – 9 September) with 16 Lincoln B.2s, its numbers of aircraft and personnel had had to be made up from other squadrons.

This small post-war bomber force had many commitments – training, in both the UK and the Middle East, for its war roles; support of ground forces in Malaya, Kenya and Aden; and overseas reinforcement when required. It also had many problems, the most serious being manpower and serviceability. The loss of hundreds of experienced aircrew and groundcrew, demobilised after 'hostilities only' service, had resulted in a shortage of trained personnel; while those who were available or under training were not necessarily in the right trades or at the right places. On the squadrons, difficulties were experienced in making up flying crews and in keeping them together, unless (as happened later) individual members could be screened from postings. Serviceability was a problem with the Lincolns – for example, defects in electrical wiring and failures of blind-bombing equipment in tropical climates.<sup>1</sup> The latter conditions were mainly encountered on Sunray detachments to Shallufa, Egypt: these were designed to exercise bomber force mobility and self-sufficiency, and to give live bombing and fighter affiliation practice in a more reliable climate than that of the UK.

During 1949 the remaining Lancaster squadrons were re-equipped with Lincoln B.2s (or Mk IVAs, as the Mk 2 version was also known), and it was the Lincolns which bore the brunt of post-war bomber operations. Apart from exercises and competitions designed to stimulate and increase efficiency the squadrons were involved in overseas campaigns like those against Communist terrorists in Malaya and Mau-Mau in Kenya. A history of the former, in which three Lincoln squadrons at a time were deployed to Singapore between March 1950 and March 1955, has stated that "when the terrorists retired to deep jungle areas, air power was frequently the only method of maintaining some pressure against them and was therefore directly instrumental in shortening the duration of the campaign". In this type of operation, the Lincolns proved more successful than the Canberras, which were not well suited for map-reading over the jungle or for visual bomb-aiming. The Lincolns, "armed with fourteen 1,000lb bombs and able to fly in a close 'vic' formation of five aircraft . . . could deliver a high concentration of bombs anywhere in the Federation of Malaya at any time of the day or night".<sup>2</sup>

Lincolns became involved in operations against the Mau-Mau from mid-October 1953, on a trials basis, though formal squadron detachments did not begin until early 1954 and continued until mid-1955.

When the Emergency had been declared in Kenya on 22 October 1952 the RAF there had no offensive capability, but in 1953 four Harvards were purchased. These had become available through the closing-down of the Rhodesian Air Training Scheme and reached RAF Eastleigh on 1 April; then their numbers

<sup>1</sup> Owing to the servo-motor lubricant in the H2S Mk 3G drying out.

<sup>2</sup> *The Malayan Emergency 1948-1960* (Ministry of Defence, June 1970). Canberra operations over Malaya are described subsequently (pages 14 – 15)

were doubled, four more arriving by 1 July. But by October it had become apparent that the effect of the four 19lb fragmentation bombs they carried was very restricted in the dense jungle country over which they operated; so the C-in-C (General Sir George Erskine) made representation for the detachment of Lincolns already in the Middle East on Sunray exercises to be sent to Kenya for trials. These trials (October–December 1953) were successful, and from March 1954 until August 1955 there were regular detachments to Kenya from UK-based Lincoln squadrons, beginning with No 61/144 Squadron (Wittering), followed by Nos 214 (Upwood), 148 (Upwood) and 49 (Upwood). The Harvards, of No 1340 Flight, continued to operate while the Lincolns were at Eastleigh – all aircraft being under the control of a Joint Operations Centre – but while they could get lower than the four-engined aircraft, could not carry anything like their weight of bombs nor command such firepower fore and aft nor bomb on radar.

While the Harvards could bomb from 300ft above Kenya's forested and mountainous terrain, the safety height for release of 500lb and 1,000lb bombs from Lincolns was 2,500ft for every bomb in the stick, unless the bombs were fused with 25sec delay pistols – in which case, they could be dropped from 1,200ft *agl*. On all sorties, the Lincolns followed up their bombing attacks by strafing their targets, with the twin 0.50in guns in front and rear turrets. With a light fuel load, on sorties lasting about 1½ hr, the Lincolns proved highly manoeuvrable. As an example of the intensity of operation, during January 1955 – a 'peak month' for them – aircraft of No 49 Squadron made 204 strikes and on these dropped 2,725 500lb and 49 350lb cluster bombs, firing 49,941 rounds of ammunition from front guns and 73,989 from rear guns.

The purpose of this bombing and strafing, in conjunction with ground operations by British Army and Kenya Police forces, was to thin-out and disperse the gangs of Mau-Mau (300 to 1,000 strong) which existed at the beginning of the Emergency; and by the early summer of 1955, when the Lincolns started dropping leaflets, this object seemed to have been achieved. A Kenya Chief Inspector of Police was quoted as saying that the bombing "did more to prove the power of Government than anything else we had been able to show yet".<sup>1</sup>

During the Lincoln period the AOC-in-C Bomber Command, Sir Hugh P Lloyd, instituted a knock-out competition – initially between squadrons on the same station, the winner taking on the best from other stations. At Sir Hugh's suggestion, King George VI was asked if he would present the Laurence Minot Trophy to the ultimate winner – and did so, at Buckingham Palace on 8 November 1950, to No 617 Squadron. Another idea by Sir Hugh, who was AOC-in-C 1950–1953 and noticeably active in stimulating the efficiency of his Command, was an essay competition for all officers.

It was No 617 Squadron which in the latter half of 1947 had participated in an imaginative and successful visit to the United States – Operation Goodwill – when 16 Lincolns had flown across Washington, DC, and from there to California and back. For this purpose the squadron, which had got its first Lincoln on 16 August 1946 (saying farewell to the Lancasters with which it had immortalised its reputation in the dams raid of 16–17 May 1943) and achieved its establishment by October, was reinforced by about 82 personnel from other squadrons.

On 22 July the squadron was visited at Binbrook by the CAS (Marshal of the RAF Lord Tedder) and on the following day the Lincolns took off at ten-minute intervals from 0800hr onwards for Gander, Newfoundland.<sup>2</sup> There the overload fuel tanks were removed from their bomb-bays and replaced by panniers, and on 28 July the squadron flew to Andrews Field, Washington, DC, where they were given a VIP reception from ACM Sir Guy Garrod and Generals Carl Spaatz and George Kenney, USAF.

<sup>1</sup> Report on Air Operations in Kenya, in file JOC/1002/39/Air, AOC's despatches. See also, for very informative first-hand reports on Lincoln operations from Eastleigh, the HQ BC (Ops) file Detachment Reports – Circulation (AHB IIH/272/3/66). This contains reports by No 214 Squadron, which took over from No 61 in June 1954, and by No 49 Squadron for January–March 1955.

<sup>2</sup> The captains' names were listed as Wg Cdr C D Milne (CO), Sqn Ldrs C K Saxelby and A G Lang, Flt Lts Speed, Hague, Simpson, Nunns and Cox, P1 Mirfin, Flt Lts Perry and Bayley, P2 Park, Flt Lts Lawson, Lennox and Crowe and Fg Off Birch.

From there, after taking part in the Air Force Day celebration, No 617's Lincolns<sup>1</sup> flew north-westwards to Detroit (Selfridge Field) via Rochester, NY, and thence over Chicago to Smoky Hill, Salina, Kansas.<sup>2</sup> Because a cold front had been forecast over the Rockies the aircraft then made their way individually to Fresno, California, via New Mexico and Arizona; from Fresno they flew in formation to Mather Field, Sacramento,<sup>3</sup> after a night-stop there over-flying San Francisco at 2,000ft en route to March Field, Los Angeles.

This was the farthest point in their journey, and the Lincolns and their crews had four days' rest before heading eastwards on 18 August, flying individually at 10,000ft across Arizona and New Mexico then forming-up over Abilene, Texas, and setting course for Fort Worth.<sup>4</sup> After three clear days there No 617 set off on 22 August for Maxwell Field, Alabama, via Mobile and Birmingham; then on 25 August the squadron left for Andrews Field, Washington, DC, where by contrast with their arrival there a month before there was "no reception committee and no organised entertainments" and the crews were stood down for six days. On 2 September No 617 began its homeward flight – via Trenton, Ontario, Canada, and Gander, Newfoundland, to Binbrook, which they reached on 9 September, and thence to Scampton, where Operation Goodwill had begun with their take-off on 22 July.

The Lincolns, admirable in many ways as successors to the Lancasters and flown and maintained with skill and enthusiasm, were nevertheless limited in range and could not have been used for attacks on Soviet targets had the Cold War – which began in 1948 – led to actual hostilities between the USSR and the West. This meant that Britain, the only member of the Western Union defence organisation and the only European member of NATO (formed on 4 April 1949) capable of providing bomber forces for the alliance, did not possess the capability of attacking targets in Soviet territory. In these circumstances, the RAF asked the United States Air Force for the loan of enough Super Fortresses (B-29s) to equip eight squadrons. These aircraft, the type which had dropped the atomic bombs on Japan, could reach Soviet targets from UK bases. Three SAC groups of them (90 machines) had been deployed to Britain during the 1948–1949 Berlin crisis.

The acquisition and operation (1950–1954) of B-29s, which the RAF named Washingtons, provided a temporary increase in long-range striking power for Bomber Command; but they brought problems as well as advantages. There were difficulties about the number of personnel needed to service them, about the size of aircrew required<sup>5</sup> and about spares to keep them operational; they needed 3,000yd runways and there were not many of these available at the time.<sup>6</sup> On the other hand, they gave the RAF a long-range strategic bombing capability<sup>7</sup> and their crews the experience of working in a pressurised environment, which would be a feature of the forthcoming jet bombers.

A total of 87 B-29s were loaned to the UK under MDAP (Mutual Defence Assistance Programme) arrangements for NATO countries approved by the US Congress; of this number, 64 were used to form eight squadrons, the remaining 23 providing a back-up. Of even earlier wartime vintage than the Lincoln,<sup>8</sup> the B-29s had been withdrawn from storage (they were cocooned to protect them against the elements). The type was still in service with Strategic Air Command, and it was their use in the Korean War – which started in June 1950 – that created a shortage of spares and engines for the RAF, the USAF naturally having priority.

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<sup>1</sup> In his book 'Fallout' (Robert Hale, 1980) AVM Stewart Menaul said that USAF personnel referred to the Lincolns as 'Abrahams'. <sup>2</sup> Weather conditions on the latter half of this leg being "very hot and bumpy". <sup>3</sup> Where they arrived 50 minutes behind schedule, "due to a navigational error in the lead aircraft". <sup>4</sup> Again "hot and bumpy conditions" and "due to engine overheating and consequent reduction in airspeed the formation arrived . . . two minutes late". (These comments are taken from ORB entries).

<sup>5</sup> Ten members, as against seven for the Lincoln. <sup>6</sup> The ORB of No 149 Sqn commented that because "the runways at Coningsby are both shorter and narrower than those at Marham on which the squadron were converted, it was thought desirable to have all the captains checked out by a qualified instructor". Marham had been one of the airfields used by SAC B-29s in the 1948–1949 Berlin crisis period. <sup>7</sup> The radius of action of the B-29 was 1,300nm compared with 950nm for the Lincoln. <sup>8</sup> The Lincoln first flew in June 1944, the B-29 in September 1942.

The first Washington arrived in the UK on 22 March 1950 and initially RAF crews were converted by USAF personnel, the first Bomber Command squadron – No 115/218 – being formed at Marham during June 1950. Two more (Nos 149 and 90) were formed there, and eventually the whole Washington force – complete by September 1951 – was based on Marham and Coningsby airfields.

The Washingtons, though suffering from shortage of spares and engine unreliability,<sup>1</sup> provided Bomber Command aircrew with a much more comfortable 'ride' than they had ever had in the Lincolns. They were pressurised to 8,000ft, which meant that crew members didn't have to fly with oxygen masks on all the time, covering their mouths and squeezing into their cheeks; throat microphones were provided, making inter-communication much easier; the cabin heating system was reliable; there was space to get up and walk around in; the Minneapolis-Honeywell automatic pilot could be used throughout a flight, except for take-off and landing; and a coffee urn was installed as part of standard equipment. All these factors contributed to good crew morale and to less fatigue – important influences should an emergency occur, especially in the later stages of a long sortie.

When trouble occurred in a Washington it usually happened very quickly – certainly as far as the engines and propellers were concerned. The pilots and engineer needed to monitor the *rpm* gauges throughout a flight; at the slightest sign of irregularity the drill was to feather the propeller.<sup>2</sup> There was usually no difficulty about flying on three engines, or even on two, while the Washington's tricycle undercarriage made asymmetric landing easier than it would have been had the aircraft been of the tailwheel type. In the event of engine failure or stoppage on one side, fuel could be transferred to the other side by electrically driven pump.<sup>3</sup>

Washingtons formed the main strategic element of the Bomber Command front line from 1950 to 1953. If war should have occurred, they were destined to attack targets in the Soviet Union; therefore much of the squadrons' training was concentrated on long-range flights – cross-countries of 14 hours' duration being normal, including 'attacks' on Luqa, Malta, and Catania, Sicily. The Washingtons also participated, as 'raiding' forces, in United Kingdom air defence exercises.

When No 149 Squadron, the second to receive them, got its first two Washingtons on 20 November 1950 the compiler of its Operations Record Book noted that the aircraft were "armed with four remotely-controlled turrets and a tail-mounted gun position . . . [giving] a total fire power of twelve 0.5in machine guns"; that provision was made for carrying a total bomb load of 20,000lb, carried internally in two bomb bays; that there was a Norden bombsight; and that special navigation equipment consisted of APQ.13 ("the American version of the British H2S radar"), radio compass and a Loran set.

Normal USAF crew for a B-29 was 11, but Bomber Command considered that an eight-man crew – two pilots, two navigators, two air gunners, one signaller and one bombardier/flight engineer – was adequate for operating the aircraft in a night-bombing role.<sup>4</sup> It had some reservations about the B-29s – that they couldn't be operated above 26,000ft as the engines were liable to blow up or catch fire when given extra boost; that their crews regarded them as "almost obsolescent" as the Lincoln (B-29s had gone into USAF service in 1944 and the Lincoln into RAF service in 1945); that the manning situation, already "very bad", would be aggravated as result of the increased B-29 personnel requirement; that there were

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<sup>1</sup> Time between overhauls was as low as 80hr, according to Air Commodore P M Brothers, CBE, DSO, DFC, RAF(Ret), who commanded No 57/104 Sqn when it had Lincolns and after it converted to Washingtons (April–June 1951) (oral interview, 1 July 1978). <sup>2</sup> Air Cdre Brothers recalled that on his first familiarisation flight, from Marham, the USAF major who was his instructor "hit the feathering button" on one of the engines immediately after they were airborne; they then landed on three and after shut-down the major demonstrated how loose the propeller was. <sup>3</sup> Could be; but Flight Lieutenant D E R Laing of No 57/104 Sqn had to force-land in France on 29 September 1951 because, after an overspeeding propeller on No 3 engine had flown off and hit No 4, a metal fragment from which penetrated the fuselage, it was impossible to transfer fuel because the wiring to the port engines hadn't been connected. <sup>4</sup> BC/S.81629/AS Plans Memorandum on the Operational, Training and Technical Aspects of the re-equipment of the two Bomber Command Combat Groups each with four squadrons of eight UE B-29s (sent to CAS by AMSO on 7 November 1949).

difficulties about the spares situation and cost of maintenance. The C-in-C<sup>1</sup> was also concerned that with the small numbers of B-29s the resultant mixed force of B-29s and Lincolns would be difficult to operate. If the two types were used as a single force the advantage of the greater range of the B-29 would be lost; if the B-29s were to operate with the USAF the Lincoln force would be still further reduced in size.

But CAS (MRAF Lord Tedder) was adamant about RAF employment of the B-29s. Replying to a minute from the Air Member for Supply and Organisation (Air Chief Marshal Sir George Pirie) summarising the implications and difficulties of accepting them, CAS said that the aircraft had been applied for as part of American aid and there could be no question of going back on that, adding: "I am not impressed by Bomber Command's attitude as apparently represented by the present C-in-C. Of course there will be difficulties, but they must, can and will be overcome".

The difficulties were indeed overcome, as far as the squadrons were concerned. Based chiefly at Coningsby and Marham in No 3 Group for the three years (1951-1953) when the Washington force was operational<sup>2</sup> they undertook an intensive programme of training, exercises and competitions. For example No 149 Squadron (whose ORB noted in January 1951 that Gee was being fitted in the aircraft to replace Loran) did air/sea firing exercises, high-level blind and radar bombing, fighter affiliation sorties, practice for and participation in the Laurence Minot Trophy competition,<sup>3</sup> an exercise in August 1952 giving special practice in maritime navigation, and an exercise the following month involving attacks on Allied fleets and air-to-air firing - for the first time since the squadron had had Washingtons.<sup>4</sup> But there were problems, particularly regarding engine serviceability.

The main reason for this was a chronic shortage of spares, and the reason for that was that the USAF Strategic Air Command was using B-29s in Korea from mid-1950 until the end of the war there and so had priority for spares. Another reason was unsatisfactory engine overhaul facilities. During June 1951 the CO of No 90 Squadron, Squadron Leader W R Sloane, attended a C-in-C's conference at Bomber Command HQ and reported in his squadron ORB that they had "learned that the Bristol re-conditioned engines<sup>5</sup> had been incorrectly assembled and all Washingtons with these engines were grounded. A vast engine-change programme had to be instituted and this, coupled with a series of engine failures in flight,<sup>6</sup> reduced the number of flying hours carried out during this month. The supply of spares continues to give rise to grave concern and it is understood that this matter is being taken up once again with higher authority".<sup>7</sup>

These technical difficulties<sup>8</sup> contributed to the decision not to retain the Washingtons in Bomber Command any longer than was necessary. In fact, the force started to run down in April 1953; by June it had been reduced to four squadrons, and these began to run down in January 1954, the last aircraft leaving for the United States - Exercise Homerun - on 30 March 1954.

During the time the Canberra light bomber force was being built up, from the end of May 1951 onwards, the medium bomber force front line was sustained by the eight squadrons of Washingtons and twelve squadrons of Lincoln B.2 4As, the latter decreasing in number during the early 1950s as some of them were re-equipped with Canberras: for example, the first four Canberra B.2 squadrons formed at Binbrook - Nos 101, 617, 12 and 9 - were all conversions of Lincoln squadrons there.

Lincoln B.2 4As,<sup>9</sup> with which the squadrons were equipped, continued to be the work-horses of Bomber Command until they were phased-out of service at the end of 1955. Unlike the Washingtons, which

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<sup>1</sup> Air Marshal Sir Aubrey B Ellwood. <sup>2</sup> By the end of July 1951 seven squadrons had been converted and at the beginning of September the Conversion Unit became the eighth squadron, No 35. <sup>3</sup> Awarded for a knock-out bombing competition instituted in 1950. <sup>4</sup> The B-29s and the Lincolns were to be the last aircraft in Bomber Command to carry air gunners. <sup>5</sup> Wright Cyclone Eighteen R-3350. <sup>6</sup> By June 1951 No 90 Sqn was expressing concern at the high rate of engine failure and a No 149 Sqn aircraft had a double engine failure in September of that year. <sup>7</sup> On 8 January 1952 Sqn Ldr Sloane was lost, with his crew, in Washington WF502 which crashed in North Wales. <sup>8</sup> Another, which emerged in the run-up to the 1952 Laurence Minot Trophy Bombing Competition, was that the Washingtons had "considerable difficulty with the opening and closing of bomb doors at altitude" (No 3 Group to HQ Bomber Command, 29 May 1952, in Air 14/3875). <sup>9</sup> Mk 2s with Mk 4A radar fit.

operated exclusively within a European environment (from UK bases with occasional visits to Germany), the Lincolns were continually being detached overseas – to Malta and Egypt for training, to Kenya, Aden and Singapore for operations. Those were the days of Britain's last colonial wars, and the Lincolns were the last WW2 bomber instruments of peace-keeping air power – co-operating with ground forces against the Mau-Mau in Kenya, against border incursions into the Aden Protectorate and against Communist terrorists in Malaya. These commitments abroad for the Lincoln squadrons were in addition to those they had in the UK, such as defence exercises, fighter affiliation and training for crew categorisation – which had been introduced in mid-1952<sup>1</sup> and was to continue throughout the years of the V-force.

Other reasons why the Lincolns, rather than Washingtons, fulfilled overseas bomber commitments were that the latter had been loaned by the United States specifically to strengthen Britain's strategic bomber force prior to the advent of the jet bombers; it would not have been politically appropriate for them to be used in colonial wars. Further, the Washingtons' serviceability was even less good than that of the Lincolns, but the latter were a well-known quantity and could command logistic support all along the route to the Far East. In broad terms, the Washingtons were being used during this period as the strategic deterrent force, the Lincolns as tactical bombers, co-operating closely with ground forces.

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<sup>1</sup> Initiated in a Training Directif of 4 July 1952 from the AOC-in-C (Air Chief Marshal Sir Hugh P Lloyd) to his two Group AOCs (AVM D A Boyle – No 1 Group and AVM W A D Brook – No 3 Group).

## CHAPTER 2

**Development and Introduction of Canberras and Build-up of the Light Bomber Force (1945-1955)**

The Canberra has become such an accepted part of RAF bomber history that its pedigree has been unquestioned; but it was not quite the thoroughbred it may have appeared to be in retrospect, for its origins were somewhat chequered – the original idea having come from industry, the Air Staff then writing a requirement and subsequently changing it. Certainly the classic sequence of an operational requirement, a specification, tenders from companies and a contract to one of them, was not followed. The company which had the idea, and put it to the Ministry of Aircraft Production, got the contract and built the aeroplane – which was not the type at first suggested (a long-range, high-altitude bomber), but a short-range tactical bomber. How that came about can be understood from the chronology of the Canberra, which will make clear the type of aeroplane which emerged, and what its operational purpose was.

The initiative which led to its evolution had been taken during 1944 by English Electric, the Preston-based company which during the war produced Hampdens, Halifaxes and Vampires under sub-contracts and wished to use its facilities for original aircraft production. A design department set up under Mr W E W Petter started work on a high-speed, high-altitude, unarmed strategic bomber referred to as a 'Mosquito replacement'; in February 1945 the company sent formal proposals on these lines to the MAP, requesting a design contract. The Ministry responded by writing both to de Havilland, manufacturers of the Mosquito (who seem at that time to have been fully committed),<sup>1</sup> and to English Electric with the suggestion that they might like to design a Mosquito replacement – although there was as yet no Air Staff Operational Requirement for such an aircraft.

In response to this suggestion, English Electric submitted a preliminary brochure during June on a single-jet-engined, high-speed, high-altitude bomber, and this was passed to the Air Ministry. The company was given a contract for a design study and the manufacture of mock-ups.

Air Ministry-MAP discussions on the brochure led to comments being sent to English Electric in June; these expressed general approval but recommended certain alterations. A major change was that two engines (Rolls-Royce Avons) should be used instead of the one large centrifugal compressor powerplant originally envisaged, and the firm issued a new brochure comprehending these changes.

Mr Petter explained English Electric's intention, and what had been achieved so far, in a letter of 3 August to the new ACAS (TR) (Air Vice-Marshal J N Boothman – of Schneider Trophy fame); he said that "you may have heard that since joining this company to start up a design organisation with a view to continuing permanently in the aircraft business, we have been working on a high-altitude bomber (nominally a Mosquito replacement although in fact much larger). I have discussed this from time to time with Breakey (Air Vice-Marshal J D Breakey – Boothman's predecessor as ACAS (TR)) and DOR (Air Commodore A R Wardle) who recently came up here to see a preliminary mock-up; and I should like, if possible, to take an opportunity when next in town of running briefly over the layout with you". Boothman replied that he could see Petter on the suggested date, but that he might pay a flying visit to English Electric before then.

As a result of these meetings and discussions between the company and members of the Air Staff and Operational Requirements Directorate an Air Staff Requirement, ASR No 199, was drafted in September–November 1945. A copy of this draft was received in the Ministry of Supply during September. Based on the revised English Electric brochure of July, it asked for a high-speed, high-altitude, twin-engined bomber with a range of not less than 1,400nm in still air at 440kt. During November a Specification, E.3/45 (later B.3/45) was drafted; and when the ASR was circulated prior to a meeting of the Operational Requirements Committee a covering letter of 15 November said that the aircraft envisaged was "intended to be a replacement for the Mosquito unarmed bomber" and that it

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<sup>1</sup> With the start of design of the Comet, Venom and Sea Vixen.

would be "complementary to a long-range, high-speed, armed bomber" – the requirements for which were being drafted.

ASR.199 represented the first official Air Staff thinking on the aircraft which became the Canberra, and it resulted from the English Electric initiative of 1944–1945. "The Canberra project began as a design project of our experimental high-speed bomber in discussions between the firm and the Ministry . . . ; it was not related to an OR until a later stage".<sup>1</sup>

In December 1945 the Ministry of Supply issued a contract for the design and construction of four prototypes to its Spec E.3/45, based on the English Electric brochure of July and ASR.199. Then on 3 January 1946 the Operational Requirements Committee, bringing together representatives of the Air Ministry, MoS and RAF Bomber Command, discussed the requirements for a high-speed, high-altitude bomber set out in ASR.199 and approved details of OR.199, which was issued in March 1946.

The prototype B.1 Canberra, built to Spec B.3/45, first flew on 13 May 1949 but was not given a CA (Controller of Aircraft) release and no production order was placed for it. This was because development of the H2S Mk 9 blind-bombing equipment had failed to keep pace with development of the new light jet bomber; when it was ready it would be urgently required for the Valiants. On 12 July the Director of Operational Requirements (Air Commodore G W Tuttle) explained the change of policy in a letter to DMARD (the Director of Military Aircraft Research and Development (Mr J E Serby)) about the English Electric blind bomber. He said that VCAS (Air Chief Marshal the Hon Sir Ralph Cochrane – who had been AOC No 5 Group, Bomber Command, during the war) had decided that in view of the fact that H2S for the B.3/45 "could not be ready before that for the B.9, the B.3/45 is no longer an Air Staff requirement and therefore the Air Staff will not require production of . . . the English Electric blind bomber. He has asked me to request that you will ensure that any effort released on the abandonment of the B.3 should be applied to the development of the B.9 and its equipment".

How the H2S Mk 9 subsequently became the H2S Mk 9A was later explained in an Air Ministry Quarterly Liaison Report (July–September 1949) which said that "H2S Mk 9 was originally required for use in the B.3/45. It has now been decided not to put H2S into this aircraft and the Mk 9 will be used for experimental purposes. . . . The same basic equipment, however, is being developed for use with larger bombers than the B.3 and incorporating a larger scanner. This is now known as H2S Mk 9A . . . .".

In parallel, the change of the Canberra concept – from high-level strategic to low-level tactical role – was referred to by VCAS before it entered service. Minuting the Chief of the Air Staff (MRAF Sir John Slessor) on 29 January about a conference held a few days earlier at Bomber Command HQ, Sir Ralph said that there had been "a tendency to look upon the Canberra as a long-range high-flying bomber, and to press for equipment to enable it to undertake this role. At the end, however, it was generally accepted that the Canberra is a short-range tactical bomber, that there is no equipment which will enable it to hit a small target from 45,000ft, and that it must therefore come down to a height from which it can achieve results . . . ."<sup>2</sup>

Another resume of Air Staff thinking, written during this period,<sup>3</sup> explained the original idea of the Canberra as a strategic bomber. Recalling that the requirement had been issued in January 1946, this said that "it was the intention that this type of aircraft should be an interim replacement for the Main Force bombers held by Bomber Command, pending the introduction of the medium-range bombers, viz B.9 and B.35. In July 1949, an examination showed that the H2S Mk 9/NBC Mk 2 equipment was delayed to a date when it would be required simultaneously by both the Canberra B.1 and Vickers B.9/48. . . . As only one type of blind bomber was required, and since the production date of the B.9/48 compared favourably with that of the fully equipped Canberra B Mk 1, the development effort for the H2S/NBC was devoted fully to the B.9/48 and further development of the Canberra B Mk 1 was cancelled".

<sup>1</sup> Draft Outline of MoS Procedure for Planning Aircraft Development and Production for the RAF (with special reference to the Canberra B.1 and B.2), Procurement Executive. <sup>2</sup> VCAS File No VCAS/4505. <sup>3</sup> File on Aircraft Production and Repair (ID/53/1/465 D of Policy (AS) 411/5).

Change in Air Staff ideas, from the original 1945 concept of a high-speed, high-altitude bomber (OR 199), able to operate at 40,000ft and with radar bombing equipment, to the tactical day bomber requirement (OR 235) resulting in the Canberra B.2, led to a more realistic interpretation of the original English Electric Mosquito-replacement proposal.

OR 235 did not ask for an aircraft to carry a 10,000lb bomb load (as OR 199 had done) but to deliver a 7,500lb bomb load at an operating height of 15–20,000ft with a ceiling of 40,000ft, rather than cruising at 40,000ft with a ceiling of 50,000ft as had been required by OR 199. Thus the requirements for the aircraft which eventually entered service as the first Canberra, the B.2 version, had been considerably scaled-down from the original concept. Bomb-aiming equipment was simpler. Instead of H2S Mk 9 plus NBC Mk 2 or Gee-H Mk II as originally requested (and which, at the design stage, had been found to add considerably to the all-up weight and so to affect performance adversely) the aircraft was to have Gee-H Mk II. This of course limited its bombing range – by contrast with that of the V-bombers – to the effective available Gee coverage.

OR 235, “for a tactical day bomber version of the B.3/45”, was issued in February 1947 and the stages leading to a prototype contract followed: in August an advisory design conference was held; in October, a mock-up conference. On 12 November the Ministry of Supply issued Specification B.5/47 and in April 1948 placed a contract with English Electric for one prototype, bringing the first RAF jet bomber within sight of becoming an operational reality.

Thus in the case of the Canberra, the chicken came before the egg; and even so, the aircraft which eventually materialised was not the one requested in the original (OR 199) Air Staff Operational Requirement – a “blind” (*ie* radar bomb-aiming equipped) bomber capable of delivering a 10,000lb bomb at an altitude of up to 50,000ft. These requirements, which envisaged an interim jet replacement for the Lancaster/Lincoln force of Bomber Command, were subsequently modified in favour of a tactical day bomber version – the “Mosquito replacement” which English Electric originally had in mind.

The Canberra’s chronology clearly shows that the first RAF jet bomber resulted from an English Electric initiative, fostered by the MAP/MoS<sup>1</sup> and confirmed by an Air Staff Requirement – for a Mosquito replacement, drafted when the European operational scenario for which the Mosquito had been designed no longer existed.

Shortly after the Operational Requirements Committee had met to discuss and approve the Operational Requirement, the AOC-in-C Bomber Command (Air Marshal Sir Norman Bottomley) wrote to ACAS(TR); unfortunately his letter, dated 7 February 1946, has been destroyed. But since the reply it received was a detailed vindication of the E.3/45 bomber, it may be conjectured that the AOC-in-C had asked how it had come about and how it was to fit into his Order of Battle; also that his Command had not been consulted in the drafting of the OR, for the reply assures him that they will be consulted in the drafting of the medium bomber (OR 229) requirement which was to follow.

ACAS (TR) explained that “the aircraft under discussion” was “being built by the English Electric Co, not as a private venture, but in response to a MAP specification based on requirements prepared by the Air Staff”. It had been evolved as an operational aircraft and the requirements “were not based entirely on technical considerations as you suggest” – although “the employment of jet propulsion, while offering considerable advantages in speed, did impose limitations in the range performance for which we could ask”.

The reply to the AOC-in-C then went on to outline the Air Staff’s post-war procurement plans for Bomber Command. It said that

“The suitability of the E.3/45 specification should be examined in relation to the bomber fleet as a whole; it must not be regarded as an aircraft intended for the whole sphere of bomber employment. It appears impracticable, and it would certainly be uneconomical, to cover every role of our bomber forces with one type of aircraft, and our intention is to provide two types – a long-range bomber, the primary feature of which will be long range at very high cruising speed, and a much smaller bomber with a relatively modest range but a very high cruising speed.

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<sup>1</sup> The Ministry of Aircraft Production was merged with the Ministry of Supply on 1 April 1946.

"The long-range bomber is likely to be an aircraft capable of 5,000 miles range in still air at a speed of 500mph or more and a bomb capacity of 20,000lb or less. Such requirements are likely to produce an aircraft of well over 100,000lb gross weight, and although such a type may be the primary bomber of the RAF, it would obviously be uneconomical to employ it for the many tasks at shorter ranges which will undoubtedly be required. A smaller aircraft is therefore indicated, even though only a small proportion of the total force may be equipped with this type . . . .<sup>1</sup>

" . . . Air Staff requirements for the E.3/45 bomber have deliberately limited the role for which the prototype is being designed to high-altitude operations and completely 'blind' bombing in order to concentrate technical effort on the most difficult problems for which solutions are required . . . ."

ACAS(TR) concluded his letter by saying that the high-speed bomber

"must be regarded as complementary to the long-range bomber, and judgement as to its value in relation to the long-range bomber, and the place it shall take in the long-range bomber fleet of the Royal Air Force must be reserved at least until the specification for the long-range bomber is completed. The E.3/45 will in any case, as you suggest, be useful for the study of the many tactical and technical problems involved in performance which will be obtained by the employment of turbine engines".

This last remark was percipient, though not perhaps in the denigratory way it seems to have been made by the AOC-in-C Bomber Command; for the Canberra, apart from its intrinsic operational value and versatile capability, proved to be the best training aid the Command could have had for its V-force aircrew.

However, the 'blind bomber' requirement was to undergo another sea-change after the prototype had flown, and the aircraft eventually entered service as a short-range tactical day bomber. This was why the first Canberras in Bomber Command were B.2s, as the B.1 version – which OR 199 had said was to have radar bomb-sighting equipment – was not put into production, because this equipment (H2S Mk 9) was required for the B.9 Valiant, the first of the V-bombers.

The Canberra, as it finally emerged in its B.2 tactical bomber version, was very much a 'NATO' aircraft – ordered into production in March 1949 (before any prototype had flown) at the height of a European crisis which had seen the Communist take-over of Czechoslovakia, the Berlin Airlift, the Western Union Defence Treaty and the formation of NATO. "The RAF" (as the Chief of the Air Staff, MRAF Sir John Slessor, recalled later<sup>2</sup> in describing the vast expansion programme which was put under way in 1951) "were the only people, apart from the Americans, who could make any serious bomber contribution to NATO. Our Washingtons and Lincolns were obsolescent and anyway far too few. The Valiant had not flown, but we placed a small order off the drawing board. The only other bet was the Canberra, and we ordered as many of them as we could get to build-up a first-line force of 560 in the UK, all for the support of SHAPE (Supreme Headquarters, Allied Powers Europe), plus 64 in the Middle East where we had nothing but 16 obsolescent Brigands".

Although the total of 560 Canberras prognosticated by CAS was not realised,<sup>3</sup> his reference to these bombers being "all for the support of Shape" showed the operational purpose for which the B.2s were destined – close air support for the NATO armies in Europe. It may be invidious to make such a comparison, but their role – in the event of an offensive by Communist Bloc forces – was to be exactly like that of the Battles and Blenheims of the Advanced Air Striking Force in 1940.

The Chiefs of Staff were told of the virtues and limitations of the Canberra at the end of 1950 – that it would be a "most useful tactical bomber" and have valuable attributes in the fields of reconnaissance and intruder operations; that it would have an effective radius of action of "not more than 1,300 miles with 6,000lb of bombs". It would not, however, be able to carry the atomic bomb or any bomb of over 5,000lb weight. Nor would it be a satisfactory mining aircraft because its size and weight precluded the installation of the full range of accurate navigational equipment required for that role. It was, and would remain, an interim type "originally designed in accordance with a long-term development programme to

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<sup>1</sup> In the event, a larger proportion of the bomber force was equipped with Canberras than with the medium (V-)bomber. <sup>2</sup> Writing to the Air Minister (Lord De L'Isle and Dudley) on 10 March 1952 about the projected size and shape of the RAF. <sup>3</sup> The highest RAF total was 408, of all Mk's, in BC and 2nd TAF, in mid-1955.

be the first step in the conversion of the British bomber force of the piston-engine era to one of comparable, or greater, hitting power and effectiveness equipped with modern jet aircraft of advanced design. . . .<sup>1</sup>

Thus from the outset the Canberra had two primary roles – one operational, a designated contribution to the defence of Europe; the other logistic, an introduction to jet aircraft for Bomber Command prior to its equipment with four-jet V-bombers.

The Canberra first flew on 13 May 1949; but this prototype – and the second, third and fourth, which flew in November and December of that year – were B.1s, built to Specification B.3/45, for which no production order was placed; however, they were used extensively for development flying for the later marks of Canberra. The first prototype B.2 flew on 23 April 1950: this was the first aircraft built to Specification B.5/47, based on OR 235, the tactical day bomber version; a second prototype flew in August and the first production aircraft in October.

Canberras represented a big change – and a challenge – for the Lincoln pilots and navigators of Bomber Command: their Avon turbojet engines gave much greater power more smoothly than the Merlin piston engines; they were more than twice as fast, pressurised, unarmed, highly manoeuvrable and carried a two-man/three-man<sup>2</sup> crew compared with seven in the Lincoln. Writing of “the change in outlook . . . from that of the slow-heavy bomber, armed with free guns and conventional bombs and usually working in concentration, to the fast, jet-propelled high-altitude bomber, unarmed and . . . working usually in very small numbers”, ACAS (Training) (Air Vice-Marshal Sir Basil Embry) said that

“Conversion of aircrew to new equipment has seldom previously given rise to trouble and is not expected to do so in this instance. It is anticipated that when the first re-equipment (with the B.3/45) is begun, complete squadrons will be sent through the OCU as courses. Before this stage is reached, however, the OCU should have been enabled to build up a certain amount of experience in jet handling on the dual Meteor, and of course sufficient experience on the B.3/45 to enable the staff to teach the squadrons”.<sup>3</sup>

In the event, however, there was no Operational Conversion Unit initially – No 231 OCU, which became responsible for pre-squadron Canberra aircrew training, re-formed at Bassingbourn on 1 December 1951 with Meteors; by the time it received Canberras, in early 1952, and started courses, two squadrons had already been formed – at Binbrook, where Bomber Command’s Jet Conversion Flight was based.

This Flight started work in January 1951, using Meteors for training in high-speed, high-altitude jet flying. Also, aircrew got experience of Canberras by flying with English Electric pilots from the company’s airfield at Warton, Lancashire. The Canberra made a sensational debut when on 21 February 1952 a Royal Air Force crew – Squadron Leader A E Callard (pilot) and Flight Lieutenants E A J Haskett (navigator) and A J R Robson (signaller), based at A&AEE, Boscombe Down – made the first direct Atlantic crossing by a jet aircraft without refuelling, in a Ministry of Supply B.2 from Aldergrove to Gander, Newfoundland, covering 2,100 miles in an elapsed time of 4hr 37min at an average altitude of 40,000ft. The previous best Aldergrove-Gander time had been 6hr 40min by a Pan American Constellation. The RAF crew took the Canberra to Andrews Field, near Washington, and it was subsequently evaluated by the USAF prior to licence-production of the type (as the B-57) by the Martin Co.

The first Canberra B.2 to reach Bomber Command was flown to Binbrook by the English Electric chief test pilot, Wing Commander R P Beamont, on 25 May 1951. There it became the first aircraft in the first RAF Canberra squadron, No 101, which had formerly operated Lincolns. This change in equipment, from a wartime piston-engined bomber with tail-wheel undercarriage and gun turrets to a sleek, tricycle-undercarriage, streamlined unarmed jet that could challenge contemporary fighters with its speed and manoeuvrability, marked the beginning of a new era for Bomber Command. During this first year of the Canberra’s service No 101 Squadron held the field, not only converting pilots but also

<sup>1</sup> In COS(50)538 Production of the B.9/48 Jet Bomber Note by the CAS, COS Mtg 28 December 1950.

<sup>2</sup> Originally Canberras had three-man, later two-man, crews. <sup>3</sup> Draft paper, The Training Aspects of the Re-equipment of Bomber Command (BC/1/ACAS (Training)).

carrying-out intensive flying trials covering the entire operational capability and performance of the aircraft and including a completely new range of flying clothing. When, by the end of 1951, the squadron had been fully equipped with aircraft (nine out of a UE of ten) and crews (nine) the Air Ministry organised a Press visit to Binbrook in January 1952 and *The Aeroplane* reported:-

“The introduction of the Canberra is more than a re-equipment programme, and marks the start of the general expansion of Bomber Command. Selected crews from existing Lincoln, and later from Washington, squadrons will convert to Canberras to form new squadrons; but the piston-engined bombers will remain . . . in service . . . until the introduction of the Vickers Valiant . . . .

“No wireless operator is carried in the Canberra, which has a crew of three – pilot, navigator/plotter and observer, each with a Martin-Baker ejection seat. The observer acts as assistant navigator, and as bomb aimer when the target is reached. With the re-introduction of the observer category into aircrew, the wheel has turned full circle, now that bomber crews are being reduced in size and individuals must specialise in more than one task”.

Referring to the intensive flying trials, the magazine said that in accordance with a recent Air Ministry decision, IFTs of an entirely new character were to be made “with all new aircraft in the future, as soon as the first squadron is equipped”. This procedure was later to be followed with the Valiant, Vulcan and Victor squadrons. “With the Canberra”, the report continued, No 101 Squadron is flying at two or three times the intensity of normal peacetime squadron routine. When an aircraft is in large-scale production, it is preferable that any changes found necessary under intensive operations should be incorporated as soon as possible on the production lines, rather than made retrospectively on a large number of aircraft in general squadron service. This system of intensive flying trials should assist in accelerating re-equipment of RAF squadrons with aircraft ready for immediate and effective operational employment”.<sup>1</sup> The IFTs covered the complete range of aircraft performance, and included tests of flying clothing and equipment.

The first five Canberra B.2 squadrons were all formed at Binbrook, which became the centre of Canberra knowledge in the RAF, as was Gaydon later for the Valiants and Victors and Waddington for the Vulcans. During 1951 the build-up was slow, only No 101 Squadron being re-equipped with the new light bomber; but in 1952, when delays in production had been largely overcome and deliveries were catching up with the planned expansion rate, seven more squadrons were formed (more aircraft having become available also through the decision not to form a second Canberra OCU).<sup>2</sup> Four of these squadrons, like No 101, had formerly operated Lincolns and they were all re-equipped with Canberras at Binbrook: Nos 617, 12, 9 and 50 – in that order. Conversion flying was done on Meteors at Binbrook, except in the case of No 50 Squadron, which got its first four crews from No 231 OCU at Bassingbourn and four more – one from each – from the Canberra squadrons at Binbrook. The fifth and sixth Canberra B.2 squadrons to form in 1952 were ex-Light Marker Force at Hemswell, with Mosquito B.35s, Nos 109/105 and 139; and the seventh was the first Canberra photographic reconnaissance squadron, No 540 at Benson (which had Mosquito PR.34As). However, there was some delay in its re-equipment with Canberra PR.3s. The Air Ministry Quarterly Liaison Report for October–December 1952<sup>3</sup> said that the first PR.3, which arrived at Benson on 3 December, was “the first of the production aircraft and was given limited release in advance of completion of official trials, in order that type familiarisation could start . . . without delay”. It was anticipated that full release for the production PR.3 would be given during January 1953. But a later issue of the AMQLR (April–June 1953) commented that “owing to failure by the English Electric Company to produce Canberra PR.3s to CS(A) specification, it has been decided to stop the supply of this aircraft to No 540 Squadron . . . . Familiarisation and continuation training is proceeding in the squadron on two Canberra B.2s”. By then No 540 Squadron had received four PR.3s.

In the transformation of Bomber Command into a jet bomber force, which occurred between 1951 and 1954, a well-defined pattern of change can be observed. First there was the conversion of five Lincoln squadrons, as already mentioned, centred on Binbrook – Nos 101, 617, 12, 9 and 50; and of the three Mosquito squadrons, also mentioned – Nos 109 and 139 of the Light Marker Force and the

<sup>1</sup> Issue of 18 January 1952. <sup>2</sup> AMQLR No 25, October–December 1952. <sup>3</sup> Ibid, in File C 47790/52.

PR squadron, No 540. These constituted the changes up to the end of 1952 and they occurred at three stations – Binbrook, Hemswell and Benson, although the last-named was to be replaced by Wyton as the strategic reconnaissance base.

The pattern followed during 1953–1954 was for squadrons which had been disbanded in 1950 (or in 1946, in one case) to be re-formed with Canberras: this accounted for the appearance of Nos 10, 18, 27, 40, 82 and 76 Squadrons; and for the whole of the Washington force to be converted to Canberras: this accounted for Nos 149, 44/45, 57/104, 15/21, 90, 207, 115/218 and 35 Squadrons. In addition No 58 (PR) Squadron began the change from Mosquito PR.35s, No 199 (RCM) Squadron added a Canberra to its Lincolns early in 1954, and in April–May of that year No 100 Squadron became the last of the Lincoln bomber squadrons to convert to Canberras.

Another development, later in 1954, was the formation at Cottesmore of the first Canberra squadron to be based in Germany – No 149, deployed to Gutersloh on 17 September. By the end of that year there were two more Canberra squadrons there, Nos 102 and 103, and by March 1955 a fourth – No 104. At that time, the spring of 1955, the Canberra force was nearing its zenith, with 264 aircraft authorised and 259 on hand in 29 squadrons – 22 of these forming the light bomber force, three the reconnaissance force and four based in Germany (these four being under Bomber Command's overall policy control but under the day-to-day operational control of the 2nd Tactical Air Force: their role will be described later). These totals of 264/259 included 52 Canberra B.6s authorised and 36 on hand. The first of these more powerful, longer-range versions had gone to No 101 Squadron at Binbrook on 11 June 1954. They never, however, equipped more than a third of the light bomber force.

This build-up of the Canberra LBF directly reflected the pledge made by Britain to the North Atlantic Council at its meeting in Brussels in December 1950 to help “strengthen the defences of the free world”, as the Prime Minister (Mr C R Attlee) put it in the House of Commons on 29 January 1951, announcing the accelerated defence expenditure which included the increased bomber force. Canberras thus formed the spearhead of the RAF bomber force until the advent of the Valiants in 1955. From 1951, when the B.2s were introduced into service by the pioneer efforts of No 101 Squadron, until the build-up of the V-force they operated in remarkably versatile and ubiquitous fashion from five airfields in the UK – Binbrook, Coningsby, Hemswell, Scampton and Marham – and one in Germany (Gutersloh) as a conventional bombing force, being able to carry up to 6,000lb of bombs per aircraft.<sup>1</sup> There were four squadrons, with an establishment of ten Canberras each, on these stations and the aircrew were kept busy with a variety of tasks – some of them common to Bomber Command as a whole and some of them unique to individual squadrons. In the former category were continuation training, leading to crew classification of different grades (“combat”, “combat star”, “select”); competitions, on the stations, in the Groups and in the Command as a whole; and exercises – involving only Bomber Command, or Fighter and Bomber Commands, or bringing-in RCAF and USAF squadrons based in the UK, or the Royal Navy, or NATO air forces. In the latter category were various kinds of trial of engines or equipment, laid upon individual squadrons: for example, No 101 Squadron did intensive flying trials on the Canberra, between 10 September 1951 and 11 January 1952 (four months) completing 1,000hr IFT; and it also carried out trials of Orange Putter, the tail-warning radar which would advise the Canberras of fighter interception from the rear. No 109/105 also had the task of operational trials of Blue Shadow, which was the first sideways-looking radar to go into squadron service in the RAF; these trials went on for about a year.<sup>2</sup> No 50 Squadron at Binbrook also did RA.3 trials, in December 1952 being given the task of flying 400hr as soon as possible in Canberra WH654 “so that the engines could be returned to Rolls-Royce for research purposes”. When the weather was unsuitable at Binbrook the aircraft operated from master airfields, principally Leuchars, “supported by a Lincoln of No 100 Squadron from Scampton carrying groundcrew, relief aircrew and equipment”. No 50 also participated in the Orange Putter trials, but the ORB for the first six months of their existence makes it clear that the operational emphasis was on Gee-H bombing, which enabled the Canberras to bomb “blind” at altitudes of up to 30,000ft and over.

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<sup>1</sup> These were the original Canberra bases, and until 1958 it was a conventional bombing force. <sup>2</sup> BC OR Branch Memorandum No 163, May 1955.

Like the Lincolns which were used in two post-war theatres of operations, Kenya and Malaya, to drop bombs "in anger" the Canberras were likewise used in two theatres – Malaya and Egypt, in the latter co-operating with the Valiants during the Suez action of October–November 1956, which will be described subsequently.

In Malaya, detachments of Canberra B.6s which carried out strikes against Communist Terrorist positions began and ended with No 101 Squadron, which first went to Malaya under Operation 'Mileage' in February 1955 and was the last squadron to be detached there from June 1956 until August of that year when its aircraft were recalled to take part in the Suez operations. In between No 101's debut and finale, detachments from Nos 617, 12 and 9 Squadrons were sent out.

The ORB of No 101 Squadron, which first operated from Changi for two months and then from Butterworth in its February–June 1955 detachment, reflects vividly the Canberras' operational role in Malaya and some of the difficulties which were encountered there. When at Changi their bombing practice was carried out on the North China Rock range, and when at Butterworth on the Song Song Reef; their Firedog strikes – attacking CT targets with six 1,000lb bombs – were made in co-operation with Army Austers<sup>1</sup> which marked the targets with phosphorus grenades or reconnaissance flares. These Auster-marked targets were area-bombed.<sup>2</sup> No 101 Squadron had their first experience of the latter on 23 February when an initial attack was made by the CO (Squadron Leader W D Robertson) leading three aircraft, and of the former on 28 February when three aircraft with six 1,000lb bombs aboard attacked an Auster-marked target. Such attacks left light patches visible in the jungle, caused by dead vegetation, destroyed in the bomb explosions. On several occasions the crews experienced bomb hang-ups, and on one sortie during March two bombs released themselves on to the bomb-doors when the aircraft landed at Changi.<sup>3</sup> These hang-ups were found to be due to a design fault in the Avro Triple Carrier with which the Canberras were equipped, and which was subsequently replaced by a modified Avro Universal Carrier.

In general, these attacks were made in daylight, and one of the most concentrated series was Operation 'Saturation' which No 12 Squadron carried out in the Portang area from 30 November to 5 December 1955, five or six aircraft from the squadron bombing the area every day and generally twice a day – 144 tons of bombs being dropped during a period of 144 flying hours.<sup>4</sup>

There was no air, and hardly any ground-to-air, opposition to the Canberras during these operations; the biggest hazard they had to face was the unstable Malayan climate, and particularly the build-up of cumulo-nimbus clouds. On one occasion (5 April 1955) when No 101 Squadron sent off two aircraft on high-level night cross-countries the B.6s returned early, their crews having "encountered extremely uncomfortable conditions in cumulo-nimbus cloud embedded in thick cirrus; one aircraft was struck by lightning and had a flame-out on one engine".<sup>5</sup>

In addition to their prime task, the bombing strikes called for by ground forces in their campaign against the Communist Terrorists, the Canberra squadrons detached from Bomber Command to Malaya took part in various exercises and goodwill flights. Two of No 101's Canberras flew in Exercise Joss Stick, to test the Malayan air defences, on 22 May 1955; also taking part were Lincolns, Sunderlands, Vampires, Venoms and USAF B-29s. During April 1956 four of No 9 Squadron's aircraft participated in Exercise Monsoon against the aircraft carrier HMS *Centaur*, and five of its B.6s made a goodwill tour (12–16 April) of Manila.<sup>6</sup>

The Canberras took over the bombing role in Malaya during the later stages of the Emergency, in succession to the Lincolns, and in the view of the official historian were "too elaborate for the task they were required to carry out. They carried half the bomb load of Lincolns and their cruising speed of 250kt at the optimum bombing height<sup>7</sup> required more elaborate navigational aids and made map-reading

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<sup>1</sup> Of No 656 (Air OP/LL) Squadron, RAF, which from 1 September 1957 became No 656 Squadron of the Army Air Corps <sup>2</sup> No 101 Squadron's ORB referred to "the method employed for marking a target for pinpoint bombing, as opposed to the area bombing of . . . static targets". <sup>3</sup> Flown by Flight Lieutenant (later Air Chief Marshal Sir) A Steedman. <sup>4</sup> No 12 Sqn ORB. <sup>5</sup> No 101 Sqn ORB. <sup>6</sup> No 9 Sqn ORB. <sup>7</sup> Lincolns bombed at about 6,000ft.

“impracticable and visual bomb-aiming difficult. . .” Further,

“The pilot had a poorer visibility than in a Lincoln and the Canberra could not be flown at night or in close formation<sup>1</sup> and could not be employed in a strafing role. They suffered, in common with all jet aircraft in the tropics, from a serious limitation in their endurance at low level, which precluded the possibility of postponing or delaying an air strike once they were airborne. This was a serious disadvantage in the uncertain weather conditions of Malaya, especially in 1958 when Canberras were operating in the northern part of the country far from their parent base at Tengah near Singapore, and was reflected in an increase in the rate of abortive air strikes when they replaced Lincolns.<sup>2</sup> When flown at their normal speed at low altitudes the swirl vanes of /their Rolls-Royce Avon / engines suffered badly from metal fatigue in the hot, turbulent air which also made flying conditions difficult for their pilots. For those Canberras that were not fitted with Godfrey air coolers, sun canopies, cooling trollies and external compressed-air supplies had to be employed to combat the danger of loss of bodyweight through sweating which could amount to as much as 3lb per sortie.

“Both from the point of view of maintenance and flying conditions, Lincolns were preferable to Canberras in the type of campaign that prevailed in Malaya. . .”<sup>3</sup>

These are severe criticisms. What they amount to is that the Canberras, going out to Malaya in 1955 when the Lincoln force in Bomber Command started to be phased-out, proved to be less operationally suitable in that environment than their piston-engined predecessors. The Canberra had been designed to operate primarily in a European environment, and to bomb by radar, while the targets it was being asked to attack in Malaya were mainly visual ones – marked physically by smoke like those in the Second World War, and more suited for attack by aircraft of that era. Canberras also operated in Malaya in the photographic reconnaissance role, PR.7s of Nos 542, 540, 82 and 58 Squadrons going out on detachment from May 1955 onwards under Operation ‘Planter’s Punch’. Two aircraft of No 542 Squadron reached Changi on 13 May 1955 “to reinforce the Photographic Reconnaissance Force in FEAF” (to quote from the squadron ORB); their tasks were “surveys of Singapore and Labuan and the photography of communications in the Federation of Malaya”. The last Canberra PR squadron to participate in ‘Planter’s Punch’ was No 58, which during September 1956 had its detachment – taken over from No 82 Squadron on 19 March 1956 – curtailed, being instructed to return to the UK “as soon after 1 October as possible”. (This was at the time of the Suez operation). Subsequently, however, as the official history of the Malayan Emergency records,<sup>4</sup> “Bomber Command continued to provide two PR Canberras in the Far East for periods of two months twice a year, usually from January to March and from July to September, for the remainder of the campaign”. The PR.7 Canberras in Malaya do not seem to have experienced any particular technical or operational problems, apart from the weather which often impeded their photography.

While certain operational limitations were revealed by the Canberra in Malaya and in the Suez action (as will be described later), the aircraft was well liked by its crews and did wonders for the morale of Bomber Command, which had never before operated so fast and streamlined a type. Overseas flights were made to show it off, the first of them in 1952, when the AOC No 1 Group (Air Vice-Marshal D A Boyle) led four Canberras of No 12 Squadron on a 24,000-mile goodwill tour of South and Central America and the Caribbean area which began when they left Binbrook on 20 October.

In Exercise ‘Round Trip’, as the flight was code-named, the four Canberras flew first to Gibraltar and on the 21st to Dakar. From there on the 23rd they crossed the Atlantic to Recife, AVM Boyle setting-up an unofficial record time of 4hr 27min for the South Atlantic crossing. At Recife Sergeant J G Simms, AVM Boyle’s second pilot, gave short demonstration flights to Brazilian Air Force personnel.

On the 25th the four Canberras left Recife for Rio de Janeiro. At take-off and at 30,000ft AVM Boyle’s aircraft suffered a loss of power; when he was trying to cure this trouble one engine failed and he had to descend to 15,000ft to re-light. Nevertheless the Canberras reached their destination on time.

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<sup>1</sup> These assertions are not wholly accurate. <sup>2</sup> No 45 Squadron, based at Tengah with Canberra B.2s, was the last bomber squadron to be engaged in Firedog operations, from July 1958 onwards, following the departure of No 1 Squadron, RAAF, with its Lincolns (No 45 Squadron ORB for July 1958). In October 1958 No 45 reverted to a strategic role (ORB). <sup>3</sup> and <sup>4</sup> *The Malayan Emergency 1948–1960* (Ministry of Defence, June 1970).

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When three of the aircraft (flown by Squadron Leader L G Press, No 12's CO, Sergeant Simms and Flight Lieutenant J G W Stroud<sup>1</sup>) gave a formation demonstration over Sao Paulo and Rio de Janeiro on the morning of the 26th they encountered "several hundred" buzzards, one of which struck Sergeant Simms' aircraft (WD987). With bomb aimer's panel shattered and its perspex nose cracked the Canberra returned to Galileo Airport, the other two aircraft continuing with their demonstration.

With WD987 unserviceable, AVM Boyle flew WD996 when the Canberras left for Montevideo on the morning of the 28th, Sergeant A B Fraser and his crew (Flying Officer M G Jones and Flight Lieutenant G Stephenson) remaining behind. On take-off Squadron Leader Press was unable to get his nose-wheel to retract, so carried on to Montevideo with it extended, arriving there half an hour late. The other two Canberras had arrived on time.

On the 29th Squadron Leader Press and Sergeant Simms demonstrated their aircraft over Montevideo, and the following day the three Canberras left for Buenos Aires, flying in formation; they made a low-level fly-past over the airport and then did a stream landing. On the 31st the Chief of the Argentine Air Force was taken for a flight over the President's Palace by Flight Lieutenant Stroud, while Squadron Leader Press and Sergeant Simms demonstrated their Canberras over the airport and the town.

No 12 Squadron's next destination in Exercise 'Round Trip' was Santiago: AVM Boyle, Squadron Leader Press and Flight Lieutenant Stroud flew there uneventfully on 1 November, all three Canberras arriving on time. On the 3rd, Squadron Leader Press, Flight Lieutenant Stroud and Sergeant Simms took off in the afternoon for a formation fly-past at Quintero airfield and also over Vina del Mar and Valpariso.

When landing after a demonstration flight over Santiago the following day Squadron Leader Press had a main-wheel tyre burst, but the Canberra stayed on the runway, which much impressed the watching Chilean Air Force personnel.

However, on the following day Sergeant Fraser wasn't so lucky when he arrived at Santiago after having been left behind at Rio de Janeiro: he burst a tyre but his aircraft ran off the runway and sustained slight damage to the undercarriage. Meanwhile AVM Boyle, Squadron Leader Press and Flight Lieutenant Stroud had flown on to Lima, encountering 180kt headwinds en route and arriving half an hour late. In the morning of 6 November Squadron Leader Press gave a demonstration flight over the airfield, and later in the day Sergeant Fraser arrived there from Santiago.

The four Canberras left Lima next morning for Bogota, where they arrived on schedule, and where on the 8th Sergeant Simms gave two demonstrations. There the 12 Squadron team suffered its first human casualty, Flying Officer J Brownlow (AVM Boyle's nav/plotter) falling ill with fever. It was decided to fly him by Hastings to Caracas, which the Canberras reached on the 10th, showing their aircraft off over the town before landing at Marquetis airfield.

Next day Squadron Leader Press flew to Carlota, giving a demonstration there before returning to Marquetis. Sergeant Fraser likewise exhibited his Canberra, over Barquisimeto, and at midday AVM Boyle took off for Merecey, where there was no VHF control. A landing was made downwind and the Canberra ran off the end of the runway, AVM Boyle swinging it to port and avoiding a 20ft drop over a cliff. Flight Lieutenant Stroud flew there by Dakota and brought it back to Caracas.

The four Canberras left there on the 12th for Belize, where they found on arrival that the cloud base was only 400ft. As there was no VHF Squadron Leader Press landed first and controlled the other aircraft in their descents and landings. On the following day he gave a demonstration over the airfield.

No 12 Squadron suffered a second human casualty at Belize, Flight Lieutenant Stroud being taken ill with a fever and flown to Mexico City on the 14th, the four Canberras following him there, and Squadron Leader Press and Sergeant Fraser demonstrating their aircraft over the City and its airfield on the 15th.

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<sup>1</sup> Later killed in the Vulcan crash at LAP on 1 October 1956.

On the morning of the 17th the Canberras left for Havana, Cuba; on the 18th Squadron Leader Press demonstrated his aircraft and Sergeant Simms flew with the Minister of Defence as passenger.

The four Canberras (with Flight Lieutenant Stroud, now recovered from his fever, flying WD993) took off for Kingston, Jamaica, on the morning of the 19th. On arrival AVM Boyle, Squadron Leader Press and Sergeant Fraser landed in quick succession, Flight Lieutenant Stroud some 20 minutes later, after orbiting over Montego Bay. On the 20th Sergeant Simms gave a demonstration over Kingston and its airport and on the 23rd Flying Officer Brownlow rejoined the force, which left for Ciudad Trujillo (Santo Domingo) on the following day. There, on the 25th, Squadron Leader Press demonstrated his Canberra over the airport and the town.

Trinidad was the next stop, the Canberras making a low run over Port of Spain when they arrived there on the 26th, and the next day Squadron Leader Press flying up to Barbados to give a demonstration there, while Sergeant Simms gave a "local" one over the town and airport. On the morning of the 18th all four aircraft took off for Belem, Brazil, en route making a low-level fly-past over Georgetown, Guyana; then on the 30th they left Belem for Recife and their return flight across the South Atlantic, which was accomplished on 2 December after an early morning departure.

Following a day's rest at Dakar the Canberras left for Gibraltar on the 4th and the next day took off for Binbrook but were diverted to St Eval: there they were welcomed home by the AOC-in-C Bomber Command, Air Chief Marshal Sir Hugh Pugh Lloyd. On the 6th they returned to Binbrook, having done 249hr 35min flying (228hr 05min en route and 21hr 30min giving demonstrations) and having covered nearly 24,000 miles in their circumnavigation of South America. This was indeed, one might say, a *tour de force* by No 12 Squadron – from whose Operations Record Book these details have been given.

The Canberra was probably the only RAF bomber since the 1930s to have an aerobatic capability; thus when Wing Commander R P Beamont, English Electric's chief test pilot, delivered the sixth B.2 to No 101 Squadron at Binbrook on 9 October 1951 he "gave a display of aerobatics on arrival" (as the squadron's ORB recorded), and during 1956 a formation aerobatic team of four Canberras was formed at No 231 OCU. Led by Squadron Leader F P Walker, a QFI at the conversion unit, it gave displays at the Coventry Air Pageant in July and at the SBAC's Farnborough Display in September, the ORB recording that the team "gave a polished performance of co-ordinated aerobatics and formation flying". Its aerobatics included a formation barrel roll and an upward bomb-burst – which, as the aviation magazine *Flight* commented, had been "hitherto regarded as the 'perk' of Fighter Command".

As may be inferred, the Canberra was an amenable aeroplane, with a low wing loading and a good power-to-weight ratio; the experience it gave to hundreds of aircrew in the 1950s of jet-powered operations formed the basis on which the V-force was subsequently built up. Many of the names which appear in the ORBs of Canberra squadrons recur in those of the Valiant, Vulcan and Victor squadrons as pilots and navigators entered on their second or third tours of post-war bomber operations.

However, despite its fine flying qualities, the Canberra was not an aircraft which could be taken lightly; situations could and did occur in which it was possible for the pilot to lose control. These were likely to arise for two reasons – through lack of experience, especially when flying on instruments; or because stick forces were set up which became too great to be counteracted manually.

- The background to these two main reasons for Canberra accidents was, first, the lack of a dual trainer until more than two years after the aircraft entered service – the first T.4 being recorded on the strength of No 231 OCU in July 1953. This meant that the first-generation Canberra pilots did their jet conversion training on Meteors, then had to "find out for themselves" about Canberras through self-education on the type; in this their previous experience, combined with jet conversion, enabled them to cope. It was less experienced pilots who found themselves in difficulties. As a review of Canberra accidents commented in 1956:-<sup>1</sup>

"Loss of control on instruments and on asymmetric power caused ten major accidents of which five were fatal. It is worthy of note that the majority of pilots involved in these accidents were relatively

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<sup>1</sup> Canberra Accident Review, issued by the Directorate of Flight Safety, December 1956.

inexperienced. A study of the reports on the accidents has revealed that, while the Canberra is a comparatively simple and comfortable aircraft, it can be most unforgiving when mishandled by the 'below-the-average' pilot. Unfortunately, in the early stages, several pilots of marginal ability were accepted for Canberra training and some time elapsed before higher standards were set for would-be trainees. Dual aircraft and/or flight simulators would undoubtedly have obviated several of these accidents".

The review summed this up by saying that the early history of the Canberra had revealed conclusively that "marginal ability, even on a comparatively safe aircraft", was "associated with many pilot error accidents" and that "the advent of dual aircraft, the selection of better trainee material and the introduction of an excellent conversion programme, did much to reduce the pilot-error accident rate".

The background to the other main reason for Canberra accidents – the setting-up of stick forces which became too great to be counteracted manually – was the occurrence of runaway tail trim actuation, so that while at low speeds (as the previously-quoted review put it) a runaway trim could be coped with, at high speeds it might "impose such severe 'G' loading as to render the pilot incapable of taking corrective action before the aircraft assumes an attitude from which it is impossible to recover". As a result of accidents for this reason, the Canberra B.2s were grounded during 1956 for modifications to their electrical circuits.

Other causes of Canberra accidents were failure of the undercarriage or hydraulic system – accounting for one-third of the 128 major accidents which occurred between January 1952 and April 1956<sup>1</sup> – and compressor stall, occurring at low speeds in a nose-up attitude, for example during the last stage of an approach to land.

But the virtues of the Canberra outweighed its defects by far, and it served in a variety of roles, reflected in the different versions in which it was built: B.2 and B.6 (bomber); PR.3, PR.7 and PR.9 (reconnaissance); T.4 (dual-control trainer); B(I).8 (bomber intruder); T.11 and T.19 (AI radar operator trainer); B.15 and 16 (tactical nuclear or conventional bomber and ground-attack aircraft); and T.17 (ECM trainer) and TT.18 (target-tower).

The Canberra light-bomber force, which started to form in 1951 and gradually took over front-line duties from the Lincolns, reached its zenith during 1956 then gradually declined in numbers as more squadrons of the V-force – for which it had provided the basis of experience in jet bomber operations – were formed.

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<sup>1</sup> Canberra Accident Review.

## CHAPTER 3

**Inception and Development of Four-engined Jet Bombers and the First British Nuclear Weapon (1946–1953)**

Three factors emerged from the Second World War which were to affect all subsequent defence thinking – the turbojet engine, surface-to-surface missiles and the atomic bomb. The appearance of He162s, Me163s, Me262s and Meteors in the embattled skies of Europe heralded the propulsive power of future aircraft; the descent of V2s on to London, Antwerp and elsewhere foreshadowed the development of American and Russian strategic nuclear missiles; and the dropping of two kiloton-range nuclear bombs on Japan from USAF B-29s in August 1945 set a precedent for future airborne weapons.

Britain took account of two of these factors – turbojet power and nuclear energy – in planning new military aircraft and weapons; the third factor, missile technology, was left entirely to the USA and USSR, which between them appropriated German hardware and technicians to develop their own programmes. The RAF Air Staff specified turbojet power for new bombers to succeed the Lincolns and Lancasters; these were to fly faster, higher and farther than any British military aircraft had ever flown before: their operational scenario would be the Soviet Union, for it had become clear after the Second World War ended that Europe was not at peace – only in an uneasy state of armed truce, and that if a Third World War began it would be between the Communist Bloc and the Western Powers.

The gravity of the post-war situation affected Britain's decision about the second factor, nuclear energy, and whether it should be used for military purposes. Her physicists had participated in the American programme; one of them (Dr William Penney) and one of the most famous RAF bomber pilots (Group Captain Leonard Cheshire) had seen 'Little Boy' and 'Fat Man' – as the two original US atomic bombs were called – fall on Japan. Their catastrophic effects – each bomb destroying a complete city and the Japanese surrendering unconditionally on the day after the second one had been dropped (9 August 1945) – made an indelible impression upon world opinion. In Britain the question was whether the military implications of atomic energy should be accepted. The new Prime Minister (Mr C R Attlee, whose party had only been in power for just over a month) put the question squarely before his senior Ministers in the Gen 75 committee in a memorandum; he said that "a decision on major policy with regard to the atomic bomb is imperative. . . . [T]he emergence of this weapon has rendered much of our post-war planning out of date . . . ."<sup>1</sup>

It was this committee which eventually, on 8 January 1947, took the decision that research and development of atomic weapons should be undertaken in Britain – but in the intervening 17 months there had been a great deal of agonising appraisal by the political leaders, civil servants, scientists and the Chiefs of Staff.

Some of the post-war planning had started as early as November 1945, when the Chiefs of Staff had asked the Joint Technical Warfare Committee – availing themselves of the best scientific advice available – to forecast developments in weapons and methods of warfare. Its subsequent report (known as the Tizard Committee Report because of the committee of distinguished scientists under Sir Henry Tizard who were largely responsible for it) was presented in July 1945 but almost immediately 'rendered out-of-date' by the advent of atomic weapons – which the scientists had mentioned as a theoretical possibility. Consequently the Tizard Report was sent back for revision and re-appeared in July 1946, its new conclusions – which included the advocacy of atomic bombs as a means of avoiding large-scale campaigns – being accepted by the Chiefs of Staff and the Cabinet Defence Committee as a basis for future planning.

But everything turned upon a Government decision on the manufacture of atomic bombs by Britain, and this was preceded by a sequence of meetings, reports and related actions bearing on the production of fissile material – against a background of the 'Iron Curtain' crisis in Europe, the formation of the United Nations Organisation, the creation of the USAF Strategic Air Command<sup>2</sup> and the passing of the McMahon Act by the US Congress, forbidding any other nation access to atomic information. Faced by

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<sup>1</sup> PM's memorandum, 'The Atomic Bomb', discussed at the Gen 75 second meeting, 29 August 1945. <sup>2</sup> It included the 509th Composite Group which had dropped the atomic bombs on Japan.

the likelihood that the newly-formed UNO would not be able to control the development of atomic weapons, should Britain acquiesce in an American monopoly until – as seemed likely – possession of them was shared by the Russians?

The British Government's decision was made only after several exploratory and advisory steps had been taken. Shortly after the American bombs fell on Japan an Advisory Committee on Atomic Energy had been set up (on 21 August); then came the Prime Minister's memorandum, in which (in effect) he said to his senior colleagues "the atomic bomb is now a fact – what do we do about it?". On 10 September the head of the British delegation to the US atomic energy programme, Sir James Chadwick, had sent a telegram to say that its military applications made a production plant "of our own" essential for the defence of Britain and the Commonwealth, and on 29 October the Prime Minister told the Commons that an R&D establishment was to be set up at Harwell to engage in research on all aspects of atomic energy. On the same day a Report by Officials<sup>1</sup> recommended the production of atomic bombs by the UK, and before the end of 1945 the Gen 75 group of senior Ministers had approved the building of a pile to produce plutonium – enough to make a small number of atomic bombs in a year.

The year 1946 was a crucial one for atomic energy development in the United Kingdom, and seminal to all that followed – the building of jet bombers designed to carry nuclear weapons, the production of atomic bombs, the philosophy of strategic nuclear deterrence and the operational deployment of the V-force. At the very beginning of the year the Chiefs of Staff recommended to the Prime Minister that a stock of atomic bombs should be built up; and in the same month the latter announced (on 29 January) that a production organisation was to be set up to manufacture fissile materials, and that Lord Portal (recently retired as chairman of the Chiefs of Staff Committee) was to be Controller of Production (Atomic Energy) at the Ministry of Supply and Professor J D Cockroft director of the Atomic Research Establishment at Harwell. Thus the means for producing atomic energy, and for researching into its possible uses, had been created in the United Kingdom – though the Government had not yet decided whether it was to have a military application. If it did, this was likely to be in the form of a bomb, delivered by an aircraft; and accordingly the Air Staff laid down their requirements – for a medium-range (*ie* 1,500nm radius of action) bomber and for an atomic bomb suitable for carriage by it: these were, respectively, OR229 of 17 December and OR1001 of 9 August 1946.

There was no complication about the atomic bomb requirement, OR1001. Nobody, apart from the Americans, had made one before – so the dimensions were worked out theoretically, extrapolated from the size of the ball-shaped warhead it had to contain. Thus it was to not exceed 60in (5ft) in diameter, 290in (24ft 4in) in length – much longer than the bombs dropped on Hiroshima and Nagasaki which were not aerodynamically shaped – or 10,000lb in weight; and it was to be capable of being dropped from heights of between 20,000ft and 50,000ft and at speeds of between 150kt and 500kt. This was the bomb which came to be known as Blue Danube.

The complication about the aircraft requirement was that originally one (OR230) was drafted for a long-range bomber with a 2,000nm radius of action, but during 1946 a less ambitious requirement, for a 1,500nm radius of action, was drawn up and this was the one finally decided upon at an Operational Requirements Committee meeting on 17 December: the aircraft was to have a speed of 500kt and a height above its target of 45,000ft. There was to be no self-defensive armament and the five-man crew were to be accommodated in a pressurised cabin.<sup>2</sup> This was the type which materialised as the Vulcan and Victor V-bombers.<sup>3</sup>

While the RAF were going to have new jet-powered bombers to replace propeller-driven types, whatever future weapons they might carry, the Government had still not decided to authorise the development of nuclear bombs. In August the McMahon Act, designed to secure a US monopoly of atomic weapons until international control of them could be achieved, and effectively destroying the Anglo-American collaboration in nuclear energy matters which had previously existed,<sup>4</sup> was signed by

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<sup>1</sup> Commissioned by senior Ministers. <sup>2</sup> Originally to be ejectable – a requirement found too difficult to fulfil. <sup>3</sup> Named so in 1952, following the 'V' of the already-named Valiant. <sup>4</sup> See M. Gowing, *Independence and Deterrence Britain and Atomic Energy, 1945–1952* (Macmillan, 1974), Ch 4, pp 21–26.

President Truman. Britain was thus 'on her own'; if she did decide to build atomic bombs, these would have to be designed and developed by her own physicists and engineers.

The catalyst to a Government decision on nuclear weapon development was provided by two men who were subsequently to play a leading part – Dr William Penney and Lord Portal. The former, who had been closely associated with the American atomic bomb programme and was now (in the latter half of 1946) Chief Superintendent of Armament Research in the Ministry of Supply, sent the Controller of Production of Atomic Energy a private note<sup>1</sup> suggesting how “the ordnance part of the manufacture of atomic bombs . . . could be carried out, if it were decided in the national interests that such work should proceed”. This memorandum, sent to Portal at the beginning of November, gave him the clearest possible read-out on what was involved – in terms of engineering and location – in the manufacture of an atomic bomb. At the same time the CPAE had been in close touch with the Chiefs of Staff Committee; he had told them (on 29 October) that he would be willing to co-operate with them to the fullest degree in the matter of requirements for atomic weapons. At the end of 1946 he reported on these discussions to his Departmental head, the Minister of Supply (Mr John Wilmot), saying that although it was not strictly his responsibility, since his department was “the sole repository of information on the subject from American sources”,<sup>2</sup> he thought he ought to bring the matter up for Ministerial decision – and that the Prime Minister had expressed a wish for a short document to be circulated.

The note which Lord Portal sent to his Minister, and which was considered by a Meeting of Ministers at 10 Downing Street on 8 January 1947, led to the most crucial decision in British politics since the war – to authorise atomic weapon research and development.

This note put it quite bluntly to the Government that a decision was required about the development of atomic weapons; it said that the Service Departments were “beginning to move in the matter” – presumably a reference to the RAF requirement for an atomic bomb – and that “certain sections of the Press” were “showing interest in it”. Three possible courses of action were suggested: not to develop an atomic weapon; to develop it “by means of the ordinary agencies in the MoS and the Service Departments”; or to develop it “under special arrangements conducive to the utmost secrecy” – with a rider that if “special arrangements” were thought desirable “we are well placed to make them” (a reference to the detailed ‘brief’ which Dr Penney had provided).

The Ministers who took the decision, under the Prime Minister’s chairmanship, were the Lord President of the Council (Mr H Morrison), Foreign Secretary (Mr E Bevin), Secretary of State for Dominion Affairs (Lord Addison), Minister of Defence<sup>3</sup> (Mr A V Alexander) and Minister of Supply and Aircraft Production (Mr J Wilmot); with them were the Permanent Secretary of the Treasury (Sir E Bridges), Lord Portal and Foreign Office (Mr N Butler) and Downing Street (Mr G Barnes) representatives.

During the preceding July, at Bikini Atoll in the Pacific, the Americans had exploded their fourth and fifth atomic bombs – the former dropped from a B-29 and the latter detonated under water.<sup>4</sup> At the 8 January 1947 meeting the Foreign Secretary said that Britain could not afford to acquiesce in an American monopoly of this new development. Other countries might well develop atomic weapons, and unless an effective international system could be set up under which the production and use of such weapons were prohibited, Britain must develop them. It was this view, that the United States should not be left in a monopoly position and that there was a likelihood of atomic weapons being developed elsewhere – in the absence of effective international control, that influenced the Ministers’ decision to authorise research and development work in the UK on atomic weapons.

This secret discussion<sup>5</sup> and the ensuing decision meant that work could go ahead on fulfilling the Air Staff Requirement of 9 August 1946 for an atomic bomb; and by chance, at almost the same date, the first steps were taken in the procurement of the aircraft which were to carry it: on 7 January 1947, the

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<sup>1</sup> Typed by Penney himself, with a hand-written covering note. <sup>2</sup> Chiefly in the person of Dr Penney.

<sup>3</sup> The creation of a Ministry of Defence had been announced on 5 October 1946. <sup>4</sup> The purpose of these trials was to determine the effect of A-bombs on ships. <sup>5</sup> All copies but three of the Minutes were destroyed, and all wax impressions.

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day before the Ministers' meeting, the approved Operational Requirement (OR229) and the Ministry of Supply Specification based on it (B.35/46) were issued, and on the day following it MoS letters were sent out to six companies inviting them to tender for the contract. These two programmes, for weapons and aircraft, formed the foundations of the RAF V-bomber force; and the philosophy of strategic nuclear deterrence had already been formulated. Probably the earliest enunciation of this was in a Minute from the Chiefs of Staff to the Prime Minister, dated 2 January 1946, in which they said that while they hoped that Britain's future military security would be assured by the United Nations Organisation, it had not yet been proved; and from a military point of view, they had to consider the position should UNO fail and a potential aggressor be in possession of atomic bombs. They were convinced that "the best method of defence against the atomic bomb is likely to be the deterrent effect that the possession of the means of retaliation would have on a potential aggressor". Although the Chiefs of Staff were referring in their Minute to the production of atomic energy<sup>1</sup> and to the building-up of a stock of bombs, their use of the phrase "means of retaliation" implied both weapons and aircraft to carry them.

Both the bomb and the aircraft programme were carried-through successfully over the next ten years – the former almost entirely without complications, despite the enormous technical problems which had to be overcome, the latter not without complications because of the advanced character of the bombers ordered and the need which arose to inject an 'interim' type into the programme (because of a worsening international situation) which would enter service earlier.

As the bomb was a separate project, involving very small numbers of people working under conditions of the strictest security,<sup>2</sup> it may be convenient to give an account of its development first – up to the time of the successful test of a warhead in the Monte Bello Islands on 2 October 1952 and the delivery of the first production atomic bombs to RAF Bomber Command in November 1953. In this project a Royal Air Force team played a crucial part in the design and assembly of the spherical-shaped warhead, working together from early 1948 onwards.

Inevitably the bomb was the product of several different agencies, under the aegis of the Ministry of Supply: the Atomic Energy Research Establishment, MoS Factories, Armament Research Establishment, Royal Aircraft Establishment, Royal Ordnance Factories, the Royal Air Force – both customers and participants in the programme – and civil contractors. The three key executive figures were Professor J D Cockcroft, who headed the Research Establishment at Harwell; Mr Christopher Hinton, who was responsible for the design, construction and operation of plants producing fissile material; and Dr William Penney, who as Chief Superintendent of Armament Research was in charge of the design of the bomb.<sup>3</sup>

As far as the RAF were concerned, the key figures in initiating and developing an atomic bomb were Air Vice-Marshal E D Davis, who had retired from the RAF in February 1946 after a career as an armament specialist and from 1947 had a special appointment in atomic energy at the Ministry of Supply, Group Captain H Ford of his staff, and Wing Commander J S Rowlands, GC, also an armament specialist, who headed the ten-man team which designed and assembled the first warhead at the Armament Research Establishment at Fort Halstead, near Sevenoaks in Kent.

Extreme secrecy was maintained about arrangements to develop atomic weapons; so much so, for example, that on 7 January 1947 – the day before the Ministers' decision to authorise R&D – ACAS(TR) (Air Vice-Marshal J N Boothman) complained to VCAS (Air Marshal Sir William Dickson) that although a requirement for an atomic bomb had been stated to the Ministry of Supply the previous September there was no organisation in the UK to develop the military side of atomic energy, nor likely to be for some time to come. Thus even the Air Staff was kept in the dark; and as ACAS(TR) explained, "the air side of the MoS" – that is, those concerned with aircraft specifications – had been told that they

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<sup>1</sup> Replying to a request made on 18 December 1945 by a Meeting of Ministers, to report on requirements for atomic bombs. <sup>2</sup> The PV (positive vetting) method of security clearance was introduced for personnel working on the atomic bomb. <sup>3</sup> Another 'key figure' in atomic energy at the time was Dr Klaus Fuchs, arrested as a spy in February 1950.

would be ill-advised to finalise the dimensions of the bomb-bays of the proposed new jet bombers until they had officially been given the probable dimensions of the new bomb, but as there was no development organisation, things had reached an impasse.

In fact, as no Governmental decision to proceed had been made up to that time, nothing could have happened; and when the Ministers on 8 January agreed that R&D on atomic weapons should be undertaken, this was on the understanding that the "special arrangements" outlined by Lord Portal – ensuring secrecy – would be put into effect. Indeed it wasn't until during May that Dr Penney – referred to by ACAS(TR) in writing to VCAS as "the only technical authority in this country on the design of atomic bombs" – was told of the Ministers' decision and to go ahead.<sup>1</sup>

As Controller of Production of Atomic Energy, Lord Portal had ultimate responsibility to the Government for the atomic bomb programme. Because of his prestige as former CAS and chairman of the Chiefs of Staff Committee, he still had strong links with the Chiefs of Staff and had taken the lead during 1945 in formulating their atomic bomb proposals. But as CPAE he was responsible for the whole field of atomic energy development – civil and military – and it was AVM Davis, recently retired from the RAF (in 1946), who co-ordinated the military programme, who picked the RAF team to work on the warhead and who led the survey team to the Monte Bello Islands where the first test was held.

The first member of the team to be chosen was Wing Commander J S Rowlands, interviewed in July/August 1947 when he was at RAE Farnborough; subsequently he and AVM Davis selected its other members from the RAF worldwide – feeding-in their qualifications into a computer, then bringing them in from wherever they happened to be serving; no matter at what point they happened to be in a tour or in their career, the new project had priority. They were all "good quality technical men"<sup>2</sup> – Squadron Leaders J H Hunter-Tod and J P Prior, Flight Lieutenants C S Betts, A H Bullock, D W Densham, H Durkin, D Mercer, P E Mitchell and M E Pulvermacher<sup>3</sup> – and their tasks were to bring together and assemble the component parts for the first warhead, which would be detonated in the first British test, and for the warhead for the first production bomb; and to write instructional manuals and draw up training schedules for Service use. They were 'starting from scratch', working under the guidance of the experienced and brilliant Dr Penney, their activities disguised under the cover name HER ('High Explosive Research'). Wing Commander Rowlands' responsibility was to "see that everything we were making could be put together in one case" – in other words, co-ordinating the activities of his RAF team with those of scientists, engineers and technicians working in other MoS establishments and factories. A characteristic of atomic energy research and production was the widespread location of its centres, partly because of geographical accident – the availability of suitable sites – and partly because, on security grounds, it was advisable that the majority of people involved should have only a partial view of the overall purpose of their activities.

Generalised atomic bomb technology is now public knowledge, the subject of magazine articles with coloured cutaway drawings. In 1948, the British and the Russians<sup>4</sup> were discovering it for themselves, the former in response to an Air Staff requirement accepted by the Ministry of Supply. Engineering work of the highest quality was required; conventional high-explosive components for the test warhead were made at Woolwich and Hunting Aircraft made the casing and container for the latter as well as contributing to the production weapons. The contrast between the cold mathematical calculations and engineering precision on the one hand, and the nuclear fission which resulted when the warhead was exploded, could not have been more dramatic.

The weapon which was being designed for the RAF was a plutonium bomb, of the type which had destroyed Nagasaki. Plutonium was decided upon for large-scale production in the UK because it was considered to be superior to U235<sup>5</sup> for military applications, and also probably superior for civil applications.<sup>6</sup> It was manufactured in the atomic piles at Windscale and fabricated at Aldermaston; and

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<sup>1</sup> M. Gowing, *Independence and Deterrence, 1945–1952*. <sup>2</sup> Author's interview with Air Marshal Sir John Rowlands, GC, KBE, BSc, CEng, RAF(Ret). <sup>3</sup> One became an air marshal and two became air vice-marshals. <sup>4</sup> Whose first atomic test was made at Semipalatinsk on 29 August 1949. <sup>5</sup> Used in the 'Little Boy' bomb dropped on Hiroshima. <sup>6</sup> Advisory Committee on Atomic Energy report (ACAE(45)62).

when the first British test came to take place in the Monte Bello Islands four containers, each holding a half ball of plutonium, were carried out to the site by Wing Commander Rowlands and Squadron Leader Mitchell, and Mr W J Moyce.

Plans for a test had begun to be made in 1950 – it was to simulate an attack on a port by a ship with an atomic bomb concealed in it – and because of difficulties over possible use of an American site, or one in Canada, the alternative of one off the west coast of Australia was considered; this alternative, the Monte Bello Islands, was surveyed during 1951 and found satisfactory.

Operation 'Hurricane', as the first British atomic test was called, involved the Royal Navy – which provided an armada of vessels, including the frigate HMS *Plym*, carrying out in her hold the warhead which was to destroy her – and the Ministry of Supply, plus the small RAF team which brought out the plutonium.

The majority of the scientific personnel, about 100 of them, had arrived in the Monte Bello area on 8 August to begin their preparatory work for the test; they were accommodated aboard the former aircraft carrier HMS *Campania*. With the three-ton warhead secured and cushioned in her hold by specially-made fittings, HMS *Plym* had left the UK in June and was now anchored for the last time off the western shore of Trimouille, one of the Monte Bello islands.

The plutonium, in four 18in deep containers of 18in diameter,<sup>1</sup> was brought out by air by Wing Commander Rowlands, Squadron Leader Mitchell and W J Moyce<sup>2</sup> and their journey had a cloak-and-dagger character. It began with two green furniture vans (one of them a back-up vehicle in case of a breakdown) proceeding from Aldermaston to RAF Lyneham, the two RAF officers (wearing civilian overcoats) and the civilian scientist travelling by car, but accompanied by RAF police.

RAF Transport Command had previously flown 44 scientists out to Australia, in August and early September. The special features about this last airlift for the test were that the three passengers were provided with parachutes – in the event of anything untoward happening to the Hastings they were to abandon it with their canisters of radioactive material – and that at Singapore they were to transfer to a Sunderland of the Far East Flying Boat Wing, which would land on the lagoon where HMS *Plym* was moored. In addition to her, portions of Spitfire and Lancaster airframes were exposed as 'targets', so that the Air Ministry could gain evidence of the effects of an atomic explosion on aircraft structures. At Singapore the Hastings landed at RAF Seletar, making the transition from the airfield to the flying-boat lying offshore a comparatively easy one for Wing Commander Rowlands and his travelling companions.

When the Sunderland alighted on the lagoon, they had their first sight of the doomed frigate, and in the early hours of 2 October 1952 boarded her – having sailed in by launch from HMS *Campania* – to load the radioactive material into the warhead; then they, and personnel who had checked the electrical firing mechanism and the telemetry circuit, returned to the aircraft carrier.

With the bomb armed, HMS *Plym* had been depopulated between 6 and 7 am (some of the scientists had been aboard since shortly after midnight), and at 0915hr Commander Ian Maddock began the count-down. A few seconds later nothing remained of the frigate: she had disappeared in a vast fireball, followed by a tremor which grew into a blast wave. The first British atomic test had been successful; it was the 33rd nuclear test since the war – 29 had been American and three Russian. As the Atomic Energy Authority's official historian put it: "two lumps of an ordinary-looking heavy grey metal, no more than one man could carry by hand on the journey to Monte Bello. One of these . . . , encapsulated in its shapes of high explosive, had produced, in a micro-second of activity, a searing plume and mushroom cloud laden with lethal contents, and blast equal to that of 20,000 tons of TNT"<sup>3</sup>

Dr Penney, knighted for his leadership of the atomic weapon project and for the success of the test, left for the UK with Wing Commander Rowlands and members of his team by Transport Command Hastings on 10 October from RAAF Onslow, 70 miles south-west of the Monte Bello Islands. The principle had been proved, but it was to be more than a year before the RAF received the first production (Blue Danube) atomic bombs.

<sup>1</sup> A 'darkish metal', it was hermetically sealed in the containers. <sup>2</sup> A civilian scientist and explosives expert. <sup>3</sup> M. Gowing, *Independence and Deterrence Britain and Atomic Energy 1945–1952, Vol II*.

Responsibility for the design and development of these lay principally with the Aldermaston and Farnborough Establishments, and with the RAF team at Fort Halstead, whose job it was to see the weapon into service. In brief, while Aldermaston were concerned with the bomb's content and Farnborough with its outward shape and ballistics,<sup>1</sup> Wing Commander Rowlands and his nine colleagues had to see that training manuals were written and plans made for housing weapons and for instructing personnel in handling them at Bomber Command stations where they would be mated with their carriers.

Wittering was to be the first RAF station to hold atomic bombs, as it was to be the first with a V-bomber squadron, and it was there that Wing Commander Rowlands was posted in August 1953 as CO of the Bomber Command Armament School – which in fact prepared for the entry of A-bombs into RAF service. In his own words,<sup>2</sup> he and his team of officers had “the confidence of knowledge”: they had been intimately involved in the weapon's development and had written virtually all the RAF training manuals on it. At BCAS, security procedures were devised, so that no one person would have access to the firing system (following USAF practice); instructional courses were started; and Wing Commander Rowlands and his staff planned buildings for storing nuclear weapons – buildings whose basic design was never modified throughout the existence of the V-force.

The uniqueness of the knowledge possessed by BCAS staff was stressed in its first Operations Record Book entry, which said that “the first atomic bombs are expected to be delivered to the Royal Air Force on 1 October 1953 and it will be necessary to train personnel in their custody, storage, servicing, transportation and use. This will be done at the Bomber Command Armament School. The RAF has no experience in dealing with atomic weapons, and it was therefore decided to staff BCAS largely with RAF personnel who had experience in the design and development of atomic weapons at the AWRE”.

Referring to the functions of BCAS, the ORB said that the unit had been “established for training purposes only. However, . . . it is clear that Air Ministry and HQBC intend to place extensive additional tasks on the unit and . . . the functions . . . will be as follows: to train RAF personnel . . . on atomic weapons and associated matters; to train selected Naval, Army and . . . Government personnel . . . ; to accept the first atomic bombs delivered to the RAF, and to be responsible for the custody, storage and servicing of these . . . ; to develop and formulate the servicing procedures relating to atomic bombs; to prepare the full servicing schedules . . . ; to write the Air Publication; and to carry out trials as required for Air Ministry and the AWRE”.

A busy agenda indeed; and during November – not October, as had been expected – the first atomic bomb was delivered, its explosive power equivalent to that of the whole of Bomber Command in the Second World War. The ORB recorded:-

“November 1953 has been a historic month for this unit, and indeed for the Royal Air Force and the country. During this month the first atomic bombs have been delivered . . . , and they are now held by this unit. These bombs will raise the striking power of Bomber Command to an order completely transcending its power hitherto”.

The bomb components had arrived from Aldermaston on the nights of 7 and 14 November (which were Saturdays), and travelling with the second convoy – whose load included radioactive materials – were Wing Commander Rowlands and Squadron Leader Mitchell, “since they had previous experience of the transport and handling of radioactive materials during the Monte Bello trials”.

Thus the RAF had started to get its atomic bombs, just over seven years after first requesting them; but it was to be more than a year before it got the first of the aircraft which were to carry them.

Inevitably the design and development of a modern aircraft, with all the contractors involved – for the airframe, engines, hydraulic systems, wheels and brakes, instruments, electronics and radio, etc, etc – is more complex than that of a weapon, even though building an atomic bomb represented pioneer

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<sup>1</sup> Some of the aerodynamic trials were flown by a Lincoln, over the marshes near Foulness. <sup>2</sup> In an interview with the author.

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technology for British scientists and engineers. The V-bombers' entry into service would have taken even longer had it not been that a deteriorating international situation brought about the insertion of an 'interim' type, the Vickers Valiant, into the programme and this aircraft went to Bomber Command more than a year before either of the two types originally ordered— the Avro Vulcan and Handley Page Victor— were accepted by the RAF. Nor was this 'leap-frogging' the only complication in the jet bomber story: a fourth type, the Short Sperrin, was built as an 'insurance' against undue delays with the Avro and Handley Page versions; but although two prototypes flew it was not ordered into production, the requirement for it (its Specification was B.14/46) being cancelled by the Air Staff.

Why were there so many different types of V-bomber to fulfil one (OR229) requirement? A somewhat cynical reason was advanced in retrospect by the Director of Operational Requirements/ACAS(OR) during that period,<sup>1</sup> who said<sup>2</sup> that the requirement for the V-bombers was dictated by two major factors – the size of the bomb and the geographical position of Moscow; and that this led to many questions, one of the main ones being survival – whether to use performance or armament, in the end the decision being made to use performance.<sup>3</sup>

He went on to say that eventually five V-bombers (with four different engines) were produced, one with a crescent wing and another with a delta wing<sup>4</sup> – commenting that the latter were “regarded by the Ministry of Supply as rather a technical gamble, and an insurance was taken out in the form of an aircraft which emerged as the Valiant. It was not easy to see”, he commented,

“why such a plethora of machinery was produced, but I believe the real reason was that the effect of the atom bomb on war had not got through to the Ministry of Supply, which wanted a big industry to fight another big and long war . . . Moreover, at this time Korea kept the ball rolling, and Mr Attlee had a defence budget of £4,700m for three years. So all the projects went ahead”.<sup>5</sup>

As has already been mentioned, it was on 9 January 1947 that the Ministry of Supply sent letters to six aircraft companies inviting them to tender for the B.35/46 medium bomber specification – with an appropriately historical (though doubtless accidental) sense of timing, on the day after the Ministers had taken their momentous decision that R&D on atomic bombs should be undertaken. The six companies were Armstrong Whitworth, Avro, Bristol, English Electric, Handley Page and Shorts, and when they had submitted brochures and these had been considered a Tender Design Conference at MoS (on 28 July) decided in favour of the Avro delta-wing proposal. The meeting was unable to come to a decision on the Handley Page crescent-wing version; it asked that this should be subjected to high-speed wind-tunnel tests at RAE, following which a choice would be made between the Handley Page and Armstrong Whitworth designs.<sup>6</sup>

As things turned out, the Handley Page H.P.80 (later named Victor) became the favoured choice and on 19 November the company were sent an ITP (intention to proceed) by the Ministry with a prototype contract for two aircraft; and on 27 November it was agreed that an ITP should be sent to Avro to cover their B.35/46 design (Type 698 – later named Vulcan) and flying models.<sup>7</sup> A prototype contract was actually issued to Avro during January 1948. Thus by the turn of the year 1947/8 the V-bomber procurement programme was under way, with a 'back-up' version of more conventional design ordered from Shorts (the S.A.14, named Sperrin) in case Avro and Handley Page should be unable to solve the aerodynamic problems posed by the advanced specification.<sup>8</sup> The Shorts version, to Specification B.14/46 (asking for less range, speed and altitude), was thus referred to as the 'insurance' bomber.

During 1947 and 1948 the international horizons darkened with storm clouds: at a Moscow conference in March 1947 the Foreign Ministers had failed to agree on the drafting of peace treaties, an event which “for all practical purposes . . . marked the end of post-war co-operation between Russia and the

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<sup>1</sup> Air Marshal Sir Geoffrey Tuttle, CB, DFC, FRAeS, RAF(Ret), who subsequently became DCAS. <sup>2</sup> In his R K Pierson Memorial Lecture to the Weybridge branch of the Royal Aeronautical Society, reproduced in the *RAF Quarterly*, Summer 1978 issue. <sup>3</sup> The V-bombers never carried any self-defensive armament, relying on height and speed. <sup>4</sup> Actually there were only four types, as mentioned above: the Short Sperrin had Rolls-Royce Avons, as did the Valiant; the Vulcan had Bristol Olympus and the Victor Armstrong-Siddeley Sapphires. <sup>5</sup> Except for the Sperrin, which didn't proceed beyond the prototype stage. The reasons become logical when looked at in their context. <sup>6</sup> The latter was a tailless design. <sup>7</sup> The five Avro 707 deltas. <sup>8</sup> ITP issued in December 1947.

democratic countries";<sup>1</sup> then on 22 February 1948 there was a Communist take-over in Czechoslovakia; and on 24 June the Russians closed road, rail and water access routes to Berlin from the west – an action which led to the 1948–1949 Berlin Airlift.

It was against this background of potential European conflict, and a defensive alliance of the Western Powers which resulted in an accelerated rearmament programme, that the Air Staff decided to order a fourth type of medium bomber – the Vickers Type 660 to Specification B.9/48, an "interim" and less advanced version of B.35/46. An ITP for this aircraft, stating the intention that two prototypes should be built, was issued on 16 April 1948.

All four types of medium bomber continued under development until the autumn of 1949, when the Air Staff was asked to consider<sup>2</sup> abandoning one of them – either the Shorts B.14 or Vickers B.9, both of which were due to fly in prototype form during 1951. As a result of this consideration, it was decided to stop further development of the Shorts version, which flew for the first time on 10 August 1951<sup>3</sup>.

The Vickers Valiant, however, which had flown nearly three months earlier – on 18 May – became one of the first beneficiaries of the rearmament programme, an expenditure of £3,600m (later increased to £4,700m) over three years which the UK Government announced during September 1950 in the wake of the outbreak of the Korean War and a meeting in Brussels of NATO's Atlantic Council. This first of the V-bombers was thus forged as an instrument of war in the heat of international tension. On 28 December – ten days after the NATO Council had taken the first steps to bring about West German participation in an integrated force under a Supreme Commander and General Eisenhower had been appointed to that post – the UK Chiefs of Staff decided that it was "strategically necessary" to accelerate production of the Vickers Valiant<sup>4</sup> and that an order for 25 should be placed. At the beginning of 1951 (on 8 January) the Minister of Defence approved a production order for 25; on the 29th the Prime Minister (Mr Attlee) told the Commons in a statement on the defence programme that an order had been placed for "the first British four-engined jet bomber"<sup>5</sup> and on 9 February Vickers got their contract. The estimated cost was £8m and deliveries were to begin in 1953. Recalling that order in 1952, when he referred to the big RAF expansion programme which had been put in hand after the Brussels meeting of the Atlantic Council – "when, under the shadows of what looked like impending disaster in Korea, the possibility of war in the next few years loomed far larger than it had before", the CAS (MRAF Sir John Slessor) said that "the RAF were the only people (apart from the Americans) who could make any serious bomber contribution to NATO. Our Washingtons and Lincolns were obsolescent and anyway far too few. The Valiant had not flown, but we placed a small order off the drawing-board . . ."<sup>6</sup> Production of the Valiant was funded also by the United States under the MAP (Military Aircraft Procurement) programme, as was that of the Canberra and Hunter.

Referring to the four new types of bomber in the RAF re-equipment programme, the aviation magazine *Flight* commented in its 9 January 1953 issue that "all four bombers are super-priority, but whereas the Canberra is already established in squadron service in two forms (B.2 tactical bomber and B.5 target marker), the Valiant is not likely to be available in any useful quantity for many months. The Vulcan and H.P.80 (Victor) are still farther distant. Of the Vulcan, Valiant and H.P.80 the Minister of Supply (Mr Duncan Sandys) recently said: 'It may be asked why we have adopted three types instead of concentrating production upon one. My answer is that in equipping an air force it is, as in racing, risky to put all your money on one horse . . . . As experience of the last war showed, there is great advantage in having several types of aircraft in service . . . .'

*Flight* pursued this analogy by going on to comment that

"a striking parallel may be drawn between the four bombers . . . and counterparts of the late war. Functionally the Canberra can be compared with the Bristol Blenheim, in that it is chiefly used for light bombing and reconnaissance . . . . Then the Valiant is clearly the modern Wellington – a Vickers-Armstrong product, succeeding the light Canberra in point of time and intended for medium bombing

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<sup>1</sup> Ismay, *NATO The First Five years*. <sup>2</sup> ACAS(TR) to VCAS, 14 October 1949. <sup>3</sup> A second prototype flew a year later, on 12 August 1952, and both aircraft were subsequently used for different kinds of trials – including drops of dummy Blue Danube bombs. <sup>4</sup> This name was first used in June 1951 and was a break in the tradition of town names for bombers; it was the origin of the V-class names, but its own origin remains obscure. <sup>5</sup> Commons Hansard Col 583. <sup>6</sup> CAS to S of S for Air (Lord De L'Isle and Dudley), 10 March 1952.

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duties. It is almost superfluous to add that the Vulcan and H.P.80 are the Lancaster and Halifax of the day . . . .”

“One thing seems certain”, the magazine added, “ – that, after the dispiriting post-war rundown, our revived Bomber Command will be handsomely served by Britain’s aircraft industry”.

None of the three V-bombers suffered from insurmountable technical problems: Valiant development was uncomplicated (though the prototype was lost through fire after an engine shut-down and attempted re-light)<sup>1</sup> ; that of the Vulcan was aided through a test programme of five Avro 707 delta-wing aircraft, in effect one-third scale models; and that of the Victor (whose prototype was also lost, through structural failure where the tailplane joined the top of the fin) by a research aircraft which had a scaled-down version of the bomber’s crescent wing.<sup>2</sup>

The biggest problem, as far as the Air Staff were concerned in a period when the Bomber Command front line was being sustained by borrowed B-29s and Lincolns with inadequate range, was the length of time taken to get the new bombers into service – a case of the first being last and the last first. For while the Victor had been given an ITP in November 1947 it didn’t reach the RAF until November 1957; the Vulcan ITP had been agreed upon just after that of the Victor and a prototype contract awarded in January 1948 and the new bomber entered service in August 1956; the Valiant was the subject of an ITP in April 1948 and first delivered to Bomber Command in February 1955. The comparable time-scales were thus ten years for the Victor, eight-and-a-half for the Vulcan and just under seven for the Valiant. By comparison, the prototype Hawker Hunter was ordered in June 1948 and the new fighter entered service in July 1954, a time-scale of nearly six years.

One aspect of V-bomber design which had subsequent repercussions was the provision of emergency escape facilities for the five-man crew. In the original Air Staff requirement and Ministry of Supply specification (OR229 and B.35/46 – or B.9/48 in the case of the Valiant) the aircraft was to have a jettisonable crew compartment, a capsule in which they would float safely to earth under parachutes once it had separated from the abandoned aircraft. Such an escape module was later used by the Americans in two of their bombers, the three-crew B-58 Hustler and the two-crew FB-111. However, when the British contractual firms – Avro, Handley Page and Vickers – considered this requirement in their V-bomber designs they decided that it was too difficult to fulfil, either because of the engineering problems involved or because the incorporation of a detachable segment of fuselage would weaken the total aircraft structure. The requirement was therefore modified by the Air Staff to one for ejection seats for the two pilots and the best possible means of escape for the rear crew members. In emergency, the latter were to leave the aircraft first, the pilots then ejecting. This worked splendidly when time and altitude were available; at low level there would be insufficient opportunity for the rear crew members to get out through the escape hatch or for their parachutes to deploy once they were clear of the aircraft. The first two occasions on which the crew had to abandon a Valiant and a Vulcan dramatically illustrated this. When the prototype Valiant (as already mentioned) caught fire during an attempt to re-light one of the port engines, at an altitude of 6,000ft, the test crew members in the rear got out and deployed their parachutes successfully, and the two pilots ejected – Squadron Leader Foster, in the right-hand seat unfortunately being fatally injured when he struck the tail fin after his seat had been blown out of the aircraft, a tragic and ironic mishap in what was otherwise a classical emergency abandonment. The other occasion was when Vulcan B.1 XA897 of No 230 OCU struck the ground on an approach to London (Heathrow) Airport on 1 October 1956 at the end of a highly successful visit to Australia and New Zealand. With full power on in order to overshoot, the aircraft started to veer to starboard and the pilot (Squadron Leader D R Howard) found himself unable to counteract this despite applying full opposite aileron. He realised that whatever damage had been done when XA897 touched the ground had resulted in a loss of control, and gave a verbal order<sup>3</sup> to abandon the aircraft, he and his co-pilot (the AOC-in-C Bomber Command, Air Marshal Sir Harry Broadhurst) then ejecting. At a height of

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<sup>1</sup> The RAF liaison officer, Squadron Leader B H D Foster, being the only casualty. <sup>2</sup> Unfortunately this aircraft, the HP Type 88, crashed on 26 August 1951, killing the pilot. <sup>3</sup> This was because the pilot, struggling to control the aircraft, couldn’t spare a hand to press the warning light button.

approximately 400ft and only a few seconds before the Vulcan struck the ground, there was insufficient altitude or time for the four rear-crew members<sup>1</sup> to get through the escape hatch or to have used their parachutes.

This was an extreme case of the low-level abandonment of a V-bomber, when the two pilots successfully used their ejection seats but the rear-crew members were unable to get out and lost their lives. Other, similar instances were to occur; and the question of retrospective modification to provide rear-crew ejection seats was considered from time to time during the existence of the V-bomber force, certainly after it began low-level operations in 1963, and again in 1968. Although such a modification was never introduced, provision was made for rear-crew members to escape from their aircraft as quickly as possible in an emergency, mainly through the installation of swivel-mounted seats and quick-disconnect personal equipment.

Another important aspect of V-bomber development was the dramatic increase in engine power from the B.1s via the B.1As to the B.2s – virtually a doubling of the thrust available. This meant that plans which had been made during 1957–1958 for RATO (rocket-assisted take-off) equipment to ensure adequate runway performance, especially at some of the smaller dispersal airfields, were abandoned by mid-1959 in favour of an engine development programme: a decision to curtail the RATO programme, and to endorse that for engine development and for relevant modification of the Mk 2 Vulcans and Victors, was made by the Air Council on 23 July 1959<sup>2</sup>. Other factors influencing this change of policy were that more power would increase the V-bombers' operating height over their targets, would make them more capable of using overseas airfields at all-up weights in limited wars, would provide an insurance against increased weight as the aircraft were developed, and would increase flight safety by providing better take-off characteristics. Also, the engine development programme was reckoned to be less expensive than that for providing RATO. As a result of it, the thrust available to the Vulcans and Victors rose from 11,000lb in the Mk 1 versions to 19,750lb (Victors) and to 20,000lb (Vulcans) in the Mk 2s.

Developing and producing the V-bombers up to the end of the first era of the V-force – that is, when the three Mk 1 types were in service, and some money had been spent on Blue Steel propelled bomb R&D and on the first 48 Mk 2 aircraft – cost £119 million. This was the figure given by the Minister of Defence (Mr Duncan Sandys) in a memorandum for the Cabinet on the strategic bomber force dated 27 May 1957. It was the first ('up to end 1956–1957') in a series of annual totals up to 1962–1963, and presumably reflected true costs while its successors were estimates. The amount spent on Blue Steel would not by that date have been large, since the development contract was not awarded to A V Roe until March 1956, so the total could be said to be a fair reflection of the costs of the Valiant, Vulcan and Victor by the time they got into service.

This was a big programme for one type of aircraft, certainly in peacetime; yet though in numbers produced it bore no comparison with the wartime production runs, each individual unit was that much more complicated<sup>3</sup> and costly. It was initiated under a Labour Government, in 1946–1947, and continued under a Conservative Government from 1951 onwards; no suggestion was made that any of the types of V-bomber should be cancelled (with the exception of the Short Sperrin which was only ordered in prototype form), although there was considerable discussion as to how large the total force should be, and what proportion of it should be of B.1s with free-falling bombs and of B.2s with powered bombs.

When the first Vickers Valiant to be delivered touched down at RAF Gaydon on 8 February 1955, having flown there from Wisley, the development era – from OR and specification to design, manufacture and test flying – may be said to have ended. From that date onwards, until 1963, Bomber Command was to receive a steady stream of V-bombers and build up squadrons with them – creating what was known collectively as the V-force with its strategic nuclear deterrent quick-reaction role.

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<sup>1</sup> Three crew members and an Avro representative. <sup>2</sup> Conclusions 17(59) Secret Annex). <sup>3</sup> During a visit to RAF Binbrook on 10 May 1951, two weeks before the first Canberra arrived there, the AOC-in-C Bomber Command (Air Marshal Sir Hugh P Lloyd), emphasising the need to increase personal knowledge of one's trade or profession, had instanced electronics: the Lancasters had had about 80 radio valves; in the new four-jet bombers there would be over 600 (Binbrook ORB).

## CHAPTER 4

**Introduction of the V-bombers and Build-up of the V-force (1955-1961)**

While the V-bombers were under development by the main contractors, the engine companies and associated sub-contractors, Air Ministry staffs – with the Air Council taking the major policy decisions – had been busy with the logistic planning involved in deploying a completely new bombing force which could total as many as 240 aircraft (the ultimate size of the MBF was a major question in the later 1950s).

The array of topics which had to be discussed and decided upon was formidable: the provision of Class 1 airfields and the equipment thereon; the training of aircrew and groundcrew, availability of personnel and continuity of experience; the development of airborne equipment for the V-bombers and of RCM for their protection; the locating of suitable dispersal airfields for the defence of the V-force on the ground; measures to keep up morale, to counteract the public relations emphasis on Fighter Command in the post-war years; and the provision of conventional weapons, for use after initial retaliation with atomic bombs or in limited wars.

The aim in providing suitable airfields for the V-bombers was to have runways of sufficient length and strength (9,000ft plus 1,000ft over-runs at each end, able to bear a take-off weight of up to 200,000lb)<sup>1</sup> plus taxiways and hardstandings which could accommodate at least 16 V-bombers. Also, large amounts of fuel would be required: it was reckoned<sup>2</sup> that a Valiant could use about 8,400gal per sortie, and that this meant supplying as much as 680,000gal during seven days' flying at intensive rates (the bigger engines of the Vulcans and Victors would of course use correspondingly more). Pipeline installations were considered necessary to keep up such a supply, and these were approved by the Air Council during 1953 for Class 1 airfields. Further logistic problems for these bases were the provision of lighting and landing aids (radar and radio), air traffic control, aircraft handling and servicing equipment, spares and the handling and storage of weapons. These were the grass-root implications of the 1946-1947 policy decisions to have a jet bomber force capable of delivering nuclear bombs.

Aircrew and groundcrew of high skill had to be selected and trained to operate these most expensive new pieces of capital equipment; and once they had been trained, care had to be taken to see that they were posted where they were most needed, and that their experienced knowledge would be made available to the V-force for as long as possible: hence the priority of postings to the force, and longer tours there than in other Commands<sup>3</sup>.

In a very lengthy and detailed memorandum, *The Development of the Medium Bomber Force*<sup>4</sup>, VCAS (ACM Sir Ronald Ivelaw-Chapman) had said that Bomber Command HQ had rightly set a very high standard for pilots before they could be accepted for training for the MBF. While the requirement could be met initially by taking the best pilots already in the Command, later, calls would have to be made on other Commands – who were certain to raise objections to the 'creaming off' of their best pilots. About 75 navigators who were bomb-aimers, and who all had had previous experience of H2S, had been selected for the MBF; their numbers would be augmented as necessary by drawing on navigators in other Commands and in staff posts. For those without H2S experience the training requirements were severe: 40hr flying using H2S Mk 4A; 350hr ground instruction; and 70hr flying using H2S Mk 9. As to the third element in a V-bomber crew after pilots and bomb-aimer – that is, the navigator – VCAS considered that requirements would be met mainly from the Canberra force. Radio officers – responsible for the aircraft electrical system, RCM operations and communications – would have to be the subject of special recruitment. As to the length of aircrew tours, it had been proposed that 'combat' and 'select' crews should do 5¼ and 7¼ years respectively. Stability of aircrew postings, VCAS opined, was essential if the MBF were to become really efficient. He made particular reference to morale, saying that the very highest state of it must prevail:-

"Training will be hard, domestic problems sometimes acute and tour lengths long. . . . In spite of Bomber Command's unequalled work during the last war, most public emphasis has since been placed on the

<sup>1</sup> Victor B.2 *auw* was 216,000lb. Runway width (including shoulders and cleared zones) was up to 1,200ft.

<sup>2</sup> Note by AMSO (AC(53)31). <sup>3</sup> A Review of the V-force (BC/TS.84435, 7 March 1955) said that "an uninterrupted tour . . . of five years" was "mandatory". <sup>4</sup> AC (54)62, 2 November 1954.

Battle of Britain and Fighter Command. Bomber Command fought the war continuously from start to finish and made as big a contribution to victory as any other Command or Service. Some way should be found for bringing this home to the public and by so doing restore within the Command the spirit of its former prestige and greatness".

Subsequently, when the V-force was in being, this balance as between Bomber and Fighter Commands was probably redressed in the former's favour by the public appearances of Valiants, Vulcans and Victors – their dramatic shapes making them probably the most striking aircraft ever produced by the British aerospace industry. Though while competing with Hunters, Javelins and Lightnings in speed and power, they could never challenge the spectacle provided by formation aerobatic teams of Hunters, Lightnings or Gnats.

In his memorandum, VCAS also made reference to delays in the development of important airborne equipment – notably NBC Mk 2/H2S Mk 9, a tail warning device (Red Garter) and RCM fits – whose unavailability would invalidate the operational capability of the V-bombers when they entered service.<sup>1</sup>

Airborne training for navigators and bomb-aimers for the light bomber and medium bomber forces was done at the Bomber Command Bombing School at Lindholme, near Doncaster in Yorkshire; this was a stage prior to the OCUs, where crews were formed and trained together in the type of aircraft they were to operate on squadrons. BCBS, together with the Armament School at Wittering, played an important role in the build-up of the V-force by educating aircrew in the navigation/bombing systems they were to use and the weapons they were to carry. *A Review of the V-force*, a comprehensive document circulated early in 1955,<sup>2</sup> noting that Valiant aircrew training had begun in earnest at Gaydon in February that year, went on to say that preparatory training on NBS and H2S was in progress at Lindholme and in the H2S training squadrons at Hemswell,<sup>3</sup> and a former CO<sup>4</sup> has written that "the Bombing School . . . , where young aircrew were trained in the complex radar, navigation and bombing equipment they would have to use on joining an operational squadron in Bomber Command, was a very important link in the training organisation". Describing the significance of its courses, he said:-

"On completion of the course at Lindholme, crew members went to Gaydon or Waddington (later Finningley)<sup>5</sup> where they joined captains and co-pilots for the remainder of their training as complete crews. Lindholme had been specially prepared and equipped to fulfil its important role in training the bomb-aimers and navigators, and as the build-up of the V-force gathered momentum, it worked at very high intensity turning out the crews needed for newly formed squadrons. Although the course was already long and demanding, it was decided to add to it elementary instruction on nuclear weapons and their effects, so that navigators and bomb-aimers, in addition to mastering the intricate equipment of their trade, would also have a good working knowledge of nuclear weapons . . . ."<sup>6</sup>

Remarking on bases for the V-bomber squadrons, VCAS said that the number of airfields built to a specification similar to that of the Class 1 stations was very small – all suitable ones had already been allocated a wartime role, for use by the USAF or other RAF Commands. Others, with shorter and weaker runways, could be used with RATO and/or flight refuelling for take-off with bomb loads. A study of the problem was being made, as was one of the questions raised by dispersal. To mount operations away from Class 1 airfields would require "considerable duplication of manpower, fuel supplies and servicing equipment".

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<sup>1</sup> As will be mentioned later, many of the Valiants were without H2S Mk 9 at the time of the Suez operation. <sup>2</sup> BC/TS.84435, 7 March 1955. Described by the AOC-in-C Bomber Command (Air Marshal Sir George H Mills) in his covering letter to the CAS (MRAF Sir William Dickson) as "our first V-force summary of progress". <sup>3</sup> In mid-1955 there were five squadrons at Hemswell – Nos 83, 97 and 199 (Lincoln Mk B.2/4A) and 109 and 139 (Canberra B.2/6). <sup>4</sup> Air Vice-Marshal Stewart Menaul, who as Gp Capt S W B Menaul commanded Lindholme from February 1957 to February 1959, in his book *Countdown Britain's Strategic Nuclear Forces* (Robert Hale Ltd, 1980.) <sup>5</sup> ie Nos 232 (Valiant/Victor) or 230 (Vulcan) OCUs. <sup>6</sup> The first Nuclear Weapons Course was held at Lindholme 8–12 September 1958. MBF Courses had started in November 1955, the first lasting from 23 November 1955 to 28 March 1956, ie four months. Employing Lincoln B.2/4As and Varsity T.1s, and later a Hastings C.1, for bombing/nav training, the station ran a number of courses simultaneously – eg Canberra, Pilots' Bombing, Qualified Bombing Instructors' and NBS – in addition to those previously mentioned.

Outlining the principle behind dispersed operations, VCAS commented that the original plans were "to operate the whole force from ten Class 1 airfields which are being built to a very high standard"; but, "with the development of the Soviet Long-range Air Force, the rapid increase in power of atomic weapons and the fact that the initiative is certain to lie with the Russians, it has become increasingly obvious that the bomber force will be extremely vulnerable in the event of a surprise attack. Dispersal is therefore essential during a period of tension".

Referring finally to the conventional bombs which the V-force would carry as a supplement to their nuclear deterrent role, VCAS said that operations as currently conceived "would consist of an initial onslaught using . . . available atomic weapons, followed by a less intense phase using conventional weapons in addition to any atomic weapons remaining after the initial phase". Much effort had been put into obtaining the maximum bomb lift in the new V-aircraft and the Vulcan was expected to be able to carry 58 x 1,000lb bombs on short-range missions.<sup>1</sup>

One other aspect of the preparation for the V-bombers which should be mentioned was the provision of synthetic training equipment. Mentioning operational flight trainers in his memorandum, VCAS said that the RAF had little experience of the use of these, but "the vastly increased capital and operating costs of new types of aircraft" made them an obvious requirement. Three Valiant OFTs had been ordered and the prototype was expected to be installed at Gaydon by the end of February 1955;<sup>2</sup> prototypes for the Vulcan and Victor had been ordered. Synthetic training for bomb-aimers was also being organised: orders had been placed for prototype and production models of an NBS/H2S Mk 9 trainer – an "urgent requirement" as great difficulty was likely to be experienced "in providing sufficient training to bring set operators up to an acceptable operational standard".

The first four Valiants to be received into service were to be used for training aircrew (VCAS had said in his memorandum), while the second four would be formed into a development flight for conducting intensive flying trials. This flight would subsequently move with its full complement of aircraft to Wittering, where it would become the first operational Valiant squadron. At the time of the memorandum (2 November 1954) it was estimated that the first aircraft would reach the RAF by the end of the year and the first squadron would form in April 1955; in fact, Bomber Command's first Valiant was flown into Gaydon on 8 February 1955 and during that year two squadrons were formed there, Nos 138 and 543.

Gaydon and Wittering (to which No 138 moved during July 1955) were key bases in the inception of the V-force, the former because of its training and trials role, the latter because of its atomic weapon tasks – the storage of bombs, training of personnel in the Bomber Command Armament School, and ballistic trials by No 1321 Flight (with a Ministry of Supply Valiant). Both stations were in No 3 Group, one of the two Groups (Nos 1 and 3) to which the wartime Bomber Command with its eight operational Groups had been reduced at the beginning of 1946<sup>3</sup>.

The whole spectrum of introducing the Valiant into service and training those who were going to fly and maintain it was covered at Gaydon from the beginning of 1955 onwards, as the station's ORB for that year shows. On 1 January the first squadron, No 138, was established there – to form as soon as its first aircraft arrived in the following month; meanwhile a series of lectures began, while eight officers were detached to BCAS for instruction on Blue Danube. On 8 January the first course (35 strong) had begun at the Valiant Servicing School. When the first Valiant (WP206) arrived on 8 February the school's instructors supervised a primary star servicing: the brand-new battleship-grey aircraft was subjected to various checks and changes – its landing-gear was given a retraction test<sup>4</sup> and the port undercarriage door actuator replaced; the port and starboard rear main wheels were changed and the compass swung. In other words, Bomber Command technicians gave the first of its V-bombers a thorough going-over, and

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<sup>1</sup> A 1965 photograph (PRB 29478) shows a Victor B.(K)1A, XH648, dropping 35 1,000lb practice bombs. <sup>2</sup> The flight simulator at Gaydon, after various installation troubles and modifications, didn't get into working order until November 1955. <sup>3</sup> During the war there had been Nos 1, 2, 3, 4, 5, 6 (RCAF) and 8 (PFF) Groups, in addition to No 100 with its Bomber Support role, and Nos 7, 91 and 92 Operational Training Groups. <sup>4</sup> This was because, on the delivery flight to Gaydon, the emergency system had had to be used to lower the port undercarriage leg (IFT report).

they repeated this process when the second one (WP207) arrived at Gaydon on 19 February. Two days later No 1 Valiant Conversion Course began; it consisted of four crews who were to make up the first flight of No 138 Squadron: their lecture programme was divided into three sections, for pilots, navigators and signallers. At the same time the first phase of Intensive Flying Trials had begun; this lasted from 18 to 25 February.

During March 1955, when No 138 Squadron still had two Valiants, intensive flying trials were going on and further courses (for airframe, electrical, engine and armament mechanics) were completed at the Servicing School, conversion of crews for 'A' Flight of No 138 Squadron began. These four crews completed their conversion during June and No 2 Valiant Conversion Course, which was to provide 'A' Flight for the second squadron – No 543 – began on the 2nd of that month, which also saw the formalisation of instructional courses on the new V-bomber with the change of unit title to No 232 Operational Conversion Unit. No 232 OCU was to be the *alma mater* for Valiant and Victor squadrons, as No 230 OCU at Waddington was to be for the Vulcan squadrons.

No 138 Squadron, which had been at Gaydon since the beginning of 1955 while its aircraft strength built up and crews were converted to form 'A' Flight, sent its advance party to Wittering on 22 June and formally moved there on 6 July, thus becoming the first V-force squadron on its own operational base (for the record, almost exactly four years and five months since – on 9 February 1951 – Vickers had received the production order for 25 B.9/48s).<sup>1</sup> The same procedure was followed with the next squadron, No 543, whose role was to be strategic reconnaissance. Its 'A' Flight was due to leave for Wyton in September; its departure had to be postponed, so it became a lodger unit at Gaydon and eventually left there on 16 November – as did 'B' Flight of No 138 Squadron for Wittering, from where two Valiants had already made a 'showing the flag' flight to Singapore, Australia and New Zealand (Operation 'Too Right' – 5 September–6 October).

By the end of 1955 the V-force thus had two Valiant squadrons, Nos 138 and 543, and two Operational Conversion Units – No 230, which had been in existence since June but as yet had no aircraft of its own, and No 232, likewise in existence since June although it grew out of the Valiant conversion activities and squadron formations at Gaydon. Had too much been attempted there? A memorandum prepared at No 230 OCU thought so<sup>2</sup> and criticised the procedure followed:-

"At the Valiant OCU an attempt was made to train crews for the first squadron concurrently with staff for the OCU. This method inevitably delays the date by which the OCU is ready to undertake its proper task; and in the haste to form a squadron, or part thereof, it is possible that the OCU does not have time to discover the full capabilities, and limitations, of the aircraft on which it is supposedly responsible for the teaching. This is a risk which must be taken in war but may be difficult to justify in peace".

The stated aim of No 230 OCU (in the memorandum already quoted) was "to train crews to operate the Vulcan efficiently to its limits"; but although it was ready to undertake ground training by March 1956<sup>3</sup> it didn't get its first aircraft at Waddington until the end of that year.

The first two Vulcan B.1s to be delivered to the RAF, allotted to No 230 OCU, XA895 and XA897, went not to Waddington but to A&AEE (Aeroplane and Armament Experimental Establishment) at Boscombe Down for Operational Reliability Trials. These involved about 200hr flying, with aircrew and servicing personnel provided by the OCU, whose ORB for August 1956 commented that the drawbacks of having to operate the aircraft there were "a major problem, particularly administratively" – but one which had to be accepted until the ORTs had been completed.

Meanwhile two ambitious overseas flights were being planned, to be made by the AOC-in-C Bomber Command (Air Marshal Sir Harry Broadhurst) in one of the new Vulcans – to the USA in company with two Valiants to observe the SAC Bombing Competition, and to Australia and New Zealand to

<sup>1</sup> The name Valiant was first applied to the first V-bomber in mid-1951, though it has been impossible to establish who first thought of it, while Air Council approval of the names Vulcan and Victor is well documented.

<sup>2</sup> Memorandum on the Formation of the Vulcan OCU at Royal Air Force Waddington, 5 November 1955.

<sup>3</sup> "Although not 'in all respects ready' for our task, the unit is in a position where, if necessary, ground training could begin at once".

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participate in Battle of Britain celebrations in those countries. The former was postponed but the latter (code-named Tasman Flight) began on 9 September with the take-off of XA897, while XA895 continued with its ORT programme. The loss of XA897 while attempting to land at London Airport on 1 October at the end of the last leg (from Aden) of its homeward flight has already been referred to; for No 230 OCU it meant the loss of three key members of its instructional staff - the senior flight simulator instructor, chief navigation and weapons instructor and senior air electronics officer (respectively Squadron Leaders J G W Stroud,<sup>1</sup> E J Eames and A E Gamble).

The Operational Reliability Trials by XA895 were completed on 4 December; it returned to Boscombe Down for some 30hr flying by the Handling Squadron, in order to amend the provisional Pilot's Notes and to produce the official ones, then on 18 January 1957 both it and XA898 became available to No 230 OCU for flying - and on the following day Intensive Flying Trials began. Ten days later a conference at the unit, attended by the AOC and SASO of No 1 Group (Air Vice-Marshal G A Walker and Air Commodore J N Whitworth), decided that the prime future commitment - which had "priority over all others in respect of the Vulcan in Bomber Command"<sup>2</sup> - was the SAC Bombing Competition to be held in October that year. This was a notable and courageous gesture, in deciding to pit the newest type of Bomber Command aircraft and newly trained crews against experienced USAF opposition.

By the date when No 230 OCU was planning the future commitments for its Vulcans (SAC bombing competition, crew training and intensive flying trials) the Valiant force of seven bomber and one strategic reconnaissance squadrons had achieved its final shape: there were two squadrons at Wittering (Nos 138 and 49), one at Wyton (No 543 in the SR role), three at Marham (Nos 214, 207 and 148) and two at Honington (Nos 7 and 90); and four of these had taken part in bombing operations over Egypt, as will be described later. This force totalled 57 bomber and nine SR Valiants, and in addition to them there were 158 bomber and 22 PR Canberras. Thus, by the end of April 1957, all the 'interim' V-bombers (those built to Specification B.9/48) were in the field; about to come into squadron service were the first of those built to the full B.35/46 Specification, representing the Air Staff OR 229 requirement, the Vulcans and Victors.

As was to be expected, the first Vulcan B.1 squadron, No 83, was formed at and from No 230 OCU at Waddington - its first five crews came directly from courses at the conversion unit and its first aircraft were 'borrowed' from there. Moreover it was to supply two crews for the USAF Strategic Air Command Bombing Competition, concentrating on this task from the day of its re-formation (21 May - having previously been a Lincoln squadron). "All efforts were immediately concentrated on selecting and training the two best crews to represent the squadron", its ORB recorded. "To compete successfully first with the picked crews of Bomber Command and then with the best of SAC after a very limited period of training on borrowed aircraft was clearly going to be a tall order, and it was decided to cut all other flying to an absolute minimum". Certainly this concentration paid off, because in June the new squadron won the Bomber Command Bombing Competition, carrying off four out of six prizes.

The second Vulcan B.1 squadron to enter the field, No 101, was again a re-formation - it had been the first of the Canberra squadrons, disbanded the previous January. Its new existence opened up a new airfield for the V-force, Finningley, from 15 October; already the first four crews (from No 230 OCU) were there and two days later the first aircraft, XA909, arrived after modification at Waddington and some delays there owing to unserviceability.

Although, however, there were two Vulcan squadrons in the V-force by the end of 1957 the Order of Battle for 31 December shows that they had only nine aircraft between them though there were 16 crews - nine on No 83 Squadron and seven on No 101. Bomber Command had also re-equipped its No 199 Special Squadron at Honington during that year with Valiants providing an electronic countermeasures force.

There was still one element of the V-force to come: the Victor. This third type of V-bomber had received its Air Ministry Release to Service on 29 July 1957. Described as "a crescent-wing medium bomber powered by four Sapphire 7 Mk 202 engines" with power-operated flying controls which had "subdivided or duplicated components as safety measures" - there being no manual reversion, the new aircraft was released for Service use by day and by night in temperate climates subject to certain limitations; for example, maximum take-off and emergency landing weight was 160,000lb.<sup>3</sup>

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<sup>1</sup> Who had been one of the Canberra captains in No 12 Squadron's 1952 South American tour. <sup>2</sup> Minutes.

<sup>3</sup> During development the *auw* had been increased from 140,000lb to 160,000lb to accommodate a greater fuel load (File on Development and Introduction of Victor aircraft, C 127845/60).

The first Victor B.1, XA930, was delivered to A&AEE Boscombe Down on 9 October but was not handed over by the manufacturers to the Establishment until the afternoon of 14 November. During this period of nearly five weeks a Handley Page working party was engaged in modifying the aircraft up to the standard required,<sup>1</sup> and only then could the Operational Reliability Trials – to be flown by two crews from No 232 OCU at Gaydon – begin. Two weeks later, on 28 November, the first Victor B.1 to be delivered to the RAF – XA931 – landed at Gaydon; so the ORTs at Boscombe Down went on concurrently with the introduction of the new V-bomber at the OCU, where a Victor flight simulator had been in use since the previous June (mainly for training instructors) – the first Victor course doing their initial ‘flying’ on it when they assembled in November, beginning their ground school on the 21st.

ORTs continued at Boscombe Down, with the detachment there successively under the command of Squadron Leaders A W Ringer and T Willmott, while the numbers of Victors at Gaydon increased – by the end of February 1958 there were five – and the main and special training courses continued. This number increased to seven during March, but it was during April that the new type came on to the operational scene with the formation of the first squadron – No 10 – at Cottesmore. Its official inauguration on 15 April made that a significant date for the Royal Air Force and Bomber Command in that from then on all three types of V-bomber were in service – the businesslike rather than beautiful Valiant, with its shoulder-high wings with compound sweepback and tailplane mounted halfway up the fin; the dramatic Vulcan, with its delta-wing planform and high fin; and the crescent-wing Victor with its tailplane (a feature lacking in the Vulcan) set high up on the top of the fin. These three striking aircraft, the outcome of Air Staff/MoS planning in 1946–1947, gave back to Bomber Command the prestige which had been lacking to it when its medium-bomber front line was being sustained until the mid-1950s by obsolescent Lincolns and borrowed B-29s.

No 10 Squadron actually received its first Victor B.1, XA893, on 9 April; it was flown to Cottesmore from the Handley Page airfield at Radlett by the CO, Wing Commander C B Owen. This inauguration of Cottesmore as a V-force base (it was to house a second Victor squadron, No 15, from September onwards) and the re-formation of No 617 Squadron with Vulcan B.1s at Scampton at the beginning of May meant that by 1958 nine stations had V-bombers – Gaydon, Wittering, Wyton, Marham, Waddington, Honington, Finningley, Cottesmore and Scampton. It was at this time that the widespread swirling-around of V-force aircraft known as dispersal – an essential element in its self-defence against attack – began to be practised: the ORB for No 232 OCU reported in April 1958 that

“ ‘Exercise Dispersal’ commenced at 0800hr on Monday, 21 April, this unit taking part as one of the dispersal airfields.<sup>2</sup> The first Alert ‘Alpha’ was received at 0925hr the same day. This exercise continued from Monday until Friday, 25 April, and a series of alerts were received during this period and the final ‘Scramble’<sup>3</sup> was received at 1218hr on Friday. The three Valiants<sup>4</sup> dispersed at Gaydon returned to their base at Marham after taking-off on the final ‘Scramble’ ”.

By the end of 1958, with all types of V-bomber established in service, there were 156 aircraft in the V-force in 15 squadrons: seven Valiant Main Force squadrons (Nos 138, 214, 49, 207, 148, 7 and 90); one Valiant strategic reconnaissance squadron (No 543);<sup>5</sup> two Valiant B.1/Canberra B.2 squadrons of the electronic countermeasures force (Nos 199 and 18); three Vulcan B.1 Main Force squadrons (Nos 83, 101 and 617); and two Victor B.1 Main Force squadrons (Nos 10 and 15). In addition to this airborne strategic nuclear deterrent force, two Thor IRBM strategic missile squadrons had been formed during that year (Nos 77 and 97), but the *raison d’être* for these, and how they were deployed, will be described in a subsequent chapter.

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<sup>1</sup> At a CSDE Final Servicing Conference on 10–11 September 1956 there were 336 observations on the Agenda and Handley Page insisted that all changes should be dealt with by modification. <sup>2</sup> Eventually there were 36 of these, all over the United Kingdom, as will be described subsequently. <sup>3</sup> This term, the wartime perquisite of Fighter Command, entered into Bomber Command terminology as the V-force developed the technique, getting their Valiants, Vulcans and Victors off the ground as fast as the Spitfires and Hurricanes. <sup>4</sup> Of No 148 Squadron. <sup>5</sup> Which also had a Victor element. The ORB of No 232 OCU for April 1958 recorded that “Victor XA924 and XA925 left the unit with No 1 Course for RAF Wyton”.

## CHAPTER 5

**Valiants and Canberras in the Suez Operation (1956)**

In the autumn of 1956, when there were five Valiant Main Force bomber squadrons and one strategic reconnaissance squadron and 19 Canberra bomber and three PR squadrons in the front line, Bomber Command were called upon to provide the RAF bomber and reconnaissance contribution to the Anglo-French operations against Egypt under the code-name Operation 'Musketeer'. The bombing sorties were mounted from Malta (Luqa and Halfar airfields) and Cyprus (Nicosia airfield) for six days (31 October – 5 November) and making them involved the movement overseas of 15 squadrons, or detachments if less than a full squadron was involved. Four Valiant squadrons (Nos 138, 148, 207 and 214) were at Luqa, as was one Canberra B.6 squadron (No 109). Three more Canberra B.6 squadrons (Nos 9, 12 and 101) were at Halfar and six shorter-range (B.2) Canberra squadrons (Nos 10, 15, 18, 27, 44 and 61) were at Nicosia, as was a B.6 squadron (No 139) which had a target-marking role.<sup>1</sup>

Although on the face of it this conventional-bombing operation was an easy one, with little to fear from Egyptian air defences, good weather in the target areas and the targets themselves large and distinctive,<sup>2</sup> there were certain inherent disadvantages. First, the Command was geared to and equipped for a possible European radar-type bomber offensive, and was not constituted nor organised for a major overseas operation. Secondly, the Canberras which formed the bulk of the force (88 as against 24 Valiants) were equipped only with Gee-H as a blind bombing device, and it was not possible to position ground beacons in order to give coverage over Egypt for this equipment; consequently, and because it was considered prudent for the early attacks to be made at night, marking techniques as used in the Second World War were revived. Thirdly, although the Valiants had the most comprehensive navigation/bombing equipment, NBS (navigation/bombing system), many of them were not fitted either with it nor with visual bomb-sights, nor were they cleared for the carriage of HE bombs.

Nevertheless, in operations which began on 31 October and lasted until 4 November some 16 different targets were attacked, the Valiants making 49 sorties from Malta and the Canberras 72 from Malta and 206 from Cyprus. Apart from the navigational problems – the Canberras had to rely entirely on dead-reckoning navigation monitored by visual pinpoints, and not many Valiants had serviceable NBS – the main difficulty was the weather over Malta when large numbers of returning aircraft had to be recovered.

The experience gained in the Suez operation – not only of bomber deployment and tactics but also the logistics of positioning supporting personnel and equipment – did not accrue to Bomber Command in its main role of strategic nuclear deterrence but in its limited-war role at short notice in an overseas theatre. However, certain deficiencies in equipment, training, techniques and preparedness were exposed which could be read across to the V-force (then consisting mainly of Valiants, for the Vulcans were still on Operational Reliability Trials) as a whole.

In an exhaustive report on Operation 'Musketeer',<sup>3</sup> Headquarters Bomber Command said that when the Suez emergency began the Valiant force was "just forming" and was "unequipped and untrained". (By July 1956 six squadrons had been formed and four of these – that is, excepting Nos 543 and 49, which had specialist roles – took part in the Suez operations). Many of the aircraft were under-equipped or not cleared for certain items – the majority of the Valiant force lacking NBS,<sup>4</sup> having no visual bomb-sights and not being cleared for HE or target-marking stores nor to requisite take-off and landing weights, while few Valiants or Canberras were fitted with radio compass, clearances for flares and TIs were "inadequate" and no aircraft had tail-warning equipment.

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<sup>1</sup> During 1955 a policy decision had been made to eliminate the marker squadrons, but this was reversed, marker trials were held early in 1956 and a squadron re-established (HQ BC Report on Operation 'Musketeer' (BC/S.87926)). <sup>2</sup> These comments are from 'Musketeer Reports' (file IIA/272/3/40A). <sup>3</sup> BC/S.87926. <sup>4</sup> NBS (navigation/bombing system) Mk 1 included H2S Mk 9 and was the heart of the V-bombers' operational capability.

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The report had similarly harsh things to say about aircrew training and about target-marking technique – that only one V-force squadron had undertaken any visual bombing or NBS training; that Canberra visual standards were ‘low’ owing to the grounding of B.2s from 17 March until June/July for actuator modifications<sup>1</sup> followed by a requirement to divert the LB force on to training for flypasts for Royal and Russian visits to Marham; and that Canberra target-marking was ‘embryonic’ owing to the marker policy having been re-established only a few months before Musketeer.

Referring to the bomber operations – the twin aims of which were to neutralise (in conjunction with ground-attack aircraft) the Egyptian Air Force and to destroy military targets – the report said that it was difficult to assess their specific effectiveness; the reaction of the Egyptian AF had been ‘negligible’, and in this the attacks – and the threat of attack – may have played a big part. As to future possible limited (HE) war commitments, the Canberra was considered more suitable than the V-bombers because of its flexibility and ease of maintenance.

In the Operation ‘Musketeer’ attacks 1,000lb bombs were delivered, the Valiants carrying 12 and the Canberras four. In four days’ operations from Malta<sup>2</sup> the Valiants dropped 523 bombs and 15 target indicators, and the Canberras 283 bombs; while the Cyprus-based Canberras dropped 1,156 bombs, 408 flares and 87 TIs. The quantity of the two latter items was accounted for by the fact that the target-marking squadron, No 139 with B.6s, was operating from there.

That the operation “was of a type in which Bomber Command would not normally expect to be extensively involved” (to quote from the radio engineering section of the Musketeer Report) was a summing-up which could be read across to other aspects. In previous limited-war deployments by the Command – to Malaya, for example, or to Kenya – a small number of aircraft had been involved and squadrons took over the detachments on rotation from their predecessors, so there was a settled format for operations which successive crews inherited. But in Musketeer not only were there big concentrations of aircraft (at Nicosia, the report commented, they were “parked wing-tip to wing-tip on all aprons and subsidiary runways” and “a more resolute enemy than the Egyptians could ... have considerably reduced the operational effectiveness of the force”) but groundcrews had to work against time and in unfamiliar environments, without the facilities available on Class 1 bases. For example, when it came to bombing-up at night there were no major difficulties with the Valiants but the Canberras presented problems since no bomb-bay lighting was available; also, bomb carriers were in temporary tented accommodation, described as “far removed from the heated dustproof conditions recognised to be essential on Class 1 stations”. Further, in the case of the Valiants, personnel were not familiar with large-scale arming – the largest practice previously had been of six aircraft in daylight, by personnel familiar with the layout of armament facilities, not working on a strange airfield.

‘Musketeer’ was a traumatic experience for Bomber Command, not only in its execution but also in the preparatory period when a “large number of changes of plan” occurred. Such an operation was unlikely to be repeated, and its uniqueness brought into sharp focus some deficiencies in training, equipment and techniques.

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<sup>1</sup> A major cause of Canberra B.2 accidents due to technical causes had been malfunction of the electrical tail trim, as previously mentioned. <sup>2</sup> Five days overall, 31 October to 5 November when the force was ordered to cease bombing attacks, but on 3 November the aircraft did not take off. Operations from Cyprus lasted for six days with one stand-down, for 12hr on the night of 3 November (HQ BC Report).

## CHAPTER 6

## V-force Training, Exercises, Competitions, Dispersal and Deployments (1957-1963)

The first-generation V-force – of B.1 Valiants,<sup>1</sup> Vulcans and Victors – reached a total of 141 aircraft (out of 156 authorised) by the end of March 1961<sup>2</sup> just after the entry of the first Vulcan B.2s into squadron service.<sup>3</sup> This figure of 141 included all the B.1s 'on hand' – in the operational, miscellaneous and training roles. By October 1961 the whole of the RAF bomber force in the United Kingdom was equipped with V-bombers. Its squadrons, in numerical order, and the types they operated then, were as follows:-

No	7	Wittering	Valiant B.1/(K)1/(PR)1/(PR)K1 <sup>4</sup>
	10	Cottesmore	Victor B.1
	15	Cottesmore	Victor B.1/1A
	27	Scampton	Vulcan B.2
	44	Waddington	Vulcan B.1/1A
	49	Marham	Valiant B.s/(K)1
	50	Waddington	Vulcan B.1/1A
	55	Honington	Victor B.1/1A
	57	Honington	Victor B.1/1A
	83	Scampton	Vulcan B.2
	90	Honington	Valiant B.1/(K)1
	101	Waddington	Vulcan B.1/1A
	138	Wittering	Valiant B.1/(K)1
	148	Marham	Valiant B.1/(K)1/(PR)1/(PR)K.1
	207	Marham	Valiant B.1/(K)1/(PR)K.1
	214	Marham	Valiant B.1/(K)1/(PR)K.1
	617	Scampton	Vulcan B.2

Its bombs were of the free-fall type and its operations were at high level. Yet the dynamic of the force never varied from its inception to the ending of its QRA role in mid-1969: to deliver its weapons accurately, in location and in time, on specified targets – whether operating from its own bases or from dispersed airfields or when deployed overseas. All the training so continuously undertaken, and the exercises and competitions that the V-force was so constantly engaged in, were directed to that end – to achieving maximum operational efficiency.

Any member of what became a 25—strong squadron front line, a V-force of 10,620 personnel out of a 23,216 total strength of Bomber Command<sup>5</sup> might be forgiven for wearing on his heart – as Mary Tudor said that Calais was engraved on hers – a series of code-names that became a part of Command, Group, station and squadron life for more than a decade: Bomex, Compex, Kingpin, Kinsman, Mayflight, Mick, Micky Finn, Sunspot, Yeoman, and many more – no doubt a good deal of ingenuity was displayed at Command HQ in devising these names for the exercises to which they referred, and which were designed to test the proficiency of the V-force at varying degrees of intensity. Their overall objective was to show how quickly the Valiants, Vulcans and Victors could be armed and get off the ground, under the BCAR (Bomber Command Alert and Readiness) plan for the V-force, followed by simulated attacks whose flight profile would emulate in distance the operational missions likely to be undertaken. A description of a Bomex in 1958<sup>6</sup>, after referring to the proverbial 'pickle barrel' into which the USAF Strategic Air Command claimed they could drop bombs from 40,000ft, said that the Vulcans and Valiants "were aiming at a manhole cover on Bovingdon airfield. Two other targets were the centre of a tower on the

<sup>1</sup> There were no B.2 Valiants, although one prototype (WJ954) of the B Mk 2 low-level pathfinder bomber (Vickers Type 673) was constructed and flown. <sup>2</sup> RAF Monthly Statement of Aircraft Authorised and on hand as at 31 March 1961 (Stats 603). <sup>3</sup> No 230 OCU at Waddington received its first Vulcan B.2 on 1 July 1960 and the first squadron to be equipped, No 83, got its first at Scampton on 23 December of that year. <sup>4</sup> The 'K' in the designation indicated flight-refuelling capability. <sup>5</sup> Figures given by the AOC-in-C at a Press conference at Scampton on 14 February 1963. <sup>6</sup> In *Flight* for 18 July 1958.

Little Ouse and a certain corner of a certain building near Kirkwhelpington Mill in Northumberland. All three targets were attacked during a series of criss-crossing passes over England . . . followed by a long astro-navigation leg out over the Atlantic”.

There were three parameters for the efficiency of a V-bomber squadron: the number of aircraft it had on strength (as opposed to its UE – unit establishment), the number of these which were ‘combat-ready’ (*ie* fully equipped and serviceable for operations) and the requisite number of combat-ready crews (those possessing the necessary classification – combat, select or select star).

These were the standards the V-bomber squadrons aimed to achieve, to have as many of their eight aircraft and eight or more crews combat-ready at any given time; and the way this was achieved was through continuation training and exercises such as the Bomex described in the article just quoted – flown by No 101 Squadron, based at Finningley with Vulcans, on 10 July 1958 and lasting just over four hours. This squadron’s activities, and those of its contemporaries with other types of V-bomber, provide useful documentary evidence as to how the V-force was performing its roles – and preparing for its possible strategic missions – at that time.

No 101 was a new Vulcan squadron, and it had opened-up Finningley as a new V-force base in October 1957; by April 1958 it had received its full complement of eight aircraft. Its early training programme consisted chiefly of Bomexes, profiles, RBS sorties and cross-countries; its crew complement built up from four to eight by November 1957 and the first combat classification was gained the following February (after severe winter conditions had limited flying in January): on the 10th, Flight Lieutenant P W Hubbard and his crew flew a 5hr 35min day cross-country on which they “completed the requirement for combat classification, the first crew on the squadron to classify”. This flight involved nine ‘legs’ and half-a-dozen exercises – RBS (radar bomb site) ‘bombing’, ILS (instrument landing system), GCA (ground-controlled approach) by both captain and co-pilot<sup>1</sup>, a take-off by the co-pilot, engine re-lights and practice diversions into Waddington, Marham and Wyton. It was clear that the maximum amount of training had to be extracted from every sortie, and the Vulcans ranged widely; on 13 March, XH475 captained by Squadron Leader N E Wilkins “carried out a simulated operational exercise with an RBS target at Marrakesh in Morocco but was unable to attack the target because of *u/s* NBS equipment and lack of RT contact with the target” – this sortie lasting 6hr 15min. During April the squadron’s “main effort was put into training for the forthcoming Bomber Command Competition and took the form of planned exercises consisting of three RBS target attacks followed by a scored Astro leg”; and in May the main effort “went into final preparation for, and participation in, the 1958 Annual Bombing and Navigation Competition which was held from the 14th to the 20th” – alas, No 101 not doing well, being “last of all those taking part . . . except in bombing, in which they beat Nos 9 and 83 Squadrons”.

The activities of a Valiant squadron, No 7 at Honington, during the same period show many common features – Bomexes, Profile flights, Lone Rangers, training for Bomber Command bombing and navigation competitions, detachments and exercises – but the different ways in which the Operations record Books were written add to the picture of V-force life in 1958–1959. Thus during January 1958 the ORB of No 7 Squadron noted under ‘Training’ that there had been 11 profile flights “co-ordinated with numerous RBS attacks”; in addition five Bomex sorties had been made, and an RCM trial and two Lone Rangers had been flown – the second of the latter, to Malta, being co-ordinated with a visual bombing sortie on the Tarhuna<sup>2</sup> range, dropping twelve 1,000lb bombs “within the select classification limits”. In February the squadron concentrated on bombing and navigation training for the “forthcoming (Bomber Command) competition”, and at the end of it the Valiants left for Malta and Operation ‘Sunspot’ – in which, during March, they took part in Exercise ‘Green Cobra’ with Canberras of No 35 Squadron. The bombers made simulated attacks on land targets in northern Italy and also on CTF239,<sup>3</sup> the United States 6th Fleet, No 7 Squadron’s ORB noting that in the latter attacks “only one Valiant was intercepted and that unsuccessfully”.

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<sup>1</sup> “Bomber Command has recently been authorised to call ‘co-pilot’ all those who fly in the right-hand seat irrespective of training or experience. It was thought that this description more accurately fitted the functions and capabilities of this crew member than did the term ‘second pilot’ ”(Air Ministry Quarterly Liaison Report for April–June 1958). <sup>2</sup> South-east of Tripoli, Libya. <sup>3</sup> Carrier Task Force.

During April, back at Honington, there were Bomexes each Thursday night, repeated as Group Kingpin exercises on Monday nights; and in the Bomber Command Bombing and Navigation Competition the following month the squadron was placed seventh. Its navigation aspect was "designed to test efficiency in the use of primary . . . aids and pure astro" and "a very high standard" was reached by all competing crews – so much so that "timing errors in excess of ten seconds on an astro error of more than ten miles appeared disappointing".

June and July 1958 produced interesting ORB entries with Exercise 'Full Play' (3–5 June) and Operation 'Tornado', in the former the MBF participating with the Canberra LBF and 3rd USAF – sorties being made over France, Belgium, Holland, Germany, Denmark and Norway "to test the NATO air defence organisation. In addition, simulated NBS attacks were made on Continental targets and RBS runs . . . on UK targets". The squadron commented on Operation Tornado that "as a result of the situation in the Middle East,<sup>1</sup> Bomber Command were required to be able to reinforce MEAF<sup>2</sup> with eight Valiants . . . . The aircraft were prepared for the conventional role and were to carry a number of 1,000lb bombs . . . .".

Operation Tornado continued to be a commitment throughout August, with the detachment aircraft and crews at 24hr readiness,<sup>3</sup> and in September the squadron flew its first Western Ranger – the ORB commenting that "Bomber Command are required to operate in a wide variety of climatic and operational conditions, and in order to meet these requirements and augment training under the Lone Ranger scheme<sup>4</sup> the Western Ranger has been introduced. Flight Lieutenant W H Jordan and his crew took part in the first Western Ranger to be made by the squadron (15– 19 September). The route was from Honington to Goose Bay and then to Lincoln AFB, Neb, including three RBS attacks. The return was made by the same route . . .". In fact only one RBS attack was able to be made – at Minneapolis on the homeward flight.

Exercises of one kind and another – Sunspot, Groupexes, station exercises, Kingpin, Mick ( Bomber Command Alert and Readiness exercise to practice the alert and arming procedures of the BCAR plan), Topweight (Saceur's atomic/air defence exercise for 1959) and Buckboard (in which Bomber Command exercised the air defence of the UK) – plus Lone Rangers formed the staple of No 7 Squadron activity through the 1958-59 autumn-winter-spring period; then in May 1959 occurred Exercise Mayflight, of which the ORB gave a graphic and detailed description:-

"On 4 May alert Alpha brought the squadron to 24hr readiness, all aircraft being bombed-up and prepared for flight. The following day, on alert Bravo, aircraft throughout the Command took off with the minimum of delay for their dispersal airfields. Of the six No 7 Squadron aircraft participating, four dispersed to Lyneham and two remained at Honington.

"On arrival at their dispersal airfields the aircraft were refuelled, serviced and prepared for scramble take-offs. With its aircraft thus dispersed, Bomber Command then carried out practice scrambles both by day and night, of two types: an Orange scramble necessitating starting engines and carrying-out checks up to taxiing, and a Yellow scramble which included taxiing round to take-off position, the statistics being kept by Command of the times taken by each aircraft.

"On 7 May the actual scramble was given at which all aircraft took off on a pre-planned profile flight, landing back at their parent bases".

Looking at a Victor B.1 squadron for an equivalent period – the first, No 10, which had been formed at Cottesmore in April 1958 – shows much the same pattern of training, exercises and operations, allowing for the different style of the ORB's compiler and for individual squadron commitments, like formation practice for the SBAC and other displays in which the squadron was involved during August and September. Its main pre-occupation during that first year, when aircraft were still being collected and crews being accustomed to their new environment, was with cross-countries and radar bombing sorties:

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<sup>1</sup> As a result of the 14 July revolution in Iraq, when King Feisal and Prime Minister Nuri es-Said were murdered, American Marines landed in Beirut at the request of the Lebanese President and British troops were sent to Jordan following an appeal from King Hussein. <sup>2</sup> Which had four Canberra bomber squadrons at that time, based at Akrotiri in Cyprus. <sup>3</sup> One of No 7 Squadron's Valiants, WZ366, was struck by lightning on 22 August, at 9,000ft in cloud, causing a 2in diameter hole in the underside of the Orange Putter radome at the rear of the aircraft. <sup>4</sup> The essence of which was self-sufficiency away from base.

thus in July there were 14 of the former and three RBS, in August three cross-countries, in September four and three RBS, in October three and five and in November four and three. It is worth noting, while putting the squadron's early record thus under a microscope, that during October there were no less than 25 practice sorties in preparation for a three-Victor formation to be flown during a visit by Princess Margaret to Cottesmore – recalling the criticism made in the Bomber Command report on Operation Musketeer, that the Canberra LB force had been diverted on to training for flypasts for Royal and Russian visits to Marham.

No 10 Squadron did not become involved in exercises until December 1958, when there was one at Group level, and like the other V-force squadrons it took part in a Bomber Command Alert and Readiness Plan dispersal exercise – 'Mayflight' – during May 1959. In the previous month two of the squadron aircraft had been flown to Boscombe Down for crews to familiarise themselves with the dispersal facilities, and four Victors were detached there for the actual exercise – their scramble times varying from 4min 23sec to 7min 22sec. In May and June 1959 Western Rangers appear for the first time among squadron activities, and in the latter month a Lone Ranger. The familiar training and exercise patterns appear in the No 10 Squadron ORB – cross-countries, RBS sorties, profiles and continuation training; Groupexes, Bomexes, Mandates and Kingpins. Then in November a second dispersal exercise – 'Mayflight II' – was held when the squadron sent four Victors to Boscombe Down and the ORB compiler made the interesting comment:-

“as the necessary modifications had been incorporated, weapons were carried for the first time. XA938 and 940 were armed with 10,000lb drill weapons and 937 had an inert 10,000lb weapon. XA941 was not armed. All four aircraft were airborne within five minutes of receipt of the 'scramble'. A Kingpin-type route with simulated NBS attacks on Continental targets was then flown, after which all four aircraft landed back at Cottesmore”.

Thus the pattern of training and exercises was common to all the V-force squadrons in the first (B.1) generation of jet medium bombers; as the force had (to quote a correspondent of *The Times* who visited Marham in mid-1958) “worked up first in their Valiants and now also in the Vulcans and Victors, into a formidable weapon in their own right, well able to press home their attacks with superb efficiency”. The correspondent, who said that he had been on a “local” exercise – “a mere 2,000-mile flight which covered the English Channel, Devon, Scotland, the tip of Northern Ireland, the Shetlands and the north-east coast” – added that the “over-riding impression” to an outside observer was “the extent to which the policy of avoiding war by being capable of waging it better than their opponents” was the mainspring of the V-force.

The efficiency of the force depended upon three main components: the ability of its crews, aircraft and weapons to fulfil the task laid upon them of delivering a strategic nuclear deterrent attack (an ability developed by the training, competitions and exercises already referred to); dispersal in batches of four aircraft to airfields throughout the country, to minimise the risk of destruction by enemy attack and to ensure that a significant proportion of the force would get off the ground when so ordered; and readiness to respond to a decision that the V-bombers should scramble and head for their assigned targets. The dispersal plan, which involved the provision of requisite facilities on 36 airfields at a cost of more than £2m – an expenditure approved by the Treasury late in 1960,<sup>1</sup> was unique to the V-force. It involved the actual or potential use of 25 airfields outside Bomber Command – belonging to other RAF Commands, the Royal Navy or the Ministry of Aviation. Thus there were dispersals at all Bomber Command's Class 1 bases – Scampton, Wittering, Coningsby, Cottesmore, Honington, Waddington, Finningley, Gaydon and Wyton – and at two more of the Command's airfields, Burtonwood and Tarrant Rushton. Six Fighter Command bases were planned to be used – Bishop's Court (on the Northern Ireland coast), Leconfield, Leeming, Middleton St George and Duxford – and four each from Coastal and Flying Training Command, respectively St Mawgan, Aldergrove, Ballykelly and Kinloss; and Cranwell, Shawbury, Topcliffe and Valley. There were also six MoA airfields – Bedford, Boscombe Down, Pershore, Llanbedr, Wick and Dyce; two belonging to Transport Command – Filton and Lyneham; and three Royal Naval Air Stations – Lossiemouth, Yeovilton and Machrihanish. So the V-bombers in

<sup>1</sup> 11 November 1960 – Treasury/Air Ministry (2-DM 126/127/06).

dispersed positions could be spread over the whole of the British Isles – from St Mawgan in the south-west and Bishop's Court in the west to Lossiemouth and Wick in the north of Scotland, although not all the dispersals originally planned were in fact used.

The cost of works at these airfields, to provide requisite technical and domestic facilities for four V-bombers, aircrew and groundcrew, varied from nil in some cases – presumably where appropriate installations were indigenously available – to over £200,000 in one instance and between £100,000 and £190,000 in seven others. In giving approval to a total expenditure of over £2m, the Treasury said that they were prepared to accept the case for 36 dispersal airfields on the basis put forward by the Air Ministry – the need to make the V-force invulnerable to large-scale missile attack, and to enable a sufficient number of its aircraft to fly clear of their bases within the minimum warning period.<sup>1</sup>

Thus while physical provision was made for dispersing the V-force, the third main component of its efficiency was readiness – which, as has been seen, was regularly practised by the squadrons in BCAR (Bomber Command Alert and Readiness) exercises. As far as the Government, in the person of the Minister of Defence, was concerned the touchstone of V-force operational capability was the speed at which it could be made ready for action. A report in January 1961 (when the Thor IRBMs were part of Bomber Command's nuclear retaliatory forces)<sup>2</sup> said that after 24 hours' strategic warning 75% of the MBF could be at readiness, armed and dispersed; from first receipt of a warning, bombers should become available at the rates of 20% in two hours, 40% in four hours, 60% in eight hours and 75% in 24 hours. On receipt of a tactical warning, the force should be capable of maintaining 40 minutes' readiness in one month and/or 15 minutes in one week. From the latter state it could readily be brought to Cockpit Readiness, enabling aircraft to become airborne in three–six minutes (the aim being, it was explained, a three-minute scramble time – though that would not be achieved by the whole force until the dispersal airfield programme had been completed). The Thor force could be brought rapidly – in about 15 minutes – to 15-minute readiness, a state which it could sustain; about 60% of the force was available at all times. As to the Early Warning System, the report said that the 'reporting' element of the UK Control and Reporting System – the component which produced warning of enemy air attacks – provided continuous full cover throughout every 24 hours.

What the V-force needed to be protected against was possible attack by MRBMs (medium-range ballistic missiles) fired on low trajectories from sites in Soviet bloc satellite countries, and in response to such a threat, proposals were put forward early in 1961 for means to improve reaction times<sup>3</sup>. These chiefly centred on the provision of ORPs (operational readiness platforms) at dispersal airfields – that is, hardstandings from which the V-bombers had to roll forward only a few feet on to the runway – and the capability of starting all four engines simultaneously. Work on the latter refinement for the B.1s had already been in progress for some time when the Air Ministry put forward its proposals for the dispersed airfields programme in 1960, and the results were demonstrated publicly and dramatically at that year's SBAC Farnborough Display, when on six out of the seven days four V-bombers got airborne in less than two minutes – the quickest time being achieved by four No 617 Squadron Vulcans (1 min 24sec) and the second quickest by four No 148 Squadron Valiants (1 min 37sec)<sup>4</sup>. As the Air Ministry pointed out to the Treasury, in emphasising the need to complete the dispersal plans<sup>5</sup>, there was "nothing unrepresentative about the demonstrations of the speed of reaction at Farnborough and elsewhere, to Ministers, the Press and the public".

The V-bombers which got airborne so quickly at the SBAC Display (though an even faster time – 1 min 20sec for four aircraft – had been achieved in practice at a V-force station)<sup>6</sup> were all B.1s, and the Air Ministry intended to give the B.2s the same quick-starting capability. Describing its plans for V-bomber readiness early in 1961, the Ministry told the Treasury<sup>7</sup> that now that the B.2s were being

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<sup>1</sup> These costs, and details of the works involved, had been put to the Treasury by the Air Ministry on 21 October 1960 (CMS 2479/54/F4). <sup>2</sup> Readiness of Bomber Command and the Early Warning System, sent to the Minister of Defence on 17 January 1961. <sup>3</sup> AUS(A)/Treasury, 15 March 1961, on V-bomber Readiness. <sup>4</sup> *Flight* SBAC Display reports, issues of 9 and 16 September 1960. <sup>5</sup> AUS(A)/Treasury, 15 March 1961, *ibid.* <sup>6</sup> AUS(A)/Treasury, Minute on V-bomber readiness. <sup>7</sup> *Ibid.*

introduced<sup>1</sup> they had to be fitted with simultaneous engine starting in order to achieve a speed of reaction comparable with that demonstrated by the B.1s. The latter had an electrical starting system, which had been modified to give a quicker start; but the B.2s' compressed-air starting system was not susceptible of improvement within Service resources, as the B.1s' system had been – though the requirement was not a new or an inconsistent one. In other words, if the requisite modification – installation of compressed-air bottles to start the four engines and bring them to idling within 15 seconds – had to be done by contractors this would cost money and the Ministry asked the Treasury for approval of the requisite expenditure.

There were other implications, involving both engineering effort and expenditure, of the quick-reaction times demanded by a high state of V-bomber readiness. One related to cabin air conditioning, necessary when crews were sitting in their aircraft, wearing flying clothing,<sup>2</sup> for long periods; it was provided by air supply trolleys, which had to be disconnected at the last possible moment – hence the need for a 'snatch disconnection' between aircraft (as it rolled forward) and trolley. Another, similar, requirement related to the conditioning of weapons – so that they would be effective for use once airborne in the V-bombers. The free-falling bombs of earlier marks required to be kept in an air-conditioned bomb-bay, so that hot-air blowers were needed and also – as in the case of aircraft air conditioning – snatch disconnections. When Blue Steel came into service a heater would be needed for it. Yet another requirement concerned the power supply to the flight instrument system, to ensure that the horizon settled down accurately so as to guarantee control of the aircraft in night or low-visibility take-off conditions<sup>3</sup>.

No wonder that, early in 1961, faced with increasing costs for improving V-bomber readiness by the introduction of such modifications, the Treasury asked the Air Ministry whether that was "the end of the story", or whether further proposals were likely to be made.<sup>4</sup> To which the Ministry replied somewhat testily on 7 April<sup>5</sup> that whatever adjustment had to be made to the revised defence costing in the following month, it seemed to them that such measures to maintain the effectiveness of the RAF contribution to the deterrent over the next decade "must be regarded as essential".

Measures to improve the readiness of the B.2 V-bombers by giving them simultaneous engine starting alone were estimated at £4.5m, with an R&D element of £0.9m,<sup>6</sup> and the Minister of Defence (Mr Harold Watkinson) gave his approval on 13 July 1961 for the proposals to be implemented.

The 'readiness capability' which Bomber Command had been directed on 7 July 1958 to introduce into its medium bomber squadrons to meet the conditions of strategic warning (24 hours' notice, after which 75 per cent of the force should be at readiness, armed and dispersed) and tactical warning (either 40 minutes, capable of being sustained for one month, or 15 minutes sustained for one week) – conditions which had to be met at any time of the day, weekends or holidays, throughout the year, had been confirmed at a meeting of the Minister of Defence with the Secretary of State for Air on July 21. It involved not only the factors already mentioned – the big programme of making 36 airfields available for the V-force to operate from when dispersed from its main bases, and the modifications necessary to enable its bombers to start up and taxi in the minimum possible time – but also an increase in manning establishments to provide for a two-shift, 18-hour working day, installation of a communications system to bring the Thor IRBM squadrons into the alert and readiness plan and re-organisation of the Bomber Command Operations Centre so that it would be capable of controlling a nuclear retaliatory attack should one ever be required, and the major exercises designed to simulate such a situation. These other factors also involved additional expenditure, for example an extra 60 airmen costing about £50,000 a year, and the provision of emergency sleeping quarters some £120,000.<sup>7</sup> Also, if personnel were to be kept on stations at times – like weekends – when they might reasonably expect to be able to get away from them, extra recreational facilities needed to be provided.

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<sup>1</sup> The first B.2 V-bomber to be received by Bomber Command was a Vulcan delivered to No 230 OCU at Waddington on 1 July 1960, the first squadron to receive the type being No 83 at Scampton on 23 December of that year. <sup>2</sup> In the interest of crew efficiency the Air Ministry wished to provide an air supply to air-ventilated suits worn by crews. <sup>3</sup> The quick erection of flight instruments and run-up of powered flying control units, within 20 seconds, were as necessary to rapid take-off capability as the simultaneous starting of all four engines. <sup>4</sup> Ref 2-DM.10/32/014. <sup>5</sup> AUS(A)/9986. <sup>6</sup> Minute to Minister of Defence (SZ/702/61, 29 June 1961). <sup>7</sup> Minutes of meeting between Minister of Defence and SofS for Air, 21 July 1958.

It was such costs, which were additional to those incurred in the aircraft, weapon and airfield programmes, that helped to highlight expenditure on the RAF strategic nuclear deterrent forces and caused some friction with the other Services – particularly the Royal Navy – on the ground that the procurement of conventional weapons was being adversely affected thereby. In August 1960, for example,<sup>1</sup> the Admiralty suggested that it was their turn to have a larger share of the Defence budget, since they had accepted a setback to the new Naval construction programme in order to facilitate the financing of the deterrent force. The Air Ministry contested this view, saying that it might well be that in a time of acute stringency and competition for resources the Admiralty, in common with the Army and the Air Force, had got less than they would have liked; but that, on the evidence of appropriate official documents since 1954, “sacrifices for the sake of the deterrent” had “never entered into the matter”.

V-bomber readiness also brought the V-force into the public eye (or ear); for when readiness exercises were held, at any time of the day or night (including weekends), it was impossible to disguise entirely the fact of – say – 150 four-jet aircraft all taking-off at about the same time and then landing at other airfields in the UK. Thus clearance was required at the highest level; for example, at the beginning of December 1961 the Minister of Defence was informed that the Air Minister had approved plans for “another Bomber Command readiness exercise starting on the 5th and lasting up to 48 hours”. This would involve both the V-bombers and Thors and be broadly similar to the Command’s annual exercise (which had been held in May) in that the readiness procedures would be “carried to the point of some dispersal of aircraft”. A special feature was that, unlike the annual exercise, it would be “carried out without prior announcements, either with the Service, or publicly” – its object being “to test what the Command can do, starting from its normal day-to-day state, without advance preparation . . .”<sup>2</sup>.

The Minister of Defence thought that the Prime Minister should be informed, and an “I agree. H.M.” was received in reply on 4 December, similar notes passing between Ministers about a Bomber Command readiness exercise held in the spring of the following year, beginning on 10 March 1962.<sup>3</sup> Thus these exercises, which had to be called without notice in order to form a true test of V-force capability, could in a sense be termed political matters because of the political approval required for them – a characteristic which, with the large capital expenditure involved and the additional costs of techniques to improve readiness, showed how enmeshed the V-force was in the Government’s defence policy.

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<sup>1</sup> Correspondence in file on Cost of the Deterrent, Pt II (95/03/033/58). <sup>2</sup> Correspondence in file on the Medium Bomber Force – State of Readiness (S.95/03/032/58, pt II). <sup>3</sup> *Ibid.*

## CHAPTER 7

## Thor Missile Deployment (1958–1963)

From 29 August 1958, when the first Douglas Thor IRBM was offloaded from a C-124 Globemaster of the USAF Military Air Transport Service at RAF Lakenheath and subsequently (on 19 September) delivered to No 77 (SM) Squadron at Feltwell, the RAF strategic nuclear deterrent forces acquired a new dimension – ground-launched missiles supplementing the V-bombers. But the Thors – the only strategic nuclear missiles ever to be based in the United Kingdom<sup>1</sup> – were American property, operated by Bomber Command crews; it was as if the US had loaned B-47s to the RAF to strengthen the Western strategic deterrent forces.

Thor was a ballistic rocket capable of delivering a megaton-range warhead over a distance of about 1,500nm – too short a range for it to be used on bases in the USA against targets in the USSR, but suitable for it to be deployed to Europe or other areas (Turkey and Okinawa<sup>2</sup> were considered as possible locations) as a supplement to manned bombers. A comparable IRBM, Jupiter, developed for the US Army by the Chrysler Corporation, was deployed to Italy, where 30 were based, and to Turkey, where there were 15, in NATO squadrons. These missiles “provided the United States, and the Strategic Air Command, with much-needed weapon-system capability to counter the threat posed by Soviet IRBMs to America’s NATO allies and SAC’s overseas bases. At the same time, they furnished positive proof of America’s commitment to the defense of Western Europe against Communist aggression”<sup>3</sup>.

What has been described as “the dogged determination of the United States to deploy IRBMs among its NATO allies”<sup>4</sup> began, as far as the United Kingdom was concerned, in August 1956 when the US State Department made an approach to the UK Government about the possibility of basing Thors in Britain<sup>5</sup>. Subsequently, towards the end of January 1957, a briefing on the system was given to the BJSM (British Joint Services Mission) in Washington. This occurred on 28 January and seems to have been attended by the Minister of Defence (Mr Duncan Sandys), for two days later he informed the Prime Minister<sup>6</sup> that the Americans had explained their proposals and had said they were “most anxious” in view of the progress of Russian ballistic rockets that a “rocket deterrent should be established in Britain as soon as possible”.

The Minister of Defence explained that the United States would provide the weapons and specialised equipment, the nuclear warheads being held “under the same conditions” as American nuclear bombs for the V-bombers<sup>7</sup> while Britain provided the sites. He added that the proposal “would give us a megaton rocket deterrent . . . at least five years before we could provide it ourselves”. He made no mention of personnel, but on the same date the Commander of the RAF staff at BJSM (Air Vice-Marshal A D Selway) in a message to DCAS (Air Marshal G W Tuttle) about the 28 January meeting said that the proposal seemed to be “to set us up with four squadrons of Thor. Each . . . consists of 15 missiles, which involves the employment of 500 men. That is to say, 60 missiles and 2,000 men”.

There had therefore been meetings, briefings and discussions on the possible deployment of Thor IRBMs to the UK before the subject was taken up at the highest possible level in March 1957 when President Eisenhower and Prime Minister Macmillan met at Bermuda, leading to an agreement between the two leaders which formed the basis for subsequent US–UK political and military agreements, worked out later that year and implemented during 1958. At the time of the Bermuda Conference the Thor rocket was still under development; it was not mentioned by name in the Memorandum of Conversation between the President and Prime Minister, which referred to “a concept under which

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<sup>1</sup> The British MRBM being developed at this time, Blue Streak, was later abandoned as a military weapon. <sup>2</sup> “Bases in UK, Turkey and Okinawa” were referred to at the briefing on Thor for the BJSM in Washington on 28 January 1957. <sup>3</sup> SAC’s *From Snark to Sram: A pictorial history of Strategic Air Command Missiles*, 1976. <sup>4</sup> *Ibid.* <sup>5</sup> File on Thor Policy (AF/CMS814/65 Pt 1), minute of 17 August 1956 referring to “notes for discussion with Mr Quarles on possibility of basing US BM units in the UK”. <sup>6</sup> Telegram to Foreign Office, No 187 of 30 January 1957. <sup>7</sup> *ie* in US custody.

United States-developed intermediate-range ballistic missiles (IRBMs) might be provided for deployment in the United Kingdom, when such missiles become available for use".<sup>1</sup> The Prime Minister (who had only taken office two months previously, following the resignation of Sir Anthony Eden) "agreed that arrangements would be worked out between the two Governments, and hoped that this could be done as a matter of urgency, particularly in view of the possible effect on the UK defence programme".

The UK Minister of Defence and US Secretary of Defense had already had discussions about the possible deployment of IRBMs, as recorded in a memorandum of 1 February 1957, and during that year detailed arrangements were worked out by their respective Departments, leading to a draft agreement sent to the Ministry of Defence on 18 April.<sup>2</sup> Agreement between the two governments was not reached, however, until nearly ten months later – being published in the UK as a White Paper in February 1958.<sup>3</sup>

When the Minister of Defence (Mr Duncan Sandys) announced the Anglo-US Agreement in the House of Commons on 24 February 1958<sup>4</sup> he referred only to "technical studies by the military and scientific staffs of the two countries" following the agreement in principle by the President and Prime Minister "that certain guided missiles would be made available by the United States for deployment in Britain"; but in fact there had been extensive discussions of all aspects – strategic, financial and logistic – of such a deployment, and the Chiefs of Staff had expressed strong reservations. In a memorandum of 29 January<sup>5</sup> they described themselves as being "opposed to being rushed into this commitment, which in our view is designed to serve American ends more than British". They considered that the UK was in grave danger of having to accept – at great expense in money and manpower<sup>6</sup> – a weapon which was both untried and unreliable operationally<sup>7</sup> and was highly vulnerable to attack. It increased the attractiveness of the UK as a target at a time when the country's air defences were being reduced; and in spite of the UK's contribution in men and money, the only UK control over its use was the negative one of veto. It was "to form part of the Western deterrent" but would "make no contribution whatever to our independence".

However, despite such reservations and having made some amendments, the Government approved the agreement and Mr Sandys announced its main terms. The missiles were to be "manned and operated by units of the Royal Air Force"; they were not to be launched "except by a joint positive decision of both Governments"; the nuclear warheads were to remain in American custody and to be kept in an unarmed condition so that there would be no risk of a nuclear explosion; and the weapon was "designed in such a way that it would be impossible for it to be launched accidentally". The Minister said that the United States would supply the missiles and specialised equipment at their expense and would also pay for the training of British personnel in America. Britain would meet the cost of providing and constructing the sites and supplying certain items of equipment, the British share of this expenditure being estimated at about £10m. The missiles would be deployed in small numbers on dispersed sites, mostly on active or disused RAF airfields – these sites being mainly in East Anglia, Lincolnshire and Yorkshire.<sup>8</sup>

The inter-Governmental agreement on the *Supply of Ballistic Missiles by the United States to the United Kingdom* had been signed two days before the Minister's Parliamentary statement, on 22 February, and it had been paralleled by a technical agreement between the RAF and USAF – drafted after discussions which had taken place between representatives of the two air forces at the Air Ministry

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<sup>1</sup> Bermuda Conference Anglo-American discussions, 21–24 March 1957. <sup>2</sup> File on Thor Policy, ID/47/298 Pt 1.  
<sup>3</sup> *Supply of Ballistic Missiles by the United States to the United Kingdom*, Cmnd 366. Code-name for the provision of Thors was Project Emily, but "at the beginning of [1959] it was decided to dispense with the code name 'Emily' and to use 'Thor' for all Thor projects" (A History of No 1 (Bomber) Gp). <sup>4</sup> Commons Hansard, 24 February 1958, Cols 29–30. <sup>5</sup> COS(58)23. <sup>6</sup> "The capital expenditure . . . will . . . be approximately £10m and the Royal Air Force will have to provide some 4,000 men distributed over 20 sites . . .". <sup>7</sup> "So far only ten Thor missiles have been fired with the completed assembly and none . . . has been fully successful". <sup>8</sup> This statement generated some questions from Opposition members and subsequently there was a debate on defence (26–27 February) in which the Thor agreement was referred to, S of S for Air (Mr G Ward) describing the weapon as being "of the first generation of ballistic rockets, or the second if we count the V2" (Commons Hansard, 27 February, Col 569). Many Opposition speakers expressed disquiet about the establishment of Thor bases in the UK.

during January 1958. What resulted was a proposal that four squadrons, each of 15 missiles,<sup>1</sup> should be deployed on 20 dispersed sites; these squadrons would be under the control of Bomber Command.

Announcing this, the Air Ministry Quarterly Liaison Report for January–March 1958 said that wherever possible, Government-owned land had been selected for these deployments. Detailed surveys had already been made of the proposed squadron main bases and of the satellites for the first squadron – which would be at Feltwell, its satellites being Mepal, North Pickenham, Shepherds Grove and Tuddenham.<sup>2</sup> The four squadrons would be manned by RAF personnel, although initially the USAF would provide maintenance personnel for the first squadron; training would take place in the United States and would include actual launchings. As to logistic support, this would be provided directly through the USAF IRBM logistic support system. Missiles would be delivered by air from the US to squadron main bases, then moved by road to satellite units on a special transporter. The AMQLR added that the US/UK agreement on Thor would last for a minimum of five years. At the end of this period “the development of our own ballistic missile<sup>3</sup> should be well advanced. It will be a great improvement on Thor, having a much greater range and reduced vulnerability . . . . Wherever possible, use will be made of facilities that are at present being developed for Thor”.<sup>4</sup>

The USAF/RAF technical agreement on Thor, drafted during January 1958, was signed on 26 June. In announcing this, AMQLR for April–June gave the numbers allocated to the Thor squadrons – Nos 77, 97, 98 and 144<sup>5</sup> – and said that the second to form would be based at Hemswell with Caistor, Ludford Magna, Bardney and Coleby Grange as satellites. The first group of RAF personnel for training in the United States – 23 officers and 45 ORs – had left the United Kingdom during May and were expected to have completed their training by the end of June; the officers had been on a ballistic missile lead-in course at the RAF Flying College, Manby.

Once the decision had been taken to accept Thor into the UK armoury, and to have RAF personnel trained in its operation in the USA, squadrons were rapidly formed – the more so as, in an amoeba-like process, the four 15-missile squadrons originally planned were increased to 20 three-missile squadrons. This was done by making all the satellite positions into squadrons. Thus, while there were originally to be four main Thor bases – Feltwell, Norfolk (No 77(SM) Squadron); Hemswell, Lincolnshire (No 97); Driffield, Yorkshire (No 98); and North Luffenham, Rutland (No 144) – with four satellites each, these became main bases for five squadrons in the latter half of 1959. Thus the Thor Force line-up, by main bases, was as follows: Feltwell, Nos 77, 82, 107, 113 and 220 Sqns; Hemswell, Nos 97, 104, 106, 142 and 269 Sqns; Driffield, Nos 98, 150, 226, 240 and 102 Sqns; and North Luffenham, Nos 144, 223, 130, 218 and 254 Sqns. These were mainly former bomber squadron numbers<sup>6</sup> and the Thor squadrons – giving Bomber Command the equivalent in destructive power of 60 V-bombers carrying megaton-yield weapons, though without their re-use and conventional warfare capabilities – were based on wartime airfields. They became fully integrated with the V-force and took part in its alert and readiness exercises: “the Thor intermediate-range ballistic missiles”, it was stated<sup>7</sup> early in 1959, “are operationally and administratively part of the deterrent force under Bomber Command”; and in 1960 the Command said that its strategic missile force was to be “regarded as constituting the equivalent for Bomber Command of the Strategic Air Command Alert Force” – it was to “maintain a capability to react within tactical warning at all times”<sup>8</sup>.

For the 1,200 men of the Thor Force – there were approximately 60 to a squadron (six officers, 29 SNCOs and 25 NCOs/ORs) – life was governed for 365 days a year<sup>9</sup> by crew training, missile serviceability, readiness exercises and security. Each squadron had five six-man launch crews,

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<sup>1</sup> Subsequently (during 1959) all the launch positions were made into squadrons, so there were eventually 20 squadrons, each with three Thors. <sup>2</sup> Apart from North Pickenham, which had been used by the USAAF, these were all wartime airfields in No 3 Group, Bomber Command. <sup>3</sup> Blue Streak. <sup>4</sup> Except that Blue Streak was to be launched from underground. <sup>5</sup> 141 was the number actually quoted, but this was an error. <sup>6</sup> The exceptions were Nos 269, 240, 130 and 254. <sup>7</sup> Bomber Command Signals Plans in No 1 Group file on Project Thor. <sup>8</sup> Thor SM Force – Readiness Policy, SASO BC to Nos 1 and 3 Groups. <sup>9</sup> One station commander who was on leave when an accident occurred was nevertheless court-martialled because of it. The aviation magazine *Flight* in its 27 January 1961 issue said that the Air Ministry had announced that not only the squadron CO but also the group captain commanding the Hemswell complex had been posted to “other appointments” after a LOX (liquid oxygen) overflow at Ludford Magna (No 104 Sqn) on 7 December 1960.

maintaining a round-the clock duty roster: these crews consisted of a launch control officer (who had sitting beside him a USAF authentication officer – a major or captain), launch control console operator, three missile servicing chiefs and an electrical fitter/mechanic. Four RAF policemen were also on duty. Training of these launch crew personnel had begun at the RAF Flying College at Manby, followed by six weeks–three months at the Douglas Aircraft Co plants in California; it continued on the squadrons with regular count-down procedure practice. Allied with crew efficiency was missile serviceability – the aim being to offer up to Bomber Command HQ the maximum possible number of serviceable, ready-to-fire Thors, just as the available strength of the V-force turned on the number of combat-ready crews and Valiants, Vulcans and Victors.

The operation of Thors was a unique experience for Bomber Command, for two reasons: the RAF was the only Service in the world to deploy this type of strategic missile; and the men of the Thor squadrons were the only members of the British armed forces ever to fire such an IRBM. Further, the manner in which the missiles and their personnel were deployed reflected the military monasticism of the missile age, apotheosised in the Titan and Minuteman ICBM underground launching sites of the USAF Strategic Air Command. By comparison with these second-generation weapons, fired from unmanned and hardened silos, the Thors were exposed to the elements; they were stored in a horizontal position and had to be raised to the vertical for firing; they used liquid fuel (like the Titans but unlike the Minutemen); and their sites were protected by high concrete-post wire-mesh fencing, with patrolling RAF Police and guard dogs. This environment, with its integral risks – from the presence of nuclear warheads and of large quantities of inflammable LOX (liquid oxygen) fuel,<sup>1</sup> plus the dangers of sabotage<sup>2</sup> – and with dedicated isolation on the ground matched by feelings of vulnerability from the air, resulted in special problems of morale for Thor force personnel. A former squadron commander<sup>3</sup> has commented that nobody was happy on a Thor missile site but that personnel “could be made contented”; there were no malingerers, although the men concerned were first-class technicians, used to the circumstances and satisfactions of working on aircraft. The ex-CO considered that the largest contribution to morale – 50 per cent – was made by the commanding officer of a Thor squadron, 30 per cent by the launch control officer (because his leadership of the team doing the count-down was crucial to its efficiency) and 20 per cent by physical conditions – food, accommodation, time off duty, leave, etc. Those posted to these squadrons were told that strategic missiles were “the thing of the future” – and so they might have been, had the deployment of Thors been followed by that of Blue Streaks.<sup>4</sup> But when the British MRBM was abandoned in April 1960 and the RAF was not called upon to man any further surface-to-surface missiles after the Thors were returned to the United States in 1963, the experience which squadron personnel had gained could not be directly applied again within the Service, and being on one of the SM units has been described as “a disaster, careerwise”. However, while the 20 Thor squadrons were in being, a high standard of technical efficiency and teamwork was achieved by personnel serving on them.

USAF officers formed an integral part of the personnel on the Thor squadrons. No 77, which had been the first to form, referred in a description of its activities<sup>5</sup> just before being disbanded on 10 July 1963 to the Missile Control Centre – “permanently manned by an RAF Squadron Leader (the Missile Controller) and a USAF Authentication Controller of Lieutenant-Colonel or Major rank” – and to the composition of a launch crew: “one Launch Control Officer (Flight Lieutenant, GD<sup>6</sup>), one Authentication Officer (Major or below, USAF), one Launch Control Console Operator (NCO aircrew), three Missile Servicing Chiefs (fitters), one electrical fitter/mechanic, four RAF Police”.

The USAF officer “held the key” to a Thor launch. The same No 77 Squadron ORB describes the missiles as being “housed in a horizontal position in a retractable shelter and . . . maintained in a ‘ready-to-launch’ configuration. On turning a key each missile was designed to lift off its launch pad after 15 minutes, during which time the inertial guidance system would be run up, the shelter retracted, fuel (kerosine-type) and liquid oxygen<sup>7</sup> loaded into the missile and the engines ignited. The entire process,

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<sup>1</sup> The tank of liquid oxygen from which the missiles were fuelled held 6,000 gal. <sup>2</sup> A couple of rifle shots through this tank, for example, could have had disastrous consequences. <sup>3</sup> Squadron Leader R K Collyer, RAF(Ret), formerly CO of No 97(SM) Sqn, in an interview with the author. <sup>4</sup> Intended to come into service in about 1965. <sup>5</sup> ORB for June–July 1963. <sup>6</sup> General Duties, *ie* aircrew Branch. <sup>7</sup> Fuel for the 150,000lb thrust Rocketdyne MB-3 rocket engine was liquid oxygen and RP-1.

known as the 'count-down', was automatic, being controlled and monitored by electronic equipment housed in mobile (but normally static) trailers".

Even in the best-regulated missile circles, however, things could sometimes go wrong – as a former RAF officer described in a letter to *The Times*, when he said that its assertion that nuclear safeguards like a double-key procedure made "an unauthorised detonation" of a weapon "almost impossible" reminded him of "an occasion in the wilds of Lincolnshire some 12 years ago". Recalling that he was "an unofficial observer at the count-down of the simulated launch" of a Thor, "laid on for the benefit of a visiting group of VIPs", he described how

"the double-key procedure was then in use, and an RAF officer was sitting at the console ready to insert his key. The seat beside him, however, was vacant and, as zero hour approached, the mounting apprehension at the absence of the other key-holder (a USAF officer) was barely concealed from the VIPs.

"He never did turn up, but the situation was saved by the *sang froid* of the RAF officer, whose adroit use of a screwdriver in the other key-hole enabled the simulated launch to take place"<sup>1</sup>.

The comment has already been made that a good launch control officer, with a team he knew well, was a major contributor to the morale of a Thor squadron – each of which had five launch crews, to allow for leave periods and days off.

The No 77 Squadron ORB said that the launch crews, working a round-the-clock shift roster, "were exercised frequently, on a no-notice basis, the missiles being counted-down to a launch minus eight minutes' state (known as a Phase 2 hold). Other pre-planned exercises were also held when the missiles were counted-down to a launch minus two seconds, having first been rendered safe. Each missile was in a 'ready to launch' (standby) state for over 90 per cent of the time . . .".

The ORB also referred to key dates in the history of the Thor force – 1 September 1959 when the original satellites or flights were upgraded to squadrons; 1959–early 1960 when "steady progress was made towards becoming fully operational, procedures for different types of count-down being devised and tested;<sup>2</sup> and May 1960, when "warheads were fitted to the missiles, which completed the weapon system and finally gave it a no-notice strike capability".

The operations room at Feltwell, where No 77 Squadron was based, had telephone and radio communications links with the HQs of Bomber Command, Nos 1 and 3 Groups and USAF Strategic Air Command at Omaha, Nebraska, as well as with the satellite squadrons, and the warning which would be received by these means of an IRBM/ICBM attack being launched against the US and the UK would come from the three BMEW (ballistic missile early warning) stations in Alaska, Greenland and Yorkshire – though the third of these, at Fylingdales, did not become fully operational until September 1963.

With the ending of the construction and installation phase in the first half of 1960 the build-up of the Thor force was complete, with all 60 missiles deployed. During the same period the flow of liquid oxygen through the missile systems was introduced as a normal squadron training exercise, and from the latter half of 1960 there was a regular series of Bomber Command exercises for the Strategic Missile Force: Mayshot 3 in July 1960, when a fifth of the force actively participated (the remainder simulating it); 'Respond' in the October–December 1960 period – a 'no notice' testing of the readiness of the force, with 34 missiles taking part; more Responds in early 1961, with 44 Thors participating on 29 January and 35 on 16 March; 'Reclaim' on 16 February, when seven missiles took part, and another on 25 April when there were eight – "successfully demonstrating the ability to recover 'available' missiles within six hours";<sup>3</sup> Respond on 15 June 1961 when 44 Thors participated; Mayshot (10–15 May of that year) when 338 successful count-downs to the end of Phase 2 were achieved; Reclaim and Respond exercises in the latter half of 1961 – 13 'available' missiles in the former on 11 August, 'standby' in the latter

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<sup>1</sup> A US Congressman (Charles Porter, Oregon) asserted, after a visit to RAF Feltwell in June 1959, that an RAF officer had produced both keys needed to unlock the control mechanism and to enable a count-down to proceed (*Flight*, 11 March 1960, page 330). <sup>2</sup> eg dual-propellant flow, both types of fuel (LOX and RP-1) going into the missile at the same time. <sup>3</sup> AMQLR for April–June 1961.

on 14 August, 44 on 15 September and 37 on 21 September. These statistics, from the Air Ministry Quarterly Liaison Reports for that period, show the intensity with which the Thor squadrons were exercised by Bomber Command to prove their readiness as part of the Western strategic nuclear deterrent forces.

Mayshot was "a planned Bomber Command exercise held in conjunction with aircraft forces . . . designed to test the ability of the missile force to react to the various stages of Alert placed upon it";<sup>1</sup> Respond was the Command's first truly no-notice exercise – "designed to test the readiness of the Thor missiles which are declared to be at Standby, and to test the communications and readiness procedures";<sup>2</sup> and Reclaim was intended "primarily to test the ability of strategic missile units to recover missiles which are declared 'available' within the stipulated time of six hours, and to exercise personnel in recovery procedures".<sup>3</sup> Another exercise was 'Redouble', which was sometimes incorporated in the annual Mayshot;<sup>4</sup> its purpose was "to exercise the whole SM force in the Bomber Command alert and readiness procedures, and to test the readiness of missiles in 'standby', and the reclaiming of those missiles which are in 'available' and 'out' states".<sup>5</sup> Then there were the exercises known as Triplox, involving a single LOX flow to all three pads simultaneously; Nightcheck, called by Bomber Command or by a Thor station, a paper exercise to practice reporting procedures and target control; and special safety exercises.

Such exercises, plus count-downs (at least one or perhaps two per day) and security checks – attempts to penetrate another squadron's security fence and to evade its RAF Police and guard dogs were a regular feature of life for Thor force personnel – made up the daily agenda for SM squadrons; and in addition launch crews were categorised, and selected crews went off from time to time to the United States for CTLs (combat training launches), firing Thors which had been removed from their emplacements in Britain and therefore were 'operational' missiles, having been exposed to the vagaries of the UK climate. The first launch of this kind, code-named 'Lion's Roar', took place at Vandenberg Air Force Base, California, on 16 April 1959 – not, in this case, of a Thor removed from a UK complex for the Bomber Command SM force did not achieve its full complement of missiles until early in 1960. Later, a Thor would be removed and airlifted to the US and a crew would follow and fire it – for example, on 4 October 1960 the missile on emplacement No 47 at North Luffenham (No 144 Squadron) was removed and replaced, and a squadron crew successfully fired it at Vandenburg on 13 December.<sup>6</sup>

These firings by selected crews from Thor squadrons went on from 16 April 1959 – when there was considerable publicity because a USAF-sponsored party of British Press correspondents watched the first RAF launch of a Thor<sup>7</sup> – until 19 June 1962 when the 12th and last CTL took place. The early launchings were by crews under training in the United States; there were about nine of these during 1959 and into the early part of 1960, the last one taking place on 2 March 1960. Overlapping this programme the CTL series of firings had begun, the first (by a team from Feltwell) taking place on 6 October 1959 and the second (by a team from Hemswell) on 4 December. It was on 22 June 1960 that the first ex-UK Thor was fired – as the Air Ministry Quarterly Liaison Report for April–June 1960 put it, in American-style terminology, "the missile fired was the first to be rotated from the current RAF inventory after a period of deployment in the United Kingdom. It came from the Driffield complex and was launched by an operational crew from that complex; the result was satisfactory". It must have been especially satisfactory to the Douglas Aircraft Co that their Thor IRBM, developed in the temperate climate of California, could be exposed to the variable European elements and then successfully fired on return to the Pacific coast. In fact, out of all the 21 firings by RAF crews (u/t and on CTLs) from Vandenberg AFB only two were not completely successful – in both cases the Thors being launched but having subsequently to be destroyed, on 16 June 1959 soon after lift-off because of a technical failure, and on 19 March 1962 after 28 seconds because of an erratic flight-path.

By an extrapolation of these launch successes, set against the constant exercises of the Thor SM force by Bomber Command in alert and readiness procedures, it could be assumed that these IRBMs with

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<sup>1</sup> No 144 Sqn ORB. <sup>2</sup> No 226 Sqn ORB. <sup>3</sup> Ditto. <sup>4</sup> "During the annual Exercise Mayshot Bomber Command initiated Exercise Redouble"(No 144 Sqn ORB). <sup>5</sup> No 226 Sqn ORB. <sup>6</sup> No 144 Sqn ORB. <sup>7</sup> The launch crew were Sqn Ldr P G Coulson, MPlts M H Sloan and A E Cover, and CTech R M Carpenter.

RAF roundels on them would have given an effective account of themselves had they been counted-down as part of the Western strategic nuclear deterrent forces. But their deployment was to be only for a limited period of time; just over two years after the full complement of Thors had been received in the UK the US Secretary of Defense (Mr Robert S McNamara) told the Minister of Defence (Mr Peter Thorneycroft) – on 1 May 1962 – that the United States would no longer provide logistic support for the IRBM squadrons in Britain after 31 October 1964.<sup>1</sup> This decision, followed later by a comparable one in respect of the Jupiters in Italy and Turkey (confirmed by President Kennedy on 24 January 1963), was taken against a background of the introduction of ICBMs – Titan II and Minuteman – into Strategic Air Command. These rendered obsolete the European-based IRBMs, with their high vulnerability and slow reaction times.

As a consequence the Minister of Defence announced in Parliament on 1 August 1962 that Thor would be phased-out by the end of 1963; this followed a Government decision not to take up the option of continuing with a British-financed Thor force. The Minister of Defence had recommended to the Cabinet Defence Committee, in a memorandum of 24 July 1962,<sup>2</sup> that British expenditure on Thor should come to an end. He said that if the system began to run down from the following spring, when the five-year Anglo-American agreement came to an end, there would be savings on 1962 costings of an estimated £1½m in 1963–1964, £2½m in 1964–1965 and £1m in 1965–1966. He had referred to the IRBM's operational limitations – that, as a static, above-ground missile, it could not ride out a surprise nuclear attack; and that at present it could not be held permanently at less than about 15 minutes' readiness – and said that it was not part of Britain's independent contribution to the deterrent forces. Further, with its operational limitations it could never be a satisfactory second-strike weapon.

This recommendation was accepted by the Cabinet Defence Committee at its meeting on 31 July, the committee "taking note" that the Minister would announce it in Parliament on the following day<sup>3</sup> – an announcement that would be made in answer to a Question. This came, on 1 August, from Mr Patrick Gordon Walker, who asked what the Government's policy was "regarding the period for which Thor missiles are to be retained in this country" – to which Mr Thorneycroft replied by saying that the Government had decided that "the arrangements under which Thor missiles are stationed in this country would be brought to an end during the course of next year".<sup>4</sup>

On the following day the Secretary of State for Air (Mr Hugh Fraser) paid tribute to the RAF Thor force. Writing to the AOC-in-C Bomber Command (Air Marshal Sir Kenneth Cross) he said that "Thor was the first strategic ballistic missile system deployed in the free world", and added: "You may well be proud that you pioneered the introduction of these weapons into military service. The high state of readiness at which the Thor force has been maintained, the record of serviceability sustained and the success achieved with Combat Training Launches reflects the greatest credit on all concerned".

The AOC-in-C paid his own tribute to the force on that date (2 August) when in an Order of the Day to all Thor squadrons and stations he said that

"The decision to phase-out the Thor Force of Bomber Command in no way detracts from the vital role which the force played in the past, and the significant part it will continue to play in future, until the very last missile is withdrawn.

"Thor was the first strategic missile system operational in the West. At a time when the threat to this country came almost entirely from manned aircraft, you were the most formidable part of the defence of the United Kingdom, and the Western Alliance.

"You in the Thor force have maintained a constant vigil day and night for almost four years. You have maintained a higher state of readiness in peacetime than has ever been achieved before in the history of the Armed Forces of the Crown. I am well aware of the sacrifices, so willingly accepted, that this constant readiness has imposed on the officers and airmen of the force.

"I am content that history will recognise your devoted service in the cause of peace. I know that I can rely on you for the same devotion during the run-down phase as you have shown since the birth of the force in 1958".

<sup>1</sup> SAC's *From Snark to Sram: a Pictorial History of SAC Missiles*. <sup>2</sup> D(62)40. <sup>3</sup> D(62) 12th Meeting.

<sup>4</sup> Hansard, 1 August 1962, Col 557.

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Shortly after the announcement by the Minister of Defence that the Thor "arrangements" would be "brought to an end" during the course of 1963 a joint Air Ministry/Bomber Command meeting on 10 August decided that the run-down of the Strategic Missile Force would begin on 1 April and be completed "not later than" 30 September – dates which were in fact pre-dated when the time came, the last squadrons being disbanded on 23 August.

When the proposed arrangements were communicated to the USAF 7th Air Division, the Strategic Air Command formation in the UK, the Americans pointed out that it would be to the mutual advantage of both countries for the highest possible operational capability to be maintained in each complex at each stage of the phase-down. At this RAF-USAF meeting, on 21 August 1962, it was agreed that general training on Thor should cease in November and that Combat Training Launches should be discontinued "immediately". There were subsequently more Anglo-American discussions, and at the end of October Bomber Command issued a Thor phase-out plan; then, before the year was out, a prototype dismantling took place – of a missile at No 240 Squadron, RAF Brighton. By 20 December (as the squadron ORB put it) Launch Emplacement 40 there had "ceased to exist" – a physical obliteration which had taken 13 working days. As a continuation of this running-down process the other two Thors were removed from Brighton early in the New Year, and on 8 January 1963 No 240 Squadron was officially disbanded.

The other 19 Thor squadrons disbanded between February and August 1963, the last five – Nos 144, 130, 218, 223 and 254 of the North Luffenham complex (the last to be formed) – becoming non-operational on 15 August and disbanding on the 23rd.

With the shipment back to the United States of the last Thor on 27 September<sup>1</sup> the Bomber Command strategic missile era ended: there was no follow-on surface-to-surface weapon to which the experience gained in the 20 squadrons might be applied, for the British Blue Streak had been abandoned as a military weapon in 1960 in the expectation that Skybolt would become available for the V-bombers. The Americans now had their inter-continental Atlas and Titan missiles in service and were no longer interested in IRBMs. As the Strategic Air Command history<sup>2</sup> puts it: "During their short operational life . . . Thor and Jupiter provided the United States, and . . . Strategic Air Command, with much-needed weapon system capability to counter the threat posed by Soviet IRBMs to America's NATO allies and SAC's overseas bases . . . Strategic Air Command's experience with the deployment and maintenance of . . . Thor and Jupiter IRBMs proved both instructive and rewarding . . .".

As far as the RAF were concerned, the Bomber Command experience with Thors, though it was short and self-contained, showed that when an operational task was undertaken it was fulfilled with thoroughness, zeal and efficiency. Under the control of specially trained personnel, the Thors had helped to maintain the Western strategic nuclear defences before the full deployment of ICBMs by the USAF.

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<sup>1</sup> HQ Bomber Command ORB for September 1963. The logistic (technical and equipment) aspects of the run-down were completed by 20 December 1963. <sup>2</sup> *From Snark to SRAM: A Pictorial History of Strategic Air Command Missiles*, by Dr E Michael Del Papa (Office of the Historian, Headquarters Strategic Air Command, 21 March 1976).

## CHAPTER 8

**Canberras in RAF Germany (1954–1972)**

When Canberra B.2 WJ626 of No 149 Squadron touched-down at Ahlhorn at 1130hr on 25 August 1954 as the vanguard of the first British bomber squadron to be based in Germany since the First World War<sup>1</sup> the deployment thus begun was at first considered a temporary one<sup>2</sup>. In fact it lasted until mid-1972 when the last Germany-based squadron of Canberras, No 16, was disbanded and their interdicator role taken over by Buccaneers. To have moved Canberras from the UK into Saceur's front line<sup>3</sup> in the mid-1950s might also have been considered to be a splendid gesture of support for the NATO forces in Europe. In fact, as far as the RAF were concerned it was a matter of housekeeping. With the Canberra Light Bomber Force reaching its peak strength of 24 squadrons (240 aircraft)<sup>4</sup> by the end of 1954, and with the development of Class 1 airfields<sup>5</sup> for the V-bombers under way, there was considerable pressure on Class 2 airfield accommodation for the Canberras. This resulted in the Air Staff having to consider, towards the end of 1953, whether another airfield should be brought up to Class 2 standards so that all the Canberra force could be based in the UK or whether four squadrons should be deployed to an airfield in north-west Germany. These squadrons would still be under the control of the AOC-in-C Bomber Command, and assigned to Saceur, though administered by C-in-C 2nd TAF. It was really a question of economics and logistics: whether it would be worthwhile to spend money on developing an airfield for a limited period – for the Canberra force was due to start declining in numbers from the latter part of 1956 onwards, as the V-force increased in size – or whether it would not be better to use an already suitable airfield in Germany, from whence the squadrons could be withdrawn as the run-down proceeded.

This question arose towards the end of 1953 when at a meeting of the ERP (Expansion and Re-equipment Policy) Committee<sup>6</sup> AMSO (ACM Sir John Whitworth Jones) set out the alternative courses of action: to make adjustments in the planned build-up of the LBF so as to avoid the expenditure of about £100,000 on developing another airfield – either Full Sutton or Worksop, both of which currently housed Advanced Flying Schools – or to deploy part of the force in Germany.

The pros and cons of these alternatives (which involved also the questions of possible American aid and of declared bomber support for Saceur<sup>7</sup>) were set out in various staff papers at the end of 1953–beginning of 1954<sup>8</sup>. In particular a brief that was prepared towards the end of January<sup>9</sup> described the overall Canberra situation, saying that by the end of that year the planned build-up of squadrons should reach a peak of 24, each with an establishment of ten aircraft. One Class 2 operational airfield, in addition to those already available, would be required for the period January 1955 – September 1957 in order to accommodate the peak LBF. The only one likely to be available was Worksop, and to raise it to the standard required would involve considerable capital expenditure. (Full Sutton, an alternative, would require full installation of lighting and possible over-slabbing of the runway). CAS had expressed the view that four Canberra bomber squadrons should be deployed in Germany, thus “easing the Bomber Command problem of accommodation during the final stages of the build-up of the LBF”, and AMSO had asked for a comparative costing between basing them at Worksop and in 2nd TAF.

In the event it was the view of the Chief of the Air Staff (ACM Sir William Dickson) which prevailed, after AMSO had advised him that an examination of the practicability of deploying Canberras to Germany – “as an alternative to developing an airfield in this country to take them, at a time when the Class 1 airfield . . . programme makes the Class 2 airfields rather tight” – had shown this to be “perfectly

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<sup>1</sup> No 207 Squadron, with Handley Page 0/400s, had been based at Merheim and then at Hangelar during 1919 as part of the Army of Occupation. <sup>2</sup> “This deployment would not be permanent as squadrons would be withdrawn from Continent in due course . . .” (signal from Air Ministry to SHAPE, 4 May 1954). <sup>3</sup> On 17 September 1954 No 149 Sqn moved to Gutersloh, where Nos 102, 103 and 104 Sqns were subsequently formed. <sup>4</sup> These were bombers, as distinct from the PR Canberras. <sup>5</sup> Class 1 airfields had 11,000ft and Class 2 9,500ft runways. <sup>6</sup> Conclusions of Mtg 3(53), 18 December 1953, in AHB file ID/53/1/138 Deployment of Bomber Command Canberra Squadrons (in 2nd TAF). <sup>7</sup> *ie* 24 squadrons of Canberras. <sup>8</sup> See file Deployment of Bomber Command Canberra Squadrons (in 2nd TAF)(ID/53/1/138). <sup>9</sup> MS546/49/Pt VII/DDOP, 28 January 1954.

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practical . . . . Since the runways and taxi-tracks are of the requisite LCN,<sup>1</sup> we see no reason why four Canberra squadrons should not form at, say, Ahlhorn, beginning 1 April of this year . . . .”<sup>2</sup>

CAS's decision was taken on 29 March 1954 and agreed to by PUS (Sir James H Barnes) on the following day. The former said that having heard all the pros and cons he had come to the conclusion that “we should now go ahead and form these squadrons in 2nd TAF”, so avoiding further unnecessary expenditure at Worksop or Full Sutton, and he asked AMSO to take steps to put this decision into effect as soon as possible. CAS also advised that the directives to the AOC-in-C Bomber Command and C-in-C 2nd TAF should be revised, so that there was no risk of misunderstanding between them; also it was important to ensure that there was no doubt about the four squadrons “remaining part of the Canberra force allocated to Saceur”.<sup>2</sup>

The idea that the deployment might be only temporary was sustained in the executive order deploying the squadrons to Germany, issued by DGO (AVM RB Jordan) on 5 April 1954. He said that the decision had been made “as an alternative to developing an airfield for temporary use in the UK, since these squadrons will have to be disbanded by the last quarter of 1956”. The conditions under which they were to be deployed were that they were to remain under the operational control of Bomber Command and to be administered by HQ 2nd TAF; that they were to be based at an airfield selected by C-in-C 2nd TAF and approved by the Air Ministry; and that they were to be deployed “as soon as possible and in any event not later than September 1954”.

CAS himself also still considered the deployment to be temporary, according to the report<sup>3</sup> of a conversation he had with the Deputy (Air) to Saceur (Gen L Norstad) early in May, when he said that it “would not be permanent as squadrons would be withdrawn from the Continent in due course or on the outbreak of hostilities”. They would “remain allocated to Saceur” – who subsequently, on 6 May, signalled the Air Ministry that he had “no objection” to the proposal – “in peace and war as part of the Canberra force”.

During June 1954 the designations of the four squadrons, and of the wing which was to control them (No 551), were announced. HQ 2nd TAF signalled the Air Ministry on 1 June to say that a Canberra Wing “comprising four squadrons and second-line backing” would form in the Command in the near future. Of the four, No 149 would “arrive complete” while the other three would form between September and the end of the year. Additionally a PR squadron, No 69, would be formed. Subsequently (on 25 June) Air Ministry issued authorisations for No 149 Squadron to move from Cottesmore to Gutersloh *wef* 15 August, for No 102 to form at Gutersloh by 31 October and for Nos 103 and 104 to form there at dates to be notified later, all with an establishment of ten B.2s. Later, however, the instructions to No 149 were modified because of runway repairs at Gutersloh; it was to go to Ahlhorn, its move there to be completed by the end of August, and transfer to Gutersloh early in October.

Even during 1955 the idea of a temporary Canberra deployment to Germany was still being considered. In a minute of 25 April to DAdminPlans, DPol(AS) (Air Cdre K J McIntyre) recalled that “when, originally, lack of accommodation in the UK compelled us to position in 2nd TAF four squadrons of the Canberra light bomber force, we intended to withdraw them . . . during the December quarter of 1956, either by disbanding them *in situ* or by redeploying them to the UK to replace squadrons already disbanded”; and he asked for an estimate of the earliest date when they could be withdrawn – being assured in reply<sup>4</sup> that the Canberra squadrons could stay at Gutersloh until the second quarter of 1957 and even for a further six months; and that, with regard to bringing back the squadrons to the UK, there would be no room for them on bomber airfields in the UK – on the basis of the latest forecast for the build-up of the V-force.

This, however, was part of the gradually acquired permanence of the Canberra bomber deployment to Germany – still a temporary move of convenience when No 149, an experienced B.2 squadron (formed at Coningsby in April 1953), started to arrive at Ahlhorn from Cottesmore – shortly to be developed as a Class I airfield for V-bombers – on the morning of 25 August 1954.

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<sup>1</sup> Load Classification Number. <sup>2</sup> Minute 72, March 1954. <sup>3</sup> Signal from Air Ministry to SHAPE of 4 May 1954. <sup>4</sup> Minute of 30 April 1955 (MS 546/49/Pt IX/DAdminPlans).

No 149 had no doubt about its role and situation: its ORB for that month said unequivocally that "the squadron remains part of Main Force, Bomber Command, lodging in the 2nd ATAF. Bomber Command continues to exercise policy control; day-to-day operational and administrative control is by HQ ATAF through HQ 2 Group". It remained at Ahlhorn only just over two weeks, on 17 September moving to Gutersloh, where it described itself as "the first squadron to come under the command of No 551 Wing which is building up . . .". Its policy and training were much the same as those of the Canberra B.2/6<sup>1</sup> squadrons in the UK, to perfect Gee-H and visual bombing, operating with three-man crews – pilot, navigator/plotter and observer, whose role was that of assistant navigator and bomb-aimer. The ORB of No 149 Squadron recorded that on 26 October "WJ567 had a bird-strike on a low-level reconnaissance; navigator in bomb-aimer's position was injured". All three Canberra crew members had Martin-Baker ejection seats.

The Gutersloh-based light-bomber squadrons of Bomber Command built up to three before the end of 1954 with the formation of No 102 on 30 October and of No 103 on 30 November; the fourth squadron in No 551 Wing, No 104, was formed on 15 March 1955. All had an establishment of ten B.2s and operated like other Main Force squadrons, though their normal working environment was the 2 TAF airspace, with visits to the UK for competitions or exercises. Thus in February 1955 No 149's ORB recorded that the squadron had been "invited to take part in the Bomber Command annual bombing competition from 28 March onwards"; this event, unlike earlier ones, would "combine both blind and visual bombing attacks on specified cross-country routes". When the competition rounds were actually flown (on the nights of 28–31 March inclusive) the visual attacks were "simplified by a complete absence of low cloud over the UK". Then during April the squadron, with a No 102 crew attached to them for the period, were deployed to Honington for Exercise Sky High. This was in two phases. The first was "designed to simulate as realistically as possible the likely sequence of events in the early stages of war. Attacks were ordered in the first place by Saceur and thereafter by HQ Bomber Command and HQ No 3 Group down to the station. All attacks were simulated . . .". The second phase was intended to give practice in re-arming to, and in operating with, a full war load. No 149's ORB reported that a shortage of bombs curtailed the programme, but that attacks were made with six 1,000lb bombs per aircraft from 19,000ft and 20,000ft by Gee-H on the Sandbanks and Theddlethorpe ranges, and with one 1,000lb bomb per aircraft by Gee-H from 40,000ft and above on the Chesil Bank, Luce Bay and Sandbanks ranges.<sup>2</sup>

The Germany-based Canberra squadrons used bombing ranges both in their own Command and in the UK; thus No 102 recorded in March 1955 that those at Nordhorn and Sandbanks were "used whenever possible", while complaining that "due to bad visibility, tide conditions and bookings by HQ Bomber Command they were not available for ten flying days". During May their ORB reported that "despite the availability of only one bombing range for the greater part of the month, considerable success was made towards Combat Classification. Nine of the 11 crews are now classified". In June, No 103 Squadron noted that "good progress was being made towards higher classification and height clearance for Gee-H bombing", that all Combat crews were "cleared to bomb from 35,000ft", one crew "cleared for Gee-H bombing from 45,000ft and two crews from 40,000ft". The squadron ORB also reported Lone Ranger flights to Gibraltar and Cyprus and, in August 1955, an Exercise Loco during which 15 sorties were flown; this was designed to give training to Dutch and Belgian fighter and anti-aircraft defences.

No 104 Squadron had engaged in what its ORB described as "the first squadron exercise since re-formation" on 5 July, when "six aircraft took off at one-minute intervals . . . Route – Margate, North Wales, Lake District, Spurn Head, Bremen, base. Crews reported excellent weather conditions for the simulated visual bombing run over Barrow-in-Furness at 35,000ft but the other target at Bremen was obscured by a layer of strato-cumulus. A formation of Hunters intercepted the leading two aircraft near Liverpool". The ORB also reported that "six aircraft took part in a No 551 Wing (RAF Station Gutersloh) exercise on 29 July – . . . the first large-scale exercise in which the squadron has taken its place alongside its sister squadrons (Nos 102, 103, 149) . . .".

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<sup>1</sup> The first B.6 had come into service in June 1954 with No 101 Squadron and by October No 109/105 was starting to get them. <sup>2</sup> Respectively off the Dorset and Wigtonshire coasts and on the northern bank of the Elbe estuary.

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This kind of operational flying – continuation training, cross-countries, bombing, crew classifications, exercises and competitions – characterised the activities of the Bomber Command light bomber squadrons in Germany from their 1954–1955 formations and working-up periods to the time of their disbandment at the end of July 1956. In the meantime, however, 2nd TAF had been building-up its own Canberra force – first of reconnaissance, then of intruder, squadrons.

During the 1953–1954 discussions<sup>1</sup> on the deployment of Bomber Command Canberra squadrons to a German airfield, account had been taken of the future plans for 2 TAF to be equipped with Canberra PR and NI (night intruder) squadrons during 1955–1956;<sup>2</sup> these would not be prejudiced by the proposals for the four Main Force squadrons to be based in Germany. In the event, before the last of the latter had been formed the first 2 TAF reconnaissance squadron – No 69 – came into existence. It formed at Gutersloh on 1 October 1954 with an aircraft establishment of eight Canberra PR.3s and moved to Laarbruch – which was to be the Command's PR station – early in December. There, during the following year, two more PR(MR)squadrons were formed, both with Canberra PR.7s<sup>3</sup> – Nos 31 and 80. Subsequently, on 1 June 1956, another PR.7-equipped squadron was formed – No 17, at Wahn, giving a total PR(MR) force in 2 TAF of four squadrons.

Some indication of the kind of work these squadrons did may be gained from a reference in the No 69 Squadron ORB for March 1955 to “long-range PR sorties introduced by the squadron during the month”, these consisting of three cross-country exercises “taking-in the three practice photographic areas – South-West France, North-East Italy and Corsica/Sardinia/Sicily”. On these exercises, “photographs were taken under simulated operational conditions and at operational height 43,000 – 48,000ft” – the longest-duration sortie being one of 6hr 20min.

The Canberra reconnaissance squadrons in Germany flew either very high – No 69 Squadron, in Exercise Carte Blanche (June 1955), reported in their ORB their height over targets as 48,000ft “or even higher” – or very low; No 31, for example, referred in March 1957 to a “new low-level role” and in an Army exercise during August that year No 17 fulfilled low-level visual and PR requirements in support of ground forces. No 80 had in March 1957 simulated high-level bomber sorties for a Danish air defence exercise, while later in that year (November) recording low-level cross-countries at 300–350kt. At least two of the squadrons, Nos 69 and 31, operated at intermediate altitudes – in mid-1955, when they made a photographic survey of north-west Germany from a height of 10,000ft.

A great many activities were common to all four squadrons, for example monthly exercises like Guest and Amled – the former an inter-Group affair, its purpose being (as No 17 referred to it in an ORB entry for December 1956) “to test the 83 Group air defence system, 2 Group providing the attacking force”; the latter a probing of Denmark's air defences – and Exercise ‘Stronghold’, a major test of UK air defences, when the reconnaissance Canberras simulated bombers coming in from the Continent. Common too were the competitions, for the Sassoon Photographic Trophy (top award for RAF reconnaissance squadrons) and Royal Flush, in which PR squadrons of 2 ATAF competed against those of 4 ATAF in a test of operational efficiency. Exercises like ‘Stronghold’ and ‘Whipsaw’, with their emphasis on getting aircraft airborne as soon as possible after the announcement of targets, and post-flight rapid delivery of films to MFPS (mobile field processing sections) for processing, provided appropriate practice for such competitions. The NATO environment in which these RAF reconnaissance squadrons operated was also stressed in exercises like ‘Counterpunch’, representing a Saceur-sponsored atomic strike plan, and ‘Round Robin’ – which was designed to check cross-servicing capabilities at NATO airfields.

Some of the problems which the squadrons encountered were, however, exclusive to them and mainly resulted from the mechanical trouble of runaway tail-trim actuators which caused some accidents and some near-accidents to Canberras. As a result a speed limitation of 250kt was imposed and a modification introduced which (at least according to the No 31 Squadron ORB) did not seem to

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<sup>1</sup> See file Deployment of Bomber Command Canberra Squadrons (in 2nd TAF) (AHB ID/53/1/138).  
<sup>2</sup> HQ 2nd TAF letter and appendices on Deployment of Squadrons in 2nd TAF, September 1955 and December 1956, in previously mentioned file. <sup>3</sup> The Canberra PR.3, designed to Spec PR. 31/46, was basically similar to the B.2; the PR.7 was a photographic reconnaissance version of the B.6.

eliminate fully the possibility of a runaway actuator. This problem, of course, was not exclusive to reconnaissance Canberras – it affected the B.2s and 6s and PR.3s and PR.7s in the mid-1950s.

From mid-1958 the 2 TAF Canberra PR force became one of three squadrons (Nos 31, 80 and 17) with PR.7s, for No 69 – the original Germany-based PR(MR) squadron – moved to Luqa, Malta, with its PR.3s in April 1958.

These squadrons continued to provide the medium-range reconnaissance capability of 2 TAF (or RAF Germany as it became known from the beginning of 1959) until they were disbanded at the end of the 1960s – No 80 in September 1969, having been withdrawn from the front line on 31 August; No 17 on the very last day of 1969; and No 31 on 31 March 1971. All three were still flying Canberra PR.7s until their disbandments, and in many respects their tasks remained much the same as they had been since the 1950s – for example, there were still Royal Flush and Sassoon Trophy competitions, still Round Robin and Tempo Bello deployments, and Southern Rangers – but there was greater emphasis on tactical, low-level reconnaissance, on quick reaction and on dispersal. Exercises such as Playboy – at low level against ‘live’ enemy targets – and Lion Vert – to test a squadron’s reaction time and its dispersal plan – illustrated these changes of emphasis, while NATO exercises and 2 ATAF or Command/station evaluations – Tacevals, Maxevals or Minevals, held without prior notice being given, as a spot check on operational efficiency – occurred frequently in squadron activities.

Although the PR.7 Canberra had been succeeded in 1960 by the PR.9, which had a ceiling in excess of 60,000ft, the latter mark was used only by squadrons in the UK and Cyprus. RAF Germany’s self-contained reconnaissance force of 30 PR.7s was never directly replaced in what had become (from the beginning of 1961) the tactical reconnaissance role. They were superseded in this – as were the Canberra B(I).8s in the intruder role – by Phantom FGR.2s which had a dual capability, of ground attack and reconnaissance.

The intruder or interdicator Canberra squadrons in 2 TAF<sup>1</sup> came to their full strength on 1 March 1958 when No 16 was formed at Laarbruch with B(I).8s; there were then three squadrons with this mark – Nos 16, 59 and 88 – and one with B(I).6s,<sup>2</sup> No 213<sup>3</sup>. It was these squadrons which, during that year, were given a nuclear capability with US weapons. No 16, setting-out its roles in an ORB entry at the time of its formation, defined these as being the Gee-H and LABS delivery of atomic weapons and visual reconnaissance. The LABS (low-altitude bombing system) technique, which involved pulling the aircraft up into a half loop, releasing the bomb at a pre-computed height and angle of attack, then at the top of the half loop rolling out on a reciprocal heading, had been introduced when the Canberras were modified and equipped during 1957 to carry and deliver American nuclear weapons.

Although the modification programme – to enable the Canberras to carry an American 1,650lb bomb and to deliver it by means of a Minneapolis-Honeywell LABS computer set – began in 1957 the aircraft were still gradually coming into service during 1958 (No 16 Squadron, for example, initially had to borrow three B(I).8s from No 88 Squadron) and it was only in the last quarter of the latter year that a working agreement was reached with the USAF on the actual supply of nuclear weapons to the four Canberra airfields in Germany and on the arrangements for their storage and safe keeping there. The German Federal Government had indicated its willingness to allow these weapons on German soil; Saceur had acquiesced in a reduction in the size of 2nd TAF because, with these weapons, its striking power would not be reduced;<sup>4</sup> and a USAF-RAF Memorandum of Understanding, reached during 1957, according to which the USAF would furnish the RAF with atomic weapons in the event of general war, formed the diplomatic background for what was known as Project E – the supply of such weapons to the Saceur-assigned RAF bomber squadrons, of Canberras in Germany and (later – 1960–64) Valiants of the Tactical Bomber Force at Marham. These weapons were kept at all times in USAF custody, special

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<sup>1</sup> The term NI (night interdicator) disappeared from the 2 TAF Order of Battle late in 1957 and by December had been replaced by I (interdicator). <sup>2</sup> The B.16s had a crew of three, the B(I).8s a crew of two. <sup>3</sup> Formed in 1956, as were Nos 59 and 88 Sqns. <sup>4</sup> “In statements in NATO and in public pronouncements of defence policy the UK Government has repeatedly made it clear that the equipment of the RAF Canberras with a nuclear strike capability will substantially increase their striking power . . . and offset the reduction in size of 2nd TAF” (memorandum to UK Military Rep at SHAPE, 27 March 1958).

arrangements being made for the personnel on these duties at the airfields to which they were assigned – as occurred at the Thor bases, where USAF officers participated in the launch procedure and the warheads were under USAF control. In the cases of the bomber airfields where American nuclear weapons had been supplied, these were kept in guarded special storage areas and would only be loaded into aircraft in the event of a practice alert procedure. On training flights the crews would use ‘shapes’, simulating the weapons’ weight and size, or practice bombs.

In a manual describing the low-altitude bombing system (LABS) the Air Ministry<sup>1</sup> described it as a method of approaching a target at low level and high speed and – with the aid of special equipment – tossing a bomb on to the target from a release angle of between 20° and 135°; but it pointed out that in practice there were two main forms of LABS attack – low-angle release, using release angles of between 20° and 80°; and over-the-shoulder release, using angles of between 95° and 135°. It added that releases at angles of between 80° and 95° (“high-angle release”) were within the equipment’s capabilities and could also be used. The use of LABS technique implied a strictly pre-planned attack, everything about it and the flight leading to it having been worked out in detail before take-off.

The Air Ministry publication on the low-altitude bombing system<sup>2</sup> gave a vivid description of the manoeuvre and of the pre-flight planning involved – a blueprint for the kind of training Nos 16, 59, 88 and 213 Squadrons were doing in Germany from the late 1950s until the end of the 1960s. Saying that the LABS technique could be used to deliver any kind of bomb – though mainly for the delivery of nuclear weapons, it emphasised that such an attack was “strictly pre-planned” – worked out to the last detail before take-off, and with the crew flying “to reproduce their flight planning down to that last detail”. In fact it compared this planning with making a gramophone record, saying that “the actual attack should be the playing-back of that record”.

Once a LABS attack had been ordered and the weapon information – type, fusing and burst height – passed to a squadron, flight planning would begin with selection of a release angle, an approach altitude and an IP (identification or initial point), and working-out the LABS timer and gyro settings.<sup>3</sup> The correct release angle was selected after consideration of several factors – safe separation between the aircraft and the bomb burst, likely bombing accuracy, fusing and target defences. Study of a large-scale map of the target area would provide a suitable IP, whose maximum and minimum possible distances from the target would be indicated by two circles drawn round it – the IP (a feature capable of being easily identified from an aircraft flying fast at low level) being selected from within these circles. In addition to careful planning of an attack, en route navigation to an IP had to be well planned and accurately flown; “any navigation error at an IP” would be “very largely reproduced in bombing error”, the Air Ministry publication emphasised. Its description of an actual LABS attack has the vividness and clarity of an eye-over-the-pilot’s-shoulder view:-

“The pilot approaches the IP at a pre-determined height and speed with bomb doors open and on the heading required to make good the track from IP to target. When exactly overhead the IP he presses the bomb release button and keeps it pressed.

“The pilot maintains height, speed and track until the pull-up point is reached, as indicated by a warning light going out.

“At the pull-up point the pilot applies a pre-determined positive ‘g’ loading and puts the aircraft into the looping plane. When a certain stage of the loop has been reached (also pre-calculated) the bomb is automatically released. The warning light comes on again as the aircraft passes through the bomb release angle pre-set on the vertical gyro.

“After release the pilot continues to fly into the escape manoeuvre, which will normally be a roll off the top of a loop or a wing-over turn”.<sup>4</sup>

As has been indicated, LABS attacks involved considerable pre-flight planning, and this fact did – as the Air Ministry description itself admitted – “impose considerable tactical limitations on aircraft and

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<sup>1</sup> September 1958. <sup>2</sup> *Low Altitude Bombing System Vol 1 Equipment, Attack Planning and Aircrew Operating Procedures.* <sup>3</sup> The LABS MA2 Computer Set had two gyros, vertical and horizontal.

<sup>4</sup> Ch 1, paras 4-7.

crews".<sup>1</sup> In training, or on exercises, the necessary preparations could be made; in actual operations a squadron would have its targets assigned and the attacks could be pre-planned. Difficulties would probably arise against a rapidly changing war scenario such as the German invasion of France in 1940, or a Soviet bloc tank thrust into the north German plain; but the LABS manoeuvre was at that time – and until the American nuclear weapons then used by the Canberras in their primary role were superseded in the late 1960s by weapons with a retarded lay-down capability – the accepted means of delivery of atomic bombs by tactical bombers, and a priority role for the four squadrons in RAF Germany. Thus in February 1958 No 88 at Wildenrath noted in its ORB three priorities laid down by HQ 2nd TAF: low-altitude nuclear bombing; medium/high-level all-weather bombing using Gee-H with nuclear weapons; and low-level and shallow dive-bombing with conventional weapons. No 16, re-formed with B(I).8s at Laarbruch at the beginning of March 1958, set down its roles as visual reconnaissance; Gee-H delivery of atomic weapons; and LABS delivery of atomic weapons. Earlier No 213, the senior Canberra bomber squadron in 2nd TAF (re-formed in July 1955 at Ahlhorn and re-located at Bruggen in August 1957), had pioneered the LABS role – its aircrew attending courses from 1956 onwards and its B(I).6s being modified from 1957 onwards. From early in 1958 the squadron put the accent on LABS technique in its routine training and in March had the 2nd TAF LABS trainer caravan at Bruggen for three weeks, during which all its aircrew were converted on to the equipment. Its ORB commented in July that when on the 26th Squadron Leader M H Levy had been attached to the Bomber Command Development Unit at Wittering for a LABS instructor's course, "it would appear that knowledge of this subject is more advanced in 2nd TAF than in Bomber Command". Like No 213, No 88 with its B(I).8s could claim to be a pioneer unit in this respect: in December 1957 its ORB recorded that "the squadron has now relinquished both visual reconnaissance and Army support roles and with effect from 1 January 1958 is a pure LABS squadron"; then in the following month confirmed this change. "The squadron was withdrawn from Operation 'Drumfire'<sup>2</sup> in January . . . so that concentrated LABS training could commence. However, the visual reconnaissance role was re-introduced on 13 January to give the squadron an operational role until such time as the operational nuclear capability could be obtained. There is no secondary role . . .". The ORB further noted that "priority in ground training was given to LABS indoctrination in the form of set lectures and also in the LABS procedure trainer. Three LABS courses were held and students included three crews of No 213 Squadron, one . . . from 59 Squadron and two . . . designated for No 16 Squadron". In flying training, emphasis had been "mainly on LABS training" and most crews had "followed up their ground work by practice manoeuvres in the aircraft".

However hard and conscientiously the Canberra squadrons trained in the LABS delivery of nuclear weapons, however, the Canberra Strike Force in RAF Germany could not claim to have an operational nuclear capability until the American weapons were actually stored at Bruggen, Geilenkirchen, Laarbruch and Wildenrath under the Project E agreement – which was not finalised between the RAF and USAF until late in 1958, after correspondence and meetings which had been going on for most of that year. Even after agreement had been reached (involving, as has been mentioned, the approval of the Federal German Government and of NATO because of the construction costs) the storage areas had to be built and the weapons brought in – a process which went on from 1959 onwards. No 213 Squadron, however, is the only unit to have made a specific reference to this fact of life for strike Canberras in Germany – its ORB for 15 September noting that "Project E<sup>3</sup> became effective . . . but was withdrawn from the 20th to 27th because of Exercise Flashback";<sup>4</sup> then on the latter date recording: "squadron . . . at 15 minutes' readiness with a 'live' weapon for the first time". For the nuclear-armed Canberras in Germany, as for the V-bombers in the UK, QRA (quick reaction alert) was also a fact of life – and it strained their resources of aircraft and personnel when some of these were needed for overseas detachments and QRA

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<sup>1</sup> Ch 4, para 1. <sup>2</sup> In August 1957 the ORB had noted that the squadron was "operationally effective in respect of the Drumfire role, all crews being assigned their targets, for which full briefs and flight plans have been prepared". These were targets for air to ground fire. <sup>3</sup> During August its ORB noted that on the 24th "a conference on 'Project E' was held at 2nd TAF Headquarters and it was stated that it would become effective on 15 September at 0900Z". <sup>4</sup> The annual NATO autumn exercise.

had to be maintained. No 88 Squadron, in an ORB entry for September 1960, spelt out clearly the obligations of QRA standby:-

“On the 15th . . . the squadron undertook its first real ‘operational’ task – that of permanently having a crew and aeroplane on 15 minutes’ readiness for a nuclear strike on a selected target, should the need arise. This is really the goal towards which the squadron has been working since it was formed in Germany in 1956 . . . . There are two crews on per week. Each crew stands by on alternate days, the change-over time being 1300A . . .”.

For almost a decade, therefore, from 1960 until the end of the 60s–early 70s when they were disbanded the Canberra B(I).6/8 squadrons in RAF Germany maintained a QRA armed with American weapons.

But although the tactical delivery of nuclear bombs was their primary task the squadrons had several other roles, the Canberra proving itself a lithe and versatile instrument, with its adaptability and its aerobatic capability. For example, when No 213 Squadron was ordered to deploy to Sharjah at the end of June 1961 during the Kuwait crisis (finding four B(I).8s of No 88 Squadron already there when they arrived on 2 July) their B(I).6s had been hurriedly converted to the ‘conventional’ role – with gun-packs underneath the fuselage and wingtip fuel tanks<sup>1</sup>. Any one of the four squadrons was likely at any time to have to change its role quickly, and these Protean attributes were frequently tested. Thus in June 1960 the ORB of No 59 Squadron at Geilenkirchen noted that eight aircraft were “converted from LABS to interdictor fit in eight hours to test reaction times”; in April 1959 the role of No 88 Squadron at Wildenrath had “reverted to that of armed reconnaissance”; and on 22 June that year No 16 Squadron “began its Armament Practice Camp on air-to-ground firing and shallow dive bombing”. The three latter occasions were all before the start of Project E in mid-September 1960, but even after that QRA role began – with its implicit emphasis on nuclear weapon delivery – the squadrons continued to be ‘multi-role’. The Sharjah deployment was an example of this; and in April 1962 No 88 Squadron recorded a “change of role to interdictor” – involving a “refit to gunnery and dive bombing”, so that during the following month the “total squadron effort” was “devoted to gunnery and shallow dive bombing at Nordhorn”. Yet in June No 88 returned to the nuclear strike role, which meant re-fitting the LABS equipment. “By and large”, the ORB commented, “the return to the LABS fit was completed satisfactorily, despite the fact that very few of the groundcrew had experienced a role change in that direction before. The schedules produced by the Command Work Study Team were shown to be very effective”.<sup>2</sup>

In all their operations these Canberra strike/interdictor squadrons were controlled by two Tactical Operations Centres (TOCs) – No 1 at Goch, a town on the Dutch–German border, and No 2 at Sundern, Gutersloh, the most easterly RAF operational airfield in Germany. These TOCs were the successors to the former Nos 83 and 2 Groups of the 2nd Tactical Air Force after it became RAF Germany at the beginning of 1959.

In fact they were in existence before RAF Germany was formed, as in its ORB for September 1958 the B(I).8 squadron at Laarbruch, No 16, referred to “daily tasking by TOC”. During June of that year when No 59 Squadron at Geilenkirchen had taken part in Exercise ‘Full Play’ – the aim of which was to put into practice Saceur’s Strike Plan and to test the defence organisation – the squadron (its ORB noted) “was controlled by TOC Goch through Wing Operations at the station”.

This arrangement of two Tactical Operations Centres, one at Goch and the other at Sundern, continued until 1961 when two Sector Operations Centres – one at Brockzetel and the other at Uedem, the latter at the German Air Force station of that name – came into being. There had in fact been earlier references to

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<sup>1</sup> The ORB of No 213 Squadron provides a detailed description of the Sharjah deployment, and in referring to the preparations for it says that throughout the night of 29 June at Bruggen “the squadron hangar was a hive of activity, with a long succession of aircraft being towed in to be fitted with gun packs and tip tanks. These two major operations were followed smartly by gun harmonisation, fuel flow tests and compass swings, before the aircraft were once again logged as ‘serviceable’”. <sup>2</sup> It could be argued that, although the Canberra’s equipment fit might be changed quickly, it wasn’t so easy for the air crews to change their technique; that over-specialisation in LABS manoeuvres might have led to some inflexibility.

these, in a letter of 12 January 1960 from HQ RAF Germany to Air Ministry (DOEst), making a case for the establishment of Anson communications aircraft at these locations. This pointed out that "the area covered by the Sector Operations Centre at Brockzetel includes such distant airfields as Laarbruch and Bruggen with which it is essential that Sector Controller and his staff maintain a close liaison". It went on to say that "RAF Laarbruch is the nearest airfield to SOC Uedem. This Centre controls the RAF squadrons at Geilenkirchen and Gutersloh . . . As with the Centre at Brockzetel, it is essential for the Sector Commander and his staff to maintain a close liaison with these airfields . . .".

No 2 TOC at Sundern ceased to exist by mid-1961; at that time No 1 TOC at Goch was still active with the two Sector Operations Centres, at Brockzetel and Uedem, but by October 1963 it too had disappeared. SOC Brockzetel and Uedem then continued to be the controlling centres until early 1964, when the former ceased to exist. Finally, in the autumn of 1964, Uedem also disappeared in this role.<sup>1</sup>

Not only were RAF Germany Canberras deployed to Sharjah during the 1961 Kuwait crisis, as has already been mentioned; another squadron, No 16, was sent even further afield – to Malaya in 1965 when Indonesian confrontation (1963–1966) led to the Far East being reinforced by medium and light bombers, eight of No 16's B(I).8s going from Laarbruch to Kuantan. Based there for three-and-a-half months (mid-February to early June) they concentrated in training on low- and high-level navigation exercises and on air-to-ground firing, using the China Rock range; they also made Ranger flights to Kuching in Borneo and to Hong Kong. Some of their firing at least was done "in anger", for the squadron's summary of 1965 in its ORB refers to Operation 'Oak Tree' – "firing war ammunition against Indonesian terrorist positions in Western Malaysia".

These operational deployments were only part of the ubiquitous versatility of the Canberra bombers of RAF Germany, which not only frequently changed their role from nuclear weapon to conventional bomb carriers or to ground-attack aircraft armed with gun packs, but moved about frequently on training detachments, practice dispersals and single-machine Rangers or Extended Rangers.<sup>2</sup> The main locations to which squadrons were detached for intensive weapon training – with more reliable weather than they could expect in Europe – were Akrotiri, Cyprus (interdictor training – Exercise 'Citrus Grove'), and Luqa, Malta (LABS bombing on the Tarhuna range in Libya – Exercise 'Orange Grove'). Up to September 1966 the latter range had been used from RAF Idris, Libya, but this on-the-spot facility ceased when the Air Force withdrew its representation.<sup>3</sup> From the early 1970s alternative weapon-training facilities became available at Decimomannu, Sicily. For practice dispersals, squadrons moved their aircraft to the airfields of other NATO air forces, an activity with which crews had become familiar through the Round Robin exercises – exchange visits to 2 ATAF and 4 ATAF bases.<sup>4</sup> Rangers and Extended Southern Rangers – flights which brought crews experience of areas outside those in which they normally operated and tested resourcefulness when away from home base facilities – were flown respectively to Akrotiri and Gibraltar, and to Nairobi, Aden and Sharjah. The Canberra was also one of the first RAF bombers capable of aerobatic displays, which were given by selected squadron pilots at NATO airfields.<sup>5</sup> Aerobatics were *ipso facto* a part of operational flying for Canberra squadrons using LABS manoeuvres to deliver nuclear weapons. No 59 Squadron noted in August 1957 that "instruction on aerobatics has . . . begun".

The nuclear delivery role of the Canberra light bomber squadrons in RAF Germany continued from mid-September 1960 when Project E became effective<sup>6</sup> to mid-1972 when the last of them to be still operational, No 16, disbanded before being re-formed with Buccaneer S Mk 2Bs. The former date

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<sup>1</sup> Details from SD161, Locations of Units in the Royal Air Force, 1961–1964. <sup>2</sup> Similar in intent to the Western Rangers and Lone Rangers flown by V-force aircraft. <sup>3</sup> No 16 Sqn noted in September 1966 the loss of "the high utilisation factor of bombs dropped and sortie time due to the close proximity of the Tarhuna range" following "termination of the RAF Element at Idris". <sup>4</sup> "To ensure the complete mobility of squadrons between airfields in Germany", as No 59 Sqn described it in 1957. <sup>5</sup> Flt Lt P J Giddens of No 59 Sqn did practice aerobatics over Geilenkirchen on 17 May 1958 before proceeding to the USAF base at Bitburg to give a demonstration there. <sup>6</sup> On 15 September, although the 2nd TAF Canberras had been ready to carry Project 'E' bombs two years previously.

represented the start of full war capability – with aircraft modified and equipped, and crews trained, to carry the American 1,650lb bomb which was stored on the four airfields (Bruggen, Geilenkirchen, Laarbruch and Wildenrath) under US custodianship and with QRA (quick-reaction alert – a 15-minute state of readiness) in force. This armament continued until the autumn of 1966 when the squadrons were re-equipped with the American 2,100lb laydown bombs, with which they continued to be operational until the end of their existence. Throughout this period the intensity of readiness, with exercises designed to test and improve it, increased to a high pitch which bore hard on all members of the squadrons.<sup>1</sup>

This increase in intensity can be gauged by comparing QRA in its original form, as introduced during 1960, with its more sophisticated character in the later 1960s – reflecting an increase in the subtlety and complexity of the threat faced by the NATO forces. In March 1960 at least two of the squadrons had to undertake trials of readiness procedures. No 16 reported in their ORB that “an Operational Readiness Trial to meet Saceur’s Alert posture was started on 23 March and will continue to 11 April. Results . . . and recommendations will be submitted to RAF Germany”.<sup>2</sup> No 59 Squadron was much more explicit about Exercise Sunrise, which seems to have had the same purpose, was due to last for three weeks and was

“designed to assess the possibility of the squadron constantly maintaining an aircraft, aircrew and groundcrew at constant 15-minute readiness by day and night. An aircraft is being armed up under guard in one of the revetments.<sup>3</sup> The VW Combi will be used by ground- and aircrew to travel to the aircraft. Two beds are being put into the Nav Leader’s office for the aircrew and beds are being put into the Corporals’ Crew Room for the groundcrew. Any ‘Scramble’ will be given by ‘phone direct to the aircrew who will sound a buzzer to alert the groundcrew. Each crew that is on will take the opportunity of carrying out Target Study during their period of duty. There will be four shifts per day . . .”.

By mid-September the QRA was introduced with nuclear capability; on the 13th 59 Squadron noted that

“two Ford Kölns and a GCA caravan came to the squadron . . . as accommodation for the air and ground crews during the standby. These are now installed in the hangar, one [for] the aircrew and the other for the USAF custodian. The aircraft is changed weekly and now has a full nuclear capability; previously, in the early stages of the Standby, only a practice Shape was on board. The permanent 15-minute readiness and standby is now with us”.

The other two Canberra LB squadrons in RAF Germany were just as specific in their references to 15 September 1960 as the beginning of their QRA role. No 88 at Wildenrath noted that on that date it

“undertook its first real ‘operational’ task – that of permanently having a crew and aeroplane on 15 minutes’ readiness for a nuclear strike on a selected target, should the need arise. This is really the goal towards which the squadron has been working since it was formed in Germany in 1956 . . .”.

No 213, at Bruggen, started its QRA in the same way then resumed it after a week’s hiatus:-

“Project ‘E’ became effective on 15 September, but was withdrawn from the 20th–27th because of Exercise Flashback. On 27 September the squadron was at 15 minutes’ readiness with a ‘live’ weapon for the first time”.<sup>4</sup>

This, then was the operational background to these B(I).8/6 squadron activities during their last decade in Germany. In addition to maintaining QRA they had a never-ending programme of exercises,

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<sup>1</sup> An alert could be sounded at any time of day or night. <sup>2</sup> Later that year, in August, the squadron took part in Exercise Dovetail, a ground exercise “designed to test the operational readiness of No 16 Sqn and No 5 Det USAF” – ie the nuclear weapon custodians. <sup>3</sup> Precursors of the HAS (hardened aircraft shelters). <sup>4</sup> In August the squadron’s ORB had noted that “a conference on ‘Project E’ was held at 2nd TAF HQ and it was stated that it would become effective on 15 September 1960 at 0900Z. Preparation is being made to meet this task”. Their weapon, delivered by the LABS technique, was used by several other European air forces – Belgian, Italian, Dutch and West German – in addition to the RAF, RCAF and USAF.

detachments, competitions and training. Readiness was frequently tested by tactical evaluations, which started after QRA had come into existence. The purpose of 'Taceval' (as it was known) was "to assess for Saceur against prescribed criteria the operational potential of NATO Command and assigned units, to award ratings to a common standard, to indicate deficiencies and to make recommendations where necessary"<sup>1</sup>.

This 'standard' was a NATO standard; but where the latter standard didn't exist, national standards were used. When a unit was declared fully combat-capable it was eligible for initial evaluation, subsequently being evaluated annually – on a no-notice basis<sup>2</sup>, by a multi-national NATO team – on four counts: alert posture and reaction; mission effectiveness; support functions; and ability to survive. Each station so evaluated received a rating of 1, 2, 3 or 4 under each of these major headings, and would know roughly from the date of a team's previous visit when it was likely to be re-evaluated – though not precisely, for the team might arrive in the middle of the night<sup>3</sup>. No 213 Squadron described the 2 ATAF Tactical Evaluation Team arriving unannounced at Bruggen in the evening of 18 December 1968, Simple Alert being declared at 1740hr Z and QRA crews' reaction being assessed at the QRA aircraft<sup>4</sup>.

The exercises in which the B(I).8/6 squadrons took part during the 1960s were many and varied: Mineval (a kind of local Taceval – "designed to test the alert state and procedures of the squadron in its primary war role", as No 16 Squadron described it in January 1962); 'Skyblue' – described by No 14 Squadron in June 1968 as the "major 2 ATAF flying exercise of the year"; 'Sun Run' – detachments to Malta designed to outwit the European weather and to overcome the lack of flying continuity; 'Sampan', an Army exercise; 'Bawsheen' – "in order to practice dispersal procedures four Canberras loaded with 'shapes' and five crew were deployed to RNeAF Deelen, where they assumed QRA state within two hours of arrival", as No 16 Squadron put it in October 1965; 'Playboy', an exercise against ground forces; 'Golden Road', which No 16's ORB described in October 1968 as involving "the sabotage of certain squadron aircraft and the demise of some personnel . . . Aircrew issued with .38 automatic pistols and the new style NBC clothing"<sup>5</sup>. During the latter part of the exercise a full NBC alert declared and all personnel required to continue working clad in NBC clothing, helmets and gas masks, which proved to be a new and somewhat uncomfortable experience for many". There were many other kinds of exercise, but the most intensive was Taceval, especially in its more sophisticated form – simulating NBC warfare conditions.

The most regular detachments for the Canberra squadrons were those which have already been mentioned – to Malta or Cyprus for armament practice, but they also made them to other air forces: for example No 213 Squadron went to 3 Wing, RCAF (CF-104s), at Zweibrucken from 24 July to 3 August 1967 and in the following year (17-27 February 1969) to Larissa for a liaison visit to the Greek Air Force. During September 1968 No 16 Squadron detached five crews and four aircraft to the Italian Air Force base at Ghedi "to provide experience in operations with other NATO Air Forces"<sup>6</sup>. There were also regular competitions, like the Tactical Weapons Meet, in which one of the squadrons was chosen to represent RAF Germany – No 16 Squadron noting when they had been chosen for the 1968 Meet at Jever that the sortie profiles would be "exactly as the normal low-level missions flown by the squadron with the exception that they will be flown at a groundspeed of 360kt instead of 270kt" and that "to this end nine aircraft have had tip tanks removed".

This Tactical Weapons Meet, instituted in 1962, was a major annual competition between the two elements of Allied Air Forces Central Europe – the 2nd and 4th Allied Tactical Air Forces – and the RAF participated in the 2 ATAF team. The Meet was designed to test competitively the accurate delivery of weapons by four different means – LABS and skip bombing, rocketry and strafing, the LABS bombing

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<sup>1</sup> From the SHAPE Tactical Evaluation Manual. <sup>2</sup> Thus No 16 Sqn recorded on 9 December 1964: "Reinforced alert declared by a 2 ATAF tactical evaluation team at 0505: nine aircraft brought to QRA by 0830. Six crews examined on their knowledge of the war plan and their respective targets. <sup>3</sup> The author is indebted to *The Royal Air Force in Germany 1945-1978* by ACM Sir David Lee, GBE, CB (AHB, 1979), for this description of Taceval. <sup>4</sup> ORB. <sup>5</sup> Designed to protect the wearer under conditions of nuclear, biological or chemical warfare. <sup>6</sup> During a low-level sortie over Italy one of the squadron's aircraft, XM265, "became Cat 3 after a collision with some power cables. The navigator, Flying Officer A P Stephens, was ordered to abandon the aircraft and the pilot, Flight Lieutenant P A R Jones, executed a skilful landing with a ton and a half of cable attached to the aircraft . . ." (ORB entry).

element of the 2 ATAF team being provided by one of the RAF Germany Canberra squadrons<sup>1</sup>. Throughout the 1960s most of them participated – No 213 in the first, held at the French Air Force base St Dizier from 28 June to 6 July 1962, 4 ATAF winning by 2,158 to 1,436 points; No 16 in the second, at the German Air Force base Hopsten from 14 to 28 June 1963, 4 ATAF winning again, by 494 to 346 points (presumably the scoring basis was different from the first Meet); No 3 Squadron in the third – held, as were the fourth and fifth, at the USAF base Chaumont in France – when 4 ATAF again won, by 784 to 540 points; and No 213 in the fourth – held from 12 to 25 June 1965 and yet again won by 4 ATAF, by 1,753 to 1,630 points. Reporting on the fourth Meet a correspondent wrote<sup>2</sup> that “what the Aircent Commander looks for from this competition is a reading as to the operational efficiency of his ground-attack squadrons”, adding:

“As one senior officer put it at Chaumont: ‘What really matters is not who wins but why the losers didn’t do better’. Competitors have to fly a low-level cross-country of anything from 300 to 600 miles (F-84s do the shortest distance, Canberras the longest), pass over an en route target on time, then attack their actual target - on the Suippes Range, when the Meet is located at Chaumont<sup>3</sup> – on time. There are four methods of attack according to aircraft type – strafing, skip bombing, rocketry or simulated nuclear weapon delivery – but there is one common criterion for success: accurate, on-time delivery of weapons”.

No 3 Squadron took part in the fifth Meet (10–24 June 1966), which was the last in which l’Armée de l’Air competed as part of the NATO forces, before these were withdrawn from French territory, and the first to be won by 2 ATAF - by the narrow margin of 3,639 to 3,629 points.

During the rest of the 1960s the Meet ‘rotated’ among different Allied Air Forces. The sixth was held at RAF Wildenrath (16–30 June 1967), No 14 Squadron providing the Canberra strike element and 2 ATAF again winning – by 4,442 to 4,044 points. The seventh, at the GAF base Jever (7–21 June 1968), with No 16 Squadron in the 2 ATAF team saw 2 ATAF “narrowly regain” the Broadhurst Trophy<sup>4</sup>, the premier award. The eighth, when 2 ATAF won this Trophy back, was at GAF base Norvenich (30 May–14 June 1969), with No 3 Squadron providing the RAF element – as they did in the ninth, held at the USAF base Spangdahlem (1–13 June 1970). In the course of the later years of this Meet<sup>5</sup>, from 1966 onwards, the RAFG Canberra bomber squadrons had changed their weapon-delivery technique, from LABS to lay-down.

Another competition was for the Salmond Trophy, which was awarded annually for the best bombing and navigation performance by one of the RAF Germany Canberra B(I).8/6 squadrons. Thus this was a ‘domestic’ rather than an international contest like the Tactical Weapons Meet, and unlike the fortnight allotted to the latter in the annual military aviation calendar, it was flown off over several periods – at irregular intervals, according to the suitability of weather or other commitments.<sup>6</sup> Its aim was simply to improve bombing efficiency by the Canberra strike squadrons. The Salmond Trophy had originally been presented in 1930<sup>7</sup> to be competed for by the Army co-operation squadrons in India; it had been allocated to RAF Germany in 1959 for award to the winner of the Canberra LABS bombing competition but it was not actually awarded for the first time (after new rules had been drawn up) until 1964, when No 213 Squadron were presented with it at Bruggen for their 1963/64 performance. No 213 also won it in 1965; then No 3 Squadron were awarded it on 30 March 1966 “for obtaining the highest overall points in the Command Bombing and Navigation competitions during the 1965/66 period”, as the ORB put it. No 3 retained it for 1967 – the C-in-C RAF Germany, Air Marshal Sir Denis Spotswood, presenting it at Laarbruch on 27 March 1968 – then No 213 also won it for two years in succession and were presented with it twice in the same year at Bruggen: on 10 February and 28 November 1969. The latter award was made only a month before the squadron disbanded. The winners – for the first time – in 1970 were No 16 Squadron.

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<sup>1</sup> Initially with two crews; later, crews were changed at the halfway stage. <sup>2</sup> *Flight International*, 24 June 1965. <sup>3</sup> Other ranges, like Nordhorn, were used from other locations. <sup>4</sup> Named after ACM Sir Harry Broadhurst, former Commander, Aircent. <sup>5</sup> In 1978 changed to Tactical Air Meet, embodying the Royal Flush reconnaissance competition. <sup>6</sup> No 16 Sqn noted in December 1965 that “the next round of the Salmond Trophy continues to be frustrated by bad weather . . .”. <sup>7</sup> By Sir Geoffrey Salmond when AOC.

Against this background of the maintenance of QRA, exercises, detachments, Tacevals, competitions and continuation training, the squadrons had to ensure that their monthly target of flying hours was achieved and that as many crews as possible were combat-ready – able to deliver weapons accurately on a target whenever required to do so. This meant that when experienced crews were posted at the end of their tours, new crews had to be trained in nuclear and conventional weapon delivery techniques in order to replace them and to keep the crew establishment up to strength. In addition, Central Flying School 'agents' would descend upon the squadrons from time to time to categorise all the pilots according to their flying ability. Life was indeed busy for the RAF Germany Canberra strike squadrons, and their operational role was a demanding one; no wonder that, when No 213 was being disbanded the following signal was sent to HQ at Rheindahlen: "We have liked being Bumblebees<sup>1</sup> but now we've had our day, someone else can have the Salmond so farewell to Taceval, Target Study, joint inspections, staff visits and QRA . . ."<sup>2</sup>.

The Canberra strike squadrons in RAF Germany played a most important role during the 1960s in providing Saceur, together with the three Valiant squadrons of the Tactical Bomber Force based at Marham, with his bombing power. All seven squadrons maintained QRA aircraft and all carried American nuclear weapons – initially of 1,900lb and subsequently of 2,100lb, the Valiants carrying two each, the Canberras one.<sup>3</sup> Since the Valiants were phased out of service early in 1965 and were not replaced in the TBF role, the importance of the Germany-based Canberra bombers in Saceur's armoury in the latter half of the 1960s cannot be over-emphasised. Only after the Royal Navy's Polaris submarines had taken over the strategic nuclear deterrent QRA from the V-force in mid-1969 were the Vulcans freed to support the Canberras in their strike role, which the latter handed-over – as they were phased-out from 1971 onwards – to Buccaneers, which had a greater overall (internal and external) weapon-carrying capacity, higher performance and better all-weather capability.

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<sup>1</sup> Nickname given to No 213 Sqn, deriving from the hornet on the squadron badge and the motto *Irritatus lacessit crabro* (The hornet attacks when stung). <sup>2</sup> Squadron ORB. <sup>3</sup> As far as the Canberras were concerned, this change – which would obviate the need for the LABS manoeuvre – was first mooted in mid-1964, when ComAirCent told CAS (ACM Sir Charles Elworthy) he had reason to believe that an application for US 2,100lb weapons to equip the Canberra strike squadrons in Germany "would probably be well received by the US authorities" (minute, PS/CAS to PS/VCAS and ACAS(Pol), 19 June 1964, in AHB file ID9/M. 1-65 Lay Down Weapons for Canberras); but discussions and correspondence on this change continued for a year, until on 14 June 1965 the US Deputy Secretary of Defense (Mr Cyrus Vance) acknowledged a letter from the UK Minister of Defence (Mr Denis Healey) of 26 May saying that Saceur had proposed a delay in the phase-out of the original US weapons for the Canberra force. In his letter, the Minister had expressed the hope that there would be no difficulty about "phasing the exchange of weapons in the way we have proposed". The Air Force Board had on 5 April 1965 (Conclusions 5(65) Secret Annex 'B') approved the re-equipment programme involving the conversion of the Canberras to take the 2,100lb weapon.

## CHAPTER 9

**Bombers in Cyprus — Canberras (1957–1969) and Vulcans (1969–1975)**

The deployment of RAF bombers in Cyprus stemmed directly from the formation of the Baghdad Pact in 1955, a treaty organisation which became known as CENTO (Central Treaty Organisation) in 1959. By the latter date its members were Iran, Pakistan, Turkey and the United Kingdom. Iraq, one of the original signatories, had withdrawn in that year following a coup which had overthrown her Government, and the organisation's HQ had been moved from Baghdad to Ankara. The United States never became a member of CENTO, though participating in some of its activities.

When the original plans for Baghdad Pact military capability were drawn up (1955–1956) in the light of the threat its members were considered likely to face, the possession of a bomber force with nuclear weapons was considered to be necessary. Apart from the UK, none of the member countries had any bombers: Iraq, Pakistan and Turkey all had air forces whose main component was fighters and fighter/bombers. The situation was similar to that when the Western Union alliance, precursor of NATO, was formed in 1949: for the only one of its member countries with bomber capability was the UK.

During 1956 the UK offered to provide four squadrons of light bombers in support of the Baghdad Pact, plus a photographic reconnaissance squadron and a maritime force; and this commitment was approved by the Chiefs of Staff in July of that year. Although at this time reference was made to the "Canberra theatre nuclear force", the Canberras were not then capable of carrying nuclear weapons; nor were there any aircraft of this type in the Near East Air Force.

However, the UK offer to the Baghdad Pact had been made and accepted, and in fulfilment of it four new Canberra squadrons were formed (from existing Middle East-based Venom squadrons) and were deployed to Akrotiri, Cyprus, during 1957: No 32 in February, No 73 in March, No 6 in July and No 249 in November. All had B.2s and were established for eight aircraft and ten crews. They were supported by a reconnaissance squadron, No 13, equipped with Canberra PR.7s. Collectively the B.2 (later B.6 and then B.15/16) squadrons became known as the NEAF Strike Wing.

These squadrons were initially employed in a conventional bombing role, the Canberras flown by three-man crews (pilot and two navigators) and able to carry a 6,000lb (six 1,000lb bombs) weapon load. Their original directive, to quote the No 32 Squadron operations record book, was "to become familiar with Middle East air routes and . . . to attain a high standard of visual bombing as soon as possible". The Canberras were not nuclear-armed when they first appeared in NEAF, nor was there any storage for atomic bombs at Akrotiri; the latter did not become available until after 1961, but in the meantime it would have been possible in extreme emergency to fly out nuclear weapons from the UK.

The story of the Canberras in Cyprus from 1957 to 1969 is one marked by an increasing sophistication of aircraft and weaponry – from the original B.2s to B.6s (which had more power, increased tankage and greater range and some of which were equipped with Blue Shadow sideways-looking radar so could be used for target-marking) to B.15s/16s, which were specially developed for the MEAF/FEAF theatres and had a remarkable versatility of weapon-delivery roles: LABS (low altitude bombing system), as practised by the 2TAF/RAF Germany Canberra B(I).8s; pop-up delivery; shallow dive bombing; medium-level bombing; low-level and operational RPs (rocket projectiles); and the French AS30 guided missile system.

Taking No 32 Squadron as an example of these developments, it operated B.2s from its re-formation in the bomber role in 1957 until it was re-equipped with B.15s in 1961. This latter type of Canberra, a conversion of the B.6, was equipped to operate in the tactical nuclear or conventional bombing roles, or as a ground-attack aircraft. It had a 6,000lb internal bomb load and provision for two folding-fin rocket pods below the wings and for Nord AS30 air-to-ground guided missiles. The B.16, which the squadron

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subsequently also operated, was similar except in terms of radar equipment. By the end of 1962 all the NEAF Strike Wing squadrons had got these marks of Canberra: Nos 32 and 73 had B.15s and Nos 6 and 249 had B.16s (although squadrons seem to have operated both types).

With such varied forms of weapon delivery available there was great emphasis on relevant training, particularly in LABS and rocketry, and with the AS30 missile system when this came into service from 1965 onwards. No 32 Squadron received its first B.15 converted for that equipment (WH964) on 15 March that year and began training aircrews to operate the new weapon system – “the latest addition to the squadron’s roles”, as the ORB described it.

From the earliest days of their deployment to Cyprus these Canberra strike squadrons had familiarised themselves with the CENTO area – Turkey, Iran and Pakistan – through exercises and cross-countries. The organisation’s major air defence exercise was known as Shahbaz. When the first of these was held, in November 1959, six Valiants of Bomber Command and 14 NEAF Canberras participated – acting, with two American aircraft, as an aggressor force.

The Shahbaz exercises were a main feature of CENTO’s annual planning and they continued to be held until 1974, when seven Vulcan B.2s of No 35 Squadron participated, although they had not been held with annual regularity – in some years, political factors in one or other member country necessitated a cancellation. As far as the NEAF Strike/Bomber Wing was concerned, its Canberras or Vulcans always provided the bomber forces to test the air defences (fighter and radar) of the host country. Thus in May 1965 three crews of No 32 Squadron flew high-level sorties from Teheran, their Canberra B.15s “acting as targets for the F-86 Sabres of the Turkish and Iranian Air Forces”; but a Shahbaz detachment to Peshawar in the previous month had had to be cancelled because of conflict between Pakistan and India in the Rann of Kutch area. There had been other forms of co-operative exercise with the same objective: thus in June 1958 the B.2s which No 32 Squadron then had flew 15 sorties in Exercise ‘Full Play’, “to test the ability of the Turkish Air Force”; and in May 1959 three of the squadron’s crews detached to Peshawar for a Baghdad Pact exercise code-named ‘Tiger’ made 18 attacks against targets in Pakistan, Iran and Turkey, the exercise providing “excellent experience over unfamiliar terrain and an opportunity for meeting officers of the Pakistan Air Force”.

Baghdad Pact/CENTO exercises were therefore facts of life for squadrons in the NEAF Strike/Bomber Wing, and two other features resulted from the wing’s location in Cyprus – the political troubles of that island in the 1950s and ’60s; and its geographical position – at the hinge, so to speak, of the NATO and CENTO areas so that the Canberras and Vulcans were called upon by both organisations for exercises.

The political troubles, from 1958 onwards, meant that the aircraft had to be either dispersed from Cyprus or intensively guarded. Thus in April of that year, the No 32 Squadron ORB reported, “with terrorist tension building up . . . , policy towards the end of the month directed that ten Canberra B.2s from the island should be detached overnight at El Adem”; while in the autumn the situation in Cyprus was not helped, as far as the RAF were concerned, by events in the Middle East as a whole. In July there had been a coup in Iraq, removing both the King and the Prime Minister and destroying the original basis of the Baghdad Pact (from which Iraq withdrew in the following spring); King Hussein of Jordan had asked for British assistance because his own throne was threatened by events in Iraq; and the Lebanon had asked for American military aid. By September of that year (the No 32 Squadron ORB recorded) tension in the Middle East had eased but the situation in Cyprus seemed to be deteriorating. “Owing to the increased boldness of EOKA<sup>1</sup> saboteurs the guard dogs have been replaced on the dispersals by squadron airmen and the squadron duty officer, who now spends the night on the dispersal. A great deal of time and effort have gone into the erection and siting of twin sodium lights on poles designed to light up all the wire forming the squadron perimeter . . .”. During October the squadron maintained a 6hr standby, which between 19–25 October was “increased to 2hr and 4hr readiness for aircraft of the wing to cover the period of the withdrawal from Amman”.

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<sup>1</sup> Ethniki Organosis Kypriakou Agonos (The National Organisation of Cypriot Struggle for Union with Greece).

Political troubles in Cyprus continued to affect the Strike Wing from time to time: in December 1963 Exercise 'Shahbaz IX' was curtailed and flying restricted owing to the prevailing situation, while extra guards were put on the Canberras at night; then in January of the following year the Strike Wing at Akrotiri was put on four hours' standby for ten days (10-21) during the early stage of the London conference on revision of the Cyprus constitution. In March 1964 a contingent of United Nations troops arrived in the island and there was some relaxation in curfew hours. Later that year (August) an exercise called 'Cypex V' in which Nos 32 and 249 Squadrons were detached to El Adem and flew aggressor sorties from there against the island was cancelled midway through the last trip No 32 was making to Akrotiri, because of "the local situation".

The Strike Wing's dual commitment, to NATO as well as to CENTO, has already been mentioned: working with NATO involved co-operation with Royal Navy and USN (6th Fleet) forces in the Mediterranean - for example, in April 1957 the Canberras of No 32 Squadron took part in an exercise called 'Red Pivot', the aim of which was to test the 6th Fleet's carrier-borne fighter defences. Then in Exercise 'Medflex' (19-23 May 1958) the B.2s again operated against the 6th Fleet, and against Cyprus to test the Akrotiri-based Hunters; and later that month (on the 26th) two of the Canberras flew in Exercise 'Rapier', which was designed to test HMS *Ark Royal's* radar capabilities. The co-operation with NATO was spelt out in an exercise called 'Dense Crop' (13-20 September 1965) when five B.15s of No 32 Squadron operated from Luqa, Malta, in conjunction with NATO air, ground and sea forces, the Canberra participation involving high- and low-level sorties against targets in Italy and Sicily, and low-level strikes against the US 6th Fleet and a NATO convoy code-named 'Emerald Green'. Then in October 1967 "the annual NATO exercise 'Eager Beaver' provided some unfamiliar and therefore extremely useful flying experience" (to quote the No 32 Sqn ORB). "All available crews had at least one sortie between 2 and 5 October consisting of a high-low-high level profile trip, including a substantial low-level over Greece culminating in a realistic simulated high-level attack on the American 6th Fleet".

Each year the CENTO planning staffs would arrange major events designed to keep the organisation's members knowledgeable about its capabilities and also to put these to practical test, a main example of the latter being the Shahbaz air defence exercises, already mentioned. An example of the former was the firepower demonstration for the PMDs (Permanent Military Deputies). In May 1962 one of these was given by No 32 Squadron, and in April 1964 the squadron participated in a Strike Wing demonstration which "consisted of a Wing scramble and exercise route, culminating in a LABS attack on the Episkopi target". Then in September 1966, again in Episkopi Bay, No 32 Squadron described their B.15 participation as "four aircraft operational full- and half-pod RP and one low-level pop-up bomb". When the event was held in the following year (on 15 November 1967) No 32 noted that its B.15s "demonstrated both operational rocket attacks with full pod HE rockets" when "a firepower demonstration was given by all four Canberra squadrons before visiting CENTO PMDs". This was the last such demonstration given by the Strike Wing, which was replaced just over a year later by a Bomber Wing of two Vulcan B.2 squadrons.

Throughout its 12-year existence the Strike Wing had increased its skill and capability through continuous training with its aircraft and their weapon delivery, generations of crews becoming experienced with their equipment and their operational area. Life for both aircrew and groundcrew was punctuated with exercises and detachments, the overall results of which were testing of techniques and the ability to operate from bases away from Akrotiri<sup>1</sup>. Frequent use was made of the El Adem bombing range; there were detachments to Sharjah for RP attacks on the Jebajib range, preceded by low-level cross-countries, and detachments to Tengah, Singapore - as a practice reinforcement of FEAF in a limited-war role; there were Levant Rovers - trips by single aircraft - to Karachi, Nairobi, Teheran, Ankara and Salisbury, and Island Rangers to the UK. The major changes in Strike Wing squadrons' weapon capability were Akrotiri's acquisition of nuclear bomb storage facilities (1961), the arrival of the first Canberra B.15s (1961) and of the first B.15 modified to carry the Nord-Aviation AS30 tactical air-to-surface missile (1965).

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<sup>1</sup> "With added second-line backing" (the No 32 Squadron ORB noted in August 1959) "the squadron will be prepared to move at four days' notice into any operational theatre in the world".

When the UK had originally declared a nuclear weapon capability to the Baghdad Pact organization in 1956, such a capability did not exist in the Near East theatre, either in terms of bombs or of aircraft to carry them; in fact it was not until early 1958 that a nuclear capability for Canberras in Bomber Command and 2nd TAF was announced<sup>1</sup>. The Canberra B.2s with which the original Strike Wing squadrons were equipped were conventional bombers; the LABS role, for delivery of nuclear weapons, was not introduced until after the re-equipment with B.15s in 1961. In November of that year, the No 32 Squadron ORB recorded that "the squadron is now committed to reaching and maintaining high standards in LABS, visual bombing and ground attack with rocket projectiles".

This UK contribution to BP/CENTO air power of what was referred to as "the theatre nuclear strike force",<sup>2</sup> when in fact the NEAF Canberras did not possess a nuclear strike capability, caused concern to the UK member of the PMDG (Permanent Military Deputies Group) because of possible discredit in the eyes of the other member countries. Air Marshal H P Fraser put it bluntly to the Defence Staff in January 1960 when he said that the UK "must not be found out if it were to continue to carry any weight in CENTO Military Councils".<sup>3</sup> He was assured in reply that there could be an "interim capability" in NEAF by July 1960.

Financial approval for the construction of storage facilities had in fact been given at the end of 1958, but during 1959 there were changes in plans, and renewed approval had to be sought later that year – setting back the projected start of work to April 1960 with expected completion in mid-1961. In fact the work seems to have been finished towards the end of the latter year; the Akrotiri ORB noted for 28 November 1961: "Supplementary Storage Area taken over and occupied". The bombs supplied for the Canberras were British Red Beard tactical atomic weapons, one per aircraft, weighing 1,900lb.

The arrival of B.15/16s on the Strike Wing squadrons during 1961/62 gave them a versatile operational capability – for normal bombing, LABS delivery and low-level attack. No 32 Squadron, which received the first B.15s, noted in September 1961 (when it had six) that "throughout the month Tech Wing armament specialists conducted tests and trials on (WH) 971 and 970 for the harmonisation of gunsights and cameras, fitting of rocketing equipment and . . . of LABS equipment".

These squadrons were established for eight B.15s/16s, but No 32 didn't achieve this complement until 6 March 1962 when its eighth B.15 (WH 984) arrived. No 73 had eight B.15s by September of that year. No 6 Squadron didn't change its last B.2 (WH 741) for its eighth B.16 (WT 373) until 22 May 1963, when the new aircraft arrived at Akrotiri from Lyneham; its re-equipment had started in January 1962 with the first two B.16s. No 249 Squadron, which received its first two B.16s on 21 November 1961, didn't achieve its full strength of eight aircraft until April 1963.

Two of the Strike Wing squadrons, Nos 32 and 73, had aircraft modified to fire the Nord AS30 air-to-surface missile (the only other squadron subsequently equipped to carry it being No 45 of the Far East Strike Wing, based at Tengah, Singapore). No 73 got its first AS30-modified B.15 (WT 210) in April 1965; but although there was a simulator operating in the crew room that summer<sup>4</sup> the first live firing, on the El Adem range, wasn't done by the squadron until November 1965. In December of that year there was a fortnight's AS30 course at the Strike Wing at Akrotiri. Four observers of No 73 Squadron attended this, there were lectures in January 1966 for crews who were going to fire AS30s, while in the same month three of the squadron's observers attended a three weeks' course in Paris organised by the manufacturers (Nord Aviation); then in February there were live firings from El Adem and No 73's ORB announced "the latest weapon in our armoury is the AS30 missile. Only three squadrons in the RAF are to be equipped with it". (The others were Nos 32 and 45. The latter, part of the FEAF Strike Wing, didn't start receiving its AS30-modified B.15s until late in 1966.)

Thus the NEAF Strike Wing achieved the zenith of its power and versatility for three years (1966–1968 inclusive), with all of its squadrons capable of LABS, conventional bombing and rocketry, two of them additionally for AS30 delivery and two of them for target marking with Blue Shadow-equipped B.16s.

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<sup>1</sup> Memorandum accompanying the 1958–1959 Air Estimates (21 February 1958). <sup>2</sup> Air Ministry comments on Baghdad Pact Air Defence (BP/S.412/4), May 1958. <sup>3</sup> Letter to D/CDS, 28 January 1960. <sup>4</sup> Five AS30 simulators were ordered.

Long before this capability was achieved, however, plans had been made to replace the Canberras in Cyprus. During 1960 the AOC-in-C MEAF (Air Marshal W L M Macdonald) had recommended that the strike force squadrons should be re-equipped with two squadrons of TSR.2s plus three squadrons of F/GA aircraft in the period 1961–1964. It was argued that TSR.2s would give the force a better day, and a true night, capability – they would make up for the Canberras' limitations in these roles. Two squadrons of TSR.2s (16 aircraft, each with the ability to carry two nuclear weapons) would meet the CENTO commitment currently fulfilled by the Canberras. Additionally it was proposed to arm the TSR.2s with American Martin Bullpup air-to-surface missiles. The AOC-in-C was informed in October 1960 of this decision; he was told<sup>1</sup> that the TSR.2 squadrons would meet the CENTO commitment and that equipping the aircraft with Bullpup would create “a hard-hitting long-range tactical force for limited operations” in the theatre. The CENTO Military Deputies were subsequently (1964) informed of this decision to replace the Cyprus-based Canberras with TSR.2s.<sup>2</sup>

However, cancellation of the TSR.2 programme in April 1965 threw this and other plans for the replacement of Canberras in the strike/reconnaissance role into disarray. Later that year the UK Government took an option on General Dynamics F-111As for the RAF, the number being unspecified, so that an actual order could be considered within the context of other British military aircraft requirements. This option covered the possible purchase of up to 110 F-111As. Subsequently an order for the F-111As, to maintain a strike/reconnaissance capability pending the development of an Anglo-French variable-geometry aircraft (that is, with similar high- low-speed capability to that of the swing-wing F-111), was announced in the 1966 Defence Review.<sup>3</sup> This said that until the Anglo-French v-g aircraft was available, the F-111A would be supplemented in the strike role by the V-bombers.

Such a limited buy of F-111s meant that there would only be enough for three squadrons plus an OCU, and it was planned to base the whole force in the UK, though it would have great operational flexibility because of the aircraft's long range.<sup>4</sup> While the F-111Ks (the version ordered) would replace the Canberra tactical strike/reconnaissance squadrons assigned to SACEUR, there was no question of them replacing the NEAF Strike Wing squadrons committed to CENTO. Those Canberra B.15/16s would in due course be replaced either by V-bombers, or by the variable-geometry combat aircraft which was one subject of the Anglo-French Memorandum of Understanding signed on 17 May 1965.

There were to be two variants (as far as the RAF were concerned) of this variable-geometry combat aircraft – an interceptor and a strike/reconnaissance machine. But the latter type, because the French wished its size to be kept down for carrier-borne operations, would be too small (approximately 35,000lb in weight) to be a replacement for the Canberra, with *auw* of 55,000lb. Further, the French made it a condition of collaboration that the UK should not continue with a purchase of F-111s. The RAF hoped from the v-g project to acquire an adequate strike aircraft which would replace the V-force and complement the F-111<sup>5</sup>. There were no plans to use F-111s in CENTO.<sup>6</sup>

However, although this Anglo-French collaboration in the mid/late-1960s yielded the Jaguar, it failed to produce a new strike/reconnaissance aircraft or a defence fighter. The latter requirement was fulfilled by a buy of Phantoms for the RAF (ordered in 1965) but a V-bomber/strike replacement was still needed, in the absence of the AFVG which failed to materialise from the long Anglo-French negotiations of 1965–1966.

Cancellation of the AFVG officially became known following a meeting between the French and UK defence Ministers (M Pierre Messmer and Mr Denis Healey) on 29 June 1967. The aircraft decided on as an alternative to take over the strike role from the Canberra in Europe was the Buccaneer S.2, but the Canberras in Cyprus were, it had been decided in a Defence Review of 1966<sup>7</sup>, to be replaced

<sup>1</sup> ACAS(Ops)/AOC-in-C MEAF, Re-equipment of Middle East Strike Force 1961–1970, 12 October 1960.

<sup>2</sup> HQ NEAF/MOD Air signal, visit of CENTO PMDs to Cyprus, 12 September 1966. <sup>3</sup> In the *Statement on the Defence Estimates 1966* (Cmnd 2901, February 1966). <sup>4</sup> F-111 – Deployment (ID9/B.21-190).

<sup>5</sup> VG Bomber Plans and Strike Trainer files (ID9/M.17-6 Pts 1-8). It was considered that the F-111 would provide for the reconnaissance needs, leaving the long-range strike task to be fulfilled by the V-bombers pending the introduction of the AFVG. <sup>6</sup> ACAS(Pol)/DCSA(P), 21 April 1966. <sup>7</sup> Run-down and Re-deployment of Forces in the Mediterranean (COS Ctte, DPS 10 June 1966).

by Vulcans in order to maintain the CENTO and other Near East commitments. The plan was to put the V-bombers into Cyprus early in 1969. In September 1966, just prior to a visit by the CENTO Military Deputies to Cyprus, HQ NEAF asked MoD Air whether the PMDs could be informed of "the intention to replace Canberras with Vulcans".<sup>1</sup>

Initially, the Defence Staff had suggested that the Canberra squadrons should be replaced on a one-for-one basis, by four squadrons of Vulcans. But it was decided that, in order to avoid expenditure on additional facilities that would have to be provided at Akrotiri, two Vulcan squadrons only should be stationed there and two others declared to CENTO should be retained in the UK. This decision formed part of the Cyprus/CENTO policy approved by the Chiefs of Staff in February 1967. The arguments in favour of committing V-bombers to CENTO were that they possessed advanced electronic equipment and had an enhanced night/all-weather capability. They could not, however, perform the ground-attack (rocket and AS30) roles of the Canberra and in this respect were less versatile. The main concern of the UK Government was to reduce defence expenditure in the eastern Mediterranean area while still being seen to be making a convincing contribution to CENTO.

British policy on Cyprus, in the light of defence expenditure and commitments in the Persian Gulf, was fully discussed during 1967/1968 and the Chiefs of Staff view confirmed that it would be necessary to have at least two squadrons of Vulcans based at Akrotiri. These aircraft would start replacing the Canberras in January 1969.<sup>2</sup> This and other proposals for a reduction of aircraft in Cyprus, in line with the Government's Statement on Public Expenditure of 16 January 1968<sup>3</sup> - which said that the UK would make an early reduction in the number of aircraft based in Cyprus, whilst retaining membership of CENTO, and which also said that the RAF order for 50 F-111s would be cancelled - were approved in principle by the Chiefs of Staff on 27 February 1968.<sup>4</sup>

The possibility was subsequently discussed of "double-earmarking" the Vulcans, so that they would be available not only to CENTO but also to NATO for conventional operations on its southern flank. However when the Chiefs of Staff examined this proposal they felt unable to support it, largely because of the incompatibility of the different requirements.

Plans to deploy V-bombers to NEAF became public knowledge on 22 July 1968 when the BBC Overseas Service broadcast a news-item saying that Britain was to send "two squadrons of Vulcan nuclear bombers to Cyprus around the end of the year". They would be stationed at the Sovereign Base in the island and (said the BBC's Defence Correspondent) would be "part of an increased contribution to NATO forces in the Mediterranean".

This statement, that aircraft "capable of carrying nuclear weapons" would be based on Cyprus in support of NATO, inevitably caused a furore both in the island and in London, and under pressure from MoD the BBC broadcast a retraction on 24 July saying that the two squadrons of Vulcans which Britain was sending to Cyprus would be the first Vulcan units to be stationed abroad.<sup>5</sup> They would replace four squadrons of Canberras which were being withdrawn because of their age, and would be deploying in support of the Central Treaty Organisation (CENTO) - not NATO as reported earlier.

The pending move of Nos 9 and 35 Squadrons to Akrotiri was referred to at the end of that month by the retiring AOC-in-C Strike Command, Air Chief Marshal Sir Wallace Kyle, when he paid a farewell visit to RAF Cottesmore on 31 July. Speaking at a formal lunch, he said that following the departure of the two squadrons to Cyprus early in 1969 Cottesmore would continue as a flying station - accommodating the Canberra OCU from Bassingbourn and three squadrons from Watton.

RAF Akrotiri noted succinctly, in its ORB for January 1969, the change in NEAF bomber forces. The ORB recorded that the month "saw the disbandment parade for Strike Wing Canberras and the arrival of Vulcan B.2s of 35 Squadron from Cottesmore" and that "Bomber Wing, consisting of Canberras and Vulcans, came into being during the month." The Strike Wing disbanded on 10 January, when Nos 6, 32, 73 and 249 Squadrons paraded their colours before the AOC-in-C NEAF, Air Marshal Sir Edward Gordon Jones. However, the last Strike Wing Canberra operation was by B.16 WJ777 on 27 March. By 19 March the new Bomber Wing had been brought up to strength with 16 Vulcans; this

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<sup>1</sup> HQ NEAF/MOD(Air), 12 September 1966. <sup>2</sup> AFD Note, 22 February 1968. <sup>3</sup> Cmnd 3515. <sup>4</sup> COS 14th Mtg/68. <sup>5</sup> There had, of course, been many temporary deployments and detachments.

was the date on which the second four Vulcans of No 9 Squadron arrived at Akrotiri. In a briefing on the following day the squadron was told that its "primary function" was to be "continuation of the nuclear deterrent role, except that the treaty organisation of which we form a striking force is to be CENTO and not NATO."

Rangers – Lone, Island or UK – were to be a regular part of life for the Vulcans in Cyprus, as they had been for the Canberras, and in a vivid description of a reference to them at the briefing No 9 Squadron were given the ORB chronicler noted: "We were told that we should be doing Rangers or detachments to Sharjah, Masirah, Muharraq, Peshawar, Teheran, Nairobi and Tengah, and the hollow laughter of the cynics rang round the briefing room. However, as if to instantly shame such lack of faith, Flight Lieutenant C Woods and crew were nominated for a Tengah Ranger, and after an abortive attempt on the 19th (lightning strike whilst airborne) they left Akrotiri on the 20th and returned on the 26th". At a dining-in night on 28 March the two squadrons, Nos 9 and 35, were formally welcomed to Akrotiri by the station commander, Air Commodore D A Green.

The Bomber Wing which they comprised existed from January 1969 to January 1975, when the squadrons were re-deployed to the UK. This was during a period of great tension in Cyprus, following the previous year's Turkish landings and occupation of the northern part of the island; the RAF Akrotiri ORB noted that the "resident squadrons" (including Nos 9 and 35) were being replaced by "detachment squadrons" from the UK. Thus four Vulcans of No 50 Squadron arrived on 20 January, as a Strike Command detachment.

When four Vulcan B.2s of No 9 Squadron had left the snows of Cottesmore for the sunshine of Cyprus on 26 February 1969, to be followed by the rest of their aircraft on 19 March, the NEAF Bomber Wing which they formed with No 35 Squadron took over the CENTO role which the Strike Wing had performed with its Canberras since 1957. But there were great differences between the light bombers with their tactical capability (conventional bombing, rocketry, LABS and AS30) and the medium bombers fresh from a European environment, committed to SACEUR in the long-range nuclear strike role.

During its five-year existence the Bomber Wing did many of the same activities the Strike Wing had undertaken – participation in CENTO and NATO exercises, firepower demonstrations, detachments, Ranger flights, alerts, evaluations, standardisations; but though in broad terms the role was the same, performance of it differed because of the difference in aircraft type and capability, and changing political and military circumstances. The Vulcans' main commitments were to CENTO, to the reinforcement of the Persian Gulf area and to NATO; and in fulfilment of these commitments they participated in various exercises and training flights. Thus supporting CENTO meant contributing to the organisation's regular Shabaz air defence exercises, by flying aggressor sorties, and to the firepower demonstrations put on for the Permanent Military Deputies; in addition, single aircraft flew Rangers to Teheran and Ankara – all these activities helping crews to familiarise themselves with the CENTO environment and with the low-level routes (turbulence encountered on which caused the Vulcans to use up their fatigue life at an alarming rate, until procedures were devised to offset this).<sup>1</sup> Practice for the reinforcement of the Persian Gulf area was achieved by regular Pedigree detachments to Masirah island (with more low-level flying, in Iran and Oman, over "rugged and featureless terrain"<sup>2</sup>) and NATO exercises included Dawn Patrol, Deep Furrow and Epic Battle, some of these involving RN and USN forces and others, air, land and naval elements. Low flying was also done over Italy, along the Calabrian routes; thus the Vulcans operated to the west, south and east of Cyprus. A difference in this respect between them and the Canberras was that the latter used to do a good deal of training (both bombing and AS30) on the El Adem ranges, but these eventually ceased to be available after the Colonel Gadaffi coup of September 1969 had removed the pro-western King Idris from power.

No 9 Squadron soon discovered after their move to Cyprus (according to their ORB for March 1969) that "flights from Akrotiri suffer less [than those in the UK] from problems of weather and bookings". In other respects, despite the advantage of an easier climate, the Bomber Wing personnel must have found

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<sup>1</sup> No 9 Squadron ORB, August 1970. <sup>2</sup> *Ibid*, October 1972.

their operational lives just as busy and regulated as they had been in the UK. Apart from the frequent exercises already mentioned, and those to test the air defences of Cyprus and Malta, there were quick-reaction alerts, 'generation games' (generation of nuclear and conventional weapons, followed by a fly-off) and tactical evaluations. The NEAF Bomber Wing also participated in the Strike Command Bombing and Navigation Competition, the best crews being selected from the two squadrons then sent to the UK for training some weeks before the contest. Crews were also subject to the 'trappers' – the Standardisation Unit from No 1 Group – and to an MoD Weapons Standardisation Team, which checked their knowledge of the weapons carried. As in the UK, there was strong overall emphasis in training and exercises on low-level operations. No 35 Squadron noted in its ORB that on 7 July 1971 the new Italian low-level routes were flown for the first time and were "thought to be better training value than the all-too-familiar Cyprus low-level route".

After the Turkish invasion of Cyprus at dawn on 20 July 1974 the Vulcan squadrons performed some interesting roles, in maritime reconnaissance and also as airborne communications posts – relaying messages between NEOC (Near East Operations Centre), the UN controllers in Nicosia and the Turkish authorities in Ankara. Although the Sovereign Base Areas were not affected (except by an influx of refugees) by the Turkish occupation of the north of the island, the situation of Cyprus as a British base, with its Near East/CENTO commitments, had changed for good. The No 35 Squadron ORB for September 1974 noted that "flying over the Republic continues to be prohibited and the majority of training flights have been carried out either in the UK" – where an NEAF detachment had been established at Waddington – "or Malta", although by October more local flying from Akrotiri, and the range at Episkopi, had become available.

During November 1974 No 35 Squadron flew two Exercise UMBER (to Iran) and four No 9 Squadron aircraft and four crews were detached to Masirah for a Pedigree detachment – flying sorties over the Oman low-level routes.

But in the following month the squadrons were told that they were to be withdrawn from Cyprus to the UK, and this occurred early in 1975, No 9 going to Waddington and No 35 to Scampton during January, their departure from NEAF marking the end of an era in Cyprus-based RAF and CENTO operations.

## CHAPTER 10

**The Christmas Island Tests, Introduction of Megaton-range Weapons and the Start of RAF-USAF Co-ordination of Nuclear Strike Plans (1957-1958)**

If 1956 could be said to represent a nadir in Anglo-US relations, the two following years could be said to represent a zenith as far as military atomic co-operation was concerned. Early in 1957 the United States Secretary of Defense (Mr Charles Wilson) agreed to authorise discussions on two crucial issues: the supply of American atomic bombs to the RAF in the event of general war, and the co-ordination of USAF/RAF atomic strike plans. These discussions, as will be described later, eventually resulted in a Memorandum of Understanding between the two Air Forces. This represented a revolution in American military thinking, a sharing of knowledge and techniques in a field which the US Air Force had hitherto kept closely guarded and monopolised. Why had this remarkable change of policy come about?

The reasons were probably threefold. First, the need to rebuild confidence and friendship between Britain and the United States after the Suez operation of October-November 1956. Secondly, the evidence provided by the Valiants, Vulcans and Victors of Bomber Command with their British-produced nuclear weapons that the United Kingdom had a viable independent strategic nuclear deterrent force. Thirdly, the decision taken by the UK Government during 1954, and made public in 1955, that hydrogen bomb production should be authorised – a decision that was to be visibly substantiated in mid-1957 when the first British megaton weapons were dropped by Valiants in tests at Christmas Island, and in the introduction of such weapons to the RAF during 1958.

These weapons, and their carriage by the second-generation Vulcans and Victors, either in free fall (Yellow Sun) or powered bomb (Blue Steel) form, represented the acme of destructive power wielded by the V-force. The weapons which the United States supplied to Bomber Command and to RAF Germany were for tactical use, by Valiants of the TBF (Tactical Bomber Force) and by Canberras of the Germany-based strike squadrons, and for Main Force Vulcans and Victors before they were supplied with British megaton-range weapons. Ironically, when the UK Government later opted for an American megaton-range air-launched ballistic missile, Skybolt, in preference to a British-developed surface-to-surface missile with megaton warhead, Blue Streak, the Americans' failure to deliver the goods led to the ending of the V-force QRA role as the instrument of British independent strategic nuclear deterrence. In this it was replaced by Polaris-armed submarines of the Royal Navy.

The Christmas Island tests, remarkably successful in that they achieved something which neither of the other nuclear powers had achieved in their own tests – a first megaton-range explosion that was also a first air-drop of the device, had their origin in decisions taken during 1954. These decisions were reached by a familiar process – a recommendation by a group of scientists whose report was considered by the Chiefs of Staff, who in their turn made recommendations to the Cabinet Defence Policy Committee, which approved the recommendations and took the decision to authorise hydrogen bomb production. However, that decision was kept secret – except from those who had a need to know, like the Air Staff, who a month later issued a Requirement for a thermonuclear bomb. Not until early in 1955 was the British Government's decision to proceed with development and production of these weapons made public, though the Prime Minister (Sir Winston Churchill) had earlier recognised their awesome significance. "The advance of the hydrogen bomb", he had said in the Commons debate on the Queen's Speech on 1 December 1954,

"has fundamentally altered the entire problem of defence, and considerations founded even upon the atom bomb have become obsolescent, almost old-fashioned. Immense changes are taking place in military facts and in military thoughts. We have for some time past adopted the principle that safety and even survival must be sought in deterrence rather than defence . . . and this, I believe, is the policy which also guides the United States . . ."<sup>1</sup>

Here was a link expressed between the policy of deterrence, already accepted by the British Government with the procurement and deployment of bombers capable of delivering nuclear weapons, and the

<sup>1</sup> Commons Hansard for 1 December 1954, Col 176, which printed "sought in deterrents rather than defence". However, 'deterrence' would sound the same as 'deterrents' and makes better sense.

adoption of new atomic technology – leading to hydrogen bombs which combined the fission of the original device with the fusion of the later one, to create a destructive power a thousand times greater than that of the kiloton-range bombs which had destroyed the Japanese cities Hiroshima and Nagasaki. In taking this momentous decision the British Government was following the decisions previously made and implemented, in 1952 and 1953 respectively, by the United States and the Soviet Union.

The steps by which the UK Government reached its own decision have already been outlined in broad terms; these should be described in rather more detail in order to explain the background to the 1957-58 Grapple series of thermonuclear tests, in which the RAF played a leading part.

As an initial step in the scientific-military-political process of decision-making, a working party which included Britain's leading physicists and the Services' scientific advisers<sup>1</sup> had produced a report which was considered by the Chiefs of Staff in mid-1954. This report, which looked into the implications of manufacturing hydrogen bombs in the UK, came to the conclusion that there was a choice of policies – basically, either to continue with the existing programme of kiloton-range weapons and leave the production of H-bombs to the United States, or to start work additionally on a hydrogen bomb with the objectives of a test explosion in 1958 and subsequent production of Service weapons.

The Chiefs of Staff<sup>2</sup>, on the basis of this report, recommended to the Cabinet Committee on Defence Policy that a programme for producing hydrogen bombs should be put in hand, saying that if it were started straightaway a test of two weapons might be possible in 1958<sup>3</sup> – and that additionally the present projects should be continued. The Cabinet's Defence Policy Committee, under the chairmanship of the Prime Minister, accepted these recommendations at its meeting on 16 June 1954 and decided to authorise hydrogen bomb production – stipulating that no statement of Government policy in this matter should be made.

Once this policy decision had been taken, the way was clear for the relevant Ministries to take appropriate steps for its practical realisation. The Air Ministry issued an Air Staff Requirement for a thermonuclear bomb<sup>4</sup> and this was subsequently accepted by the Ministry of Supply, whose agency in the matter was the Atomic Weapons Research Establishment at Aldermaston. Only after the project was thus under way did the Government announce, in its *Statement on Defence* of February 1955<sup>5</sup>, that the United Kingdom was going to manufacture H-bombs. "The United States Government", it said, "have announced that they are proceeding with full-scale production of thermonuclear weapons. The Soviet Government are clearly following the same policy . . . . The United Kingdom also has the ability to produce such weapons. After fully considering all the implications of this step the Government have thought it their duty to proceed with their development and production".

Later in 1955 the RAF, as the 'user' Service, were given preliminary details of trials which the AWRE proposed to hold. During July the Air Council were told by DCAS (Air Marshal Sir Thomas Pike) that the Establishment was planning a series of atomic weapon trials from the spring of 1956 onwards – Operations 'Mosaic', 'Buffalo' (in which a Valiant would drop a Mk 1 weapon<sup>6</sup> and a prototype of a tactical weapon would be tested) and 'Green Bamboo', which would probably be in the spring of 1957. This last-named trial was the one which subsequently became known as 'Grapple'.<sup>7</sup> DCAS said that AWRE had already asked for air support for Mosaic and Buffalo, and that the RAF would almost certainly be asked to undertake similar tasks for the third trial.

Subsequently the Secretary of State for Air (Lord de L'Isle and Dudley) was given more specific details about Operation 'Gazette', as Green Bamboo had then become known. He was told that the plan was to test a thermonuclear weapon, that the only likely area where this could be done was the south-west Pacific, and that one possible method was an air-drop from a Valiant over an uninhabited island. There was to be a photographic survey of a number of islands in the area of Christmas Island, in the middle of

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<sup>1</sup> Among its members were Sir John Cockcroft and Sir William Penney, who had played a leading part in British development of an atomic bomb. <sup>2</sup> The CoS memorandum to the Cabinet was signed by Admiral of the Fleet Sir Roderick McGrigor, MRAF Sir William Dickson and Lt-Gen Sir Harold Redman (VCIGS). <sup>3</sup> In fact the tests were started in 1957. <sup>4</sup> OR/1136, circulated on 15 July 1954. <sup>5</sup> Cmd 9391. <sup>6</sup> *ie* a Blue Danube. <sup>7</sup> Green Bamboo was changed to Gazette and then to Grapple.

the Pacific Ocean, just north of the Equator, to find a target area and an airstrip where the task force could be based.

The Chiefs of Staff were later (in December 1955) told that reconnaissance had shown that a satisfactory trial could be held using Christmas Island as a base, with a Valiant taking-off from there and dropping the assemblies for a high air burst in the vicinity of Malden Island, 400 miles to the south. They were also told that the devices to be tested were to form the bases of warheads which would be used in the free-falling megaton-range bomb, in the powered guided bomb (Blue Steel) and in the strategic ballistic missile (Blue Streak). It can be seen, therefore, how important were the implications of the Christmas Island tests for the future of the British nuclear weapons programme. The AWRE wished to 'try out' as many devices as it could during them, especially as – in a climate of international resistance to nuclear weapon testing – there might not be another opportunity.

The Chiefs of Staff agreed at their meeting on 20 December 1955 to the trials proposals and also to the appointment of a senior Service officer as operational commander for the tests. Originally an admiral was to fill this post, but in view of the importance of the RAF role the decision was changed in January 1956 and the following month Air Vice-Marshal W E Oulton (promoted from air commodore) was appointed Task Force Commander for Operation Grapple.

During April 1956 the Air Council were told by DCAS that the Government had agreed that plans should be made for a series of nuclear test explosions in 1957, of a megaton weapon. They were to take place in the vicinity of Malden Island in the south Pacific, the advanced air base for the operation being Christmas Island, while a main base would need to be set up in Australia – probably at Edinburgh Field.<sup>1</sup> Weapons to be tested would have to burst in the air to minimise fall-out problems; they would be released from a Valiant flying at about 43,000ft for a high air burst. The Ministry of Supply would be responsible for the tests, the RAF providing the Task Force Commander.<sup>2</sup>

In the following month, on 12 May, SASO, Bomber Command,<sup>3</sup> gave details of what bomber forces would be involved in Operation Grapple – Nos 49 (Valiant B.1), 76 (Canberra B.6) and 100 (Canberra PR.7) Squadrons.<sup>4</sup> Then in June the Prime Minister (Sir Anthony Eden) made a Parliamentary statement about the tests.<sup>5</sup> He told the Commons that holding them was “an essential part of the process of providing” the United Kingdom with thermonuclear weapons. The US and USSR had already held such tests and the Government had decided to carry out “a limited number of . . . test explosions in the megaton range”. The tests would take place in a remote part of the Pacific, far from any inhabited islands, and would be high air bursts which would not involve heavy fall-out.

No 49 Squadron, which had been re-formed in May for atomic weapons trials, began its training for Grapple at the beginning of September – being already involved in Operation 'Buffalo', the air drop of an atomic weapon from Maralinga, South Australia (July–November 1956). This training, however, could not be completed in the UK owing to adverse weather conditions but was rounded-off after the squadron's four Valiants arrived on Christmas Island in March 1957.

Bomber Command's Administrative Instruction, issued at the end of 1956, showed the size of the air effort in Operation Grapple – the Command's element of the Task Group being responsible for “the air drops, cloud sampling, high-level meteorological reconnaissance and cloud tracking, together with limited high-level photography of each burst”. Further, cloud samples were to be flown to the UK in Bomber Command aircraft.<sup>6</sup> These samples were to be obtained at as great a height as possible; AWRE had been told that it was hoped to obtain them in Canberra B.6s at from 50,000 to 53,000ft. For this task, aircrew were to have special oxygen equipment and flying clothing.

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<sup>1</sup> RAAF station near Adelaide. <sup>2</sup> Note by DCAS of 11 April 1956 for Air Council (AF(56)24).  
<sup>3</sup> AVM S O Bufton. <sup>4</sup> Nos 49 and 76 Sqs were also participating in Operation Buffalo. <sup>5</sup> Commons Hansard, 7 June 1956, Col 1283. <sup>6</sup> The crew of a Canberra PR.7 of No 58 Squadron, Pilot Officer J S Loomes and Flying Officer T R Montgomery, were fatally injured on 16 May 1957 when making a GCA landing attempt in inclement weather at RCAF Goose Bay, Labrador, en route to the UK with cloud samples. Undoubtedly anxious to get these back as quickly as possible, they had had no proper sleep in the previous 26 hours and no proper meal for the previous 18 hours. (Squadron ORB and Casualty File 441666/57).

The Canberras were also to operate at comparatively low level. An operation order issued by Task Force HQ a week before the first test<sup>1</sup> said that post-burst reconnaissance of the target area was required, to assist with an immediate assessment of correct weapon functioning. The Canberras were to "reconnoitre Malden Island and ground zero" from a height of 2,000ft fifteen minutes after the explosion. They were to note (among other things) whether there was a large sea wave, whether visibility was clear under the nuclear cloud and what the state of the island's surface was.

The air samplers were Canberra B.6s of No 76 Squadron and the meteorological Canberras were PR.7s of No 100 Squadron, the latter being responsible for up-to-the-minute weather information prior to the drops and for post-burst photography after them, the former for high-level air sampling and a close look at the target area following the thermonuclear explosion above it.<sup>2</sup>

Two of No 49 Squadron's white Valiants (anti-flash paint having been applied as part of their pre-Grapple preparations) were got ready for the first live drop of a British megaton bomb: one was to carry and release it, the other to act as a 'grandstand' aircraft, giving its crew the experience of flash and blast from a thermonuclear weapon explosion.

No 49 Squadron had done three practice drops with 10,000lb weapons loaded with high explosive; then, at 0900hr 'V' time<sup>3</sup> on Wednesday, 15 May, the CO (Wing Commander K G Hubbard) and his crew<sup>4</sup> took off with a live thermonuclear weapon in its bomb bay. After the climb-out from Christmas Island and a southerly course for Malden Island, anti-flash screens were put into position prior to the first run over the target area; then, after this had been made to check the telemetry equipment, the Task Force Commander gave permission for the 'live' run – which was made at 45,000ft on a course of 203°T, the weapon being released at 1036hr 'W' time.<sup>5</sup> Immediately the Valiant was put into an escape manoeuvre – a 60°-bank turn, pulling 1.8-1.9G and rolling-out on a heading of 073°T after 38 sec, the aircraft being 8.65nm from the burst when that occurred. Inside it, no effect of flash was felt, and the air blast reached it 2.5min after release of the weapon – the effect of this blast being to produce a period of five seconds when turbulence resembling slight clear air turbulence was felt. Six minutes after the release the screens were removed and the Valiant did an orbit to observe the mushroom cloud effect, before returning to its Christmas Island base.<sup>6</sup>

A British thermonuclear bomb, developed by the AWRE, had thus been successfully tested in a trial which had been a major co-operative effort by the Establishment,<sup>7</sup> the RAF, the Royal Engineers<sup>8</sup> and the Royal Navy. To emphasise that the 15 May achievement was no one-off success, No 49 Squadron dropped two more live weapons – on 31 May and 19 June – and summed-up the megaton tests succinctly in its ORB at the end of the latter month: "Operation Grapple is now complete and it can be said that the squadron met its task in every respect. After months of specialised training the squadron occupied a section of coral strip in the Pacific and successfully dropped the first three 'H' bombs of British design . . ."

As far as AWRE were concerned, the success of the Grapple tests meant that its experimental assemblies had been proved, though the design had still to be developed into a production megaton bomb. As far as the RAF were concerned, the first Grapple trial – Grapple 'X' was to follow later in 1957 and 'Y' and 'Z' in 1958 – meant that Bomber Command would have a British megaton weapon capability by 1958.

What in fact happened was that Bomber Command received an 'interim' megaton weapon in the spring of 1958 and that in the summer of that year the Air Staff accepted a megaton weapon for introduction

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<sup>1</sup> Operation Order No 12/57 of 8 May 1957. <sup>2</sup> The No 76 Squadron ORB described how, ten seconds after the bomb burst, its B.6 which had been acting as an emergency radio link between Christmas and Malden Islands began "a maximum-rate descent" towards Malden and then "maintaining 2,000ft . . . continued towards the target area . . .". <sup>3</sup> ie the International Time Zone 'V', which was Sitka (Alaska) time. <sup>4</sup> Its members were Fg Off R L Beeson (2nd pilot) and Flt Lts A Washbrook, DFC (navigator), E J Hood (observer) and E Laraway (signaller). <sup>5</sup> In the 'W' ITZ, which was Hawaii time. <sup>6</sup> The flying time was 2hr 20min, the aircraft was XD818 and the weapon dropped was Green Granite. <sup>7</sup> Which planned the trials in order to test a thermonuclear weapon and prepared the experimental assemblies. <sup>8</sup> Who prepared the facilities at Christmas Island for the tests: see the *History of the Corps of Royal Engineers* – Chapter X, The Nuclear Test Programme.

into service on a limited-approval basis, for use by Vulcans operating from UK bases. This meant that the RAF was receiving its latest weapon "hardware" – a thermonuclear bomb – four years after the Air Staff's Operational Requirement for it had been accepted by the Ministry of Supply in July 1954. The OR had asked for this bomb to be in service by the end of 1959, so it was coming into service nearly 18 months earlier than requested, which was in line with Air Staff policy in this matter. During September 1957 the Deputy Chief of the Air Staff (Air Marshal Sir Geoffrey Tuttle) had written to DGAW (Director-General, Atomic Weapons)<sup>1</sup> to say that the RAF wanted to have megaton weapons in service as soon as it could get them; to this end they wished to have as many of the "interim" type as possible before the weapon which fulfilled the OR completely became available. In the event, the RAF received its thermonuclear bombs in three stages. The first of these – the "interim" type – consisted of a megaton-range warhead in a Blue Danube casing, so that externally it looked like the Mk 1 kiloton bomb. This weapon was known as 'Violet Club' and with it (although only a few were made) Bomber Command could claim to have a megaton-weapon capability from early 1958 onwards. The AOC-in-C (Air Chief Marshal Sir Harry Broadhurst) was informed during February that the first was being assembled at the Bomber Command Armament School, Wittering, and that it was expected to be complete by the end of the month;<sup>2</sup> but he was advised that it was "in some degree experimental" and subject to handling restrictions and operational limitations – though it provided "a megaton deterrent capability several months earlier than would otherwise have been possible". The second stage was the first version of Yellow Sun, developed to the Air Staff's OR and – like Violet Club – employing a warhead which had been tested in the Grapple trials. The major differences between these two megaton bombs, available to Bomber Command – though in the case of Violet Club, only to the Vulcans – from 1958 onwards, were that Yellow Sun was smaller and lighter – about 7,000lb as against 11,000lb.

The importance of the success of the Grapple trials in bringing-about the introduction of these megaton weapons into Bomber Command was twofold: first in the testing of British warheads, thus demonstrating publicly a national hydrogen-bomb capability; secondly in the entrée afforded by the tests – Grapple Y in April 1958 and Z (the last) in September both included air drops by Valiants of No 49 Squadron – to American nuclear weapon technology. For during August and September of that year members of the relevant Ministry of Defence and AWRE (Atomic Weapons Research Establishment) staffs went to the United States for what was the first US-UK interchange of information on nuclear warheads<sup>3</sup> – an historic liaison indeed, considering the long US isolation in atomic energy matters<sup>4</sup>. It seems clear that the Christmas Island proof of British hydrogen-bomb technology had impressed the Americans enough to share their own warhead information, and the US-UK Exchange Agreement which resulted was a parallel at the scientific/engineering level to the military Memorandum of Understanding between the USAF and the RAF in the preceding year (1957) on the co-ordination of nuclear strike plans and the supply of US atomic weapons to the RAF<sup>5</sup>.

What this Exchange Agreement and the transatlantic discussions led to was nothing less than a new type of megaton warhead for British bombs, following the advanced technical and design information which the Americans had made available. In simple terms, this was a tube-shaped capsule, by contrast to the British kiloton and megaton warheads; and as the British shape had dictated the size of the long, streamlined Blue Danube carcass which housed both types of warhead, so the 'Anglicised' American warhead meant that the first 'production' megaton bombs – that is, Yellow Sun Mk 2 with the Red Snow warhead (as the capsule was called) – would be considerably smaller than their predecessors. Production began early in 1961 and the first deliveries were made during that year, giving the Vulcans initially

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<sup>1</sup> Mr E S Jackson. <sup>2</sup> In fact it was completed later than this. ACAS(OR) was informed on 19 March that it was due for completion on that date. Though originally known as Violet Club (code-name for its warhead), this interim megaton weapon came to be referred to throughout the RAF as Yellow Sun Mk 1. <sup>3</sup> Progress Report on Weapon Systems not yet Fully Released. <sup>4</sup> The McMahon Act of 1946 had been designed to secure an American monopoly of nuclear weapons, until international control of them could be achieved. When the Americans supplied them to Britain from 1958 they retained custody through USAF personnel on RAF bases. The "severe provisions" of the Act were amended in 1958, when President Eisenhower "succeeded in carrying an amendment" through Congress (Mr H Macmillan, 30 January 1963 – Commons Hansard, Col 958). <sup>5</sup> Finalised late in 1958 and to be referred to later.

and then the Victors an emergency operational capability with the new weapon, which offered a full megaton yield, use anywhere in the world by the V-force and greater handling safety for armament personnel.

Red Snow was an extremely important addition to the V-force armoury, for it was not only the warhead for the Yellow Sun Mk 2 megaton bombs but also for the Blue Steel stand-off bomb. Thus it was a main component of the weapons carried by the V-bombers during their most developed stage, in the 1960s.

While the RAF were acquiring it, through technological co-operation with the Americans, a parallel military co-operation with the Americans had been going on which led (as has been said) to a USAF-RAF co-ordination of nuclear strike plans and also to the supply of US atomic weapons to the RAF. However, these results were not achieved without a great deal of discussion, and when the latter arrangements became a reality – affecting Valiants of the Tactical Bomber Force, Canberras of the RAF Germany strike squadrons and Main Force Vulcans and Victors with free-fall bombs – the US Air Force did not let the weapons out of their sight.

The RAF had been the suitors for this union between the two strategic bomber forces. At the end of 1956 the Chief of the Air Staff (Air Chief Marshal Sir Dermot Boyle) told the Chiefs of Staff<sup>1</sup> that he and his predecessors had been trying for some years to persuade the USAF to begin joint planning for the use of the American and British strategic air forces, but that until recently there had been little progress, mainly because the Americans had been unwilling to discuss the subject until there was a British medium bomber force in existence. But earlier that year, having realised that the V-force was becoming a reality, they had sent a team of senior USAF officers to London to discuss with the Air Ministry both the co-ordination of nuclear strike plans and also the provision of US nuclear weapons to the RAF in the event of war. This meeting was held in mid-August and at it outline arrangements for putting these measures into effect were approved, plus a concept of allied nuclear operations, with an outline plan of action for them.

Thereafter a great deal of discussion by correspondence across the Atlantic ensued, between Chiefs of Staff, Secretaries of Defence and (finally) the President and Prime Minister, resulting in a Memorandum of Understanding between the US Air Force and the Royal Air Force of May 1957, which became the working basis for all future co-operation between them on atomic plans and weapons.

Co-operation between the RAF and USAF bomber arms had been close at working level since 1951, when Bomber Command crews flew in B-29s (Washingtons) at the 3rd SAC Bombing Competition at McDill AFB, Florida. After the V-bombers came into service the RAF participated in Valiants and Vulcans,<sup>2</sup> and SAC aircraft had taken part in UK defence exercises and Bomber Command competitions. Also, Western Rangers – single RAF bombers flying to USAF bases – had become a regular feature of V-force training. But until the Memorandum of 1957 there had been no consultation between the two air forces on their offensive plans – although this seemed logical, as in the event of war they might be aiming for the same targets, and co-operation would improve coverage by obviating duplication – and there had been no use of American nuclear weapons by the RAF or any sharing of weapon information. So the Memorandum, which was in two parts – the first dealing with the co-ordination of operational plans and the second with the supply of US atomic weapons to Bomber Command, was an important innovation: not only a kind of watershed in the history of the V-force, implying American recognition of its existence and capability, but also a basis for the future planning of strategic air operations.

This planning was to be done through SAC-Bomber Command conferences which would co-ordinate the contribution of the two air forces to an overall offensive, and after it had been launched a Joint Co-ordination Centre Europe would be responsible for co-ordinating strategic nuclear attacks. The Memorandum made it clear that when the term “Bomber Command forces” was used it applied to the Command’s “atomic-capable medium bombers . . . not committed to NATO”.

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<sup>1</sup> COS(56)451, 31 December 1956. <sup>2</sup> In 1957, then with Valiants in 1958. The next participation, with Vulcans, was in 1966.

The second (and much longer) part of the Memorandum, dealing with the provision of US atomic weapons, made it clear that United States law required that these should be retained in the custody of US personnel, who should "perform all functions incident to storage, maintenance, modification, operational readiness and internal security". In other words, though such weapons were to be supplied to the RAF, the Americans – acting under legal constraints – were not prepared to let them out of their sight. As a logical corollary, US personnel were to control access to all storage sites and maintenance facilities. Only the US President had power to transfer custody to the RAF. Subsequently, a parallel agreement was entered into between the two air forces for the supply of US atomic weapons to the Canberra forces, both in Bomber Command and 2nd TAF.

One interesting feature of the second part of the Memorandum was its reference to an Alert Force, stating that "SAC and Bomber Command are encouraged to employ the principles of dispersal and alert to the extent permitted by their combat crew and support manning" – that is, as far as their human resources would allow – "and based upon their own assessments of force vulnerability as a function of force location and probable warning time": in other words, putting the aircraft where, in terms of place and advance notice of attack, they would be considered least vulnerable.

It is arguable that these 1957 agreements with the Americans, resulting in a sharing of operational secrets, led to a tightening-up of RAF procedures for dispersal and readiness, for it was in 1957 that Bomber Command was directed to introduce a readiness capability into V-force squadrons. On 7 July the directive given was for three kinds of warning: strategic – 24 hours' notice, after which 75 per cent of the force should be at readiness, armed and dispersed; tactical – 40 minutes' (capable of being sustained for a month) and/or 15 minutes' (capable of being sustained for a week); and notification of an emergency, which meant that the generation rate of aircraft on medium-bomber stations was to be 20 per cent in two hours, 40 per cent in four hours, 60 per cent in eight hours and 75 per cent in 24 hours. These conditions, based upon a total of 36 airfields, were to be met – it was stated at the time, the instructions being confirmed at a meeting between the Minister of Defence (Mr Duncan Sandys) and the Secretary of State for Air (Mr George Ward) on 21 July 1958 – at any time of the day, at weekends or on holidays throughout the year. This meant that more manpower was needed, to support the introduction of a two-shift/18-hour working day, and the establishments in various trades were increased – for example, that for air radar fitters, and that in non-technical trades like drivers, ATC personnel, firemen and cooks – while that for aircraft servicing chiefs was doubled. The new working arrangements to support the V-force readiness capability were introduced at the main stations during 1959; the Bomber Command Operations Centre was re-organised, making it capable of directing the conversion of the strike forces from peace to emergency readiness conditions, and of controlling a nuclear attack should one ever be required; and early in May 1959 a full-scale practice of the Command's alert and readiness plan took place.

This was Exercise 'May Flight', from 4 to 8 May, the last major exercise to be held during the command of Air Chief Marshal Sir Harry Broadhurst, who had brought his long Fighter Command experience of alerts and 'scrambles' to bear on the V-force: he was succeeded on 20 May by Air Marshal K B B Cross, formerly AOC No 3 Group, who was thus to hold command during the period of close collaboration with the USAF SAC.

May Flight was held within the framework of Bomber Command's Alert and Readiness plan; it involved all the V-force squadrons except those with tanker or reconnaissance roles, and also RAF Feltwell, base of the first Thor strategic missile squadron, No 77, which had been formed on 1 September 1958 and to which its three launch emplacements had been handed-over during March 1959. After this initial inclusion the Thor force, as it built up, was to be included in the Command's future alert and readiness exercises.

May Flight envisaged a situation of political tension immediately prior to the outbreak of a global war; the actual attack on the United Kingdom was to be simulated by Canberras from RAF Germany. The medium bomber force was to be alerted and dispersed; then, after a period of readiness, which included practices up to engine starting or taxiing up the the take-off point, a final scramble was ordered – the V-bombers taking-off on an operational profile mission, from which they would land back at their parent bases. At that time, these six Class 1 stations were using ten dispersal airfields: Honington had Bedford

and Lyneham; Cottesmore, Boscombe Down and St Mawgan; Waddington, Leeming; Wittering, Pershore and Gaydon; Marham, Filton and Yeovilton; and Scampton, Lossiemouth – those dispersals within 100 miles of Class 1 bases being termed 'near' and those over 100 miles away 'distant'. From the logistic implications of these dispersed sites – providing accommodation, food, technical backing and security guards – it can be seen what a big effort (subsequently increased, when the total number of airfields available to the V-force rose to 36) was being devoted to the physical embodiment of an alert and readiness plan in Bomber Command's operational policy and training for the V-force. It was this realistic capability that the Commander-in Chief could present to the US Air Force in discussions about the co-ordination of nuclear strike plans.

But before the first part of the RAF/USAF Memorandum could be implemented, in the sense of co-ordinating the Bomber Command/SAC operational objectives, the UK Chiefs of Staff decided that strategic target policy should be examined – in the light of potential targets and the ability of the medium bomber force to attack them – before the Chief of the Air Staff discussed the co-ordination of plans with his USAF opposite number and with Saceur.

The resulting memorandum on strategic target policy<sup>1</sup> pointed out that, in the event of Soviet aggression and immediate nuclear retaliation by the West, the first strike would be made by bomber forces based in the United Kingdom and on 'peripheral' USAF bases – preceding by some six hours any counter-attack mounted by SAC aircraft based in the United States. The conclusion was, therefore, that the allocation of particular targets between SAC and Bomber Command should be determined by considerations of timing, tactics, aircraft performance and weapon availability.

This memorandum was endorsed by the Chiefs of Staff in October 1957, and subsequently approved by the Minister of Defence as a basis for planning; and early in 1958 meetings were held between SAC and Bomber Command, with Air Ministry representation. What transpired when the plans of the two strategic bomber forces were examined was that every Bomber Command target was also on SAC's list for attack, and that strikes on selected targets had been 'doubled up' by each force to ensure success. What resulted from this comparison was that an integrated plan was produced, which took into account Bomber Command's ability to be over its targets in the first retaliatory wave several hours in advance of the main US-based SAC force. Under this combined plan<sup>2</sup> the total strategic air forces at the Allies' disposal were considered sufficient to cover all Soviet targets, including airfields and air defence installations. Bomber Command's contribution was defined as 92 aircraft by October 1958, increasing to 108 by June 1959, and 106 targets were allocated to the V-force. During the 1959 defence debate the Minister of Defence (Mr Duncan Sandys) quoted the SAC commander, General Thomas S Power, as saying that this force, "with its high-performance jet aircraft and thermonuclear weapons" was "an essential element of the Western deterrent" and had "an important place in our joint operational plans, which are now fully co-ordinated". Referring to speed of response and the geographical location of the V-force, General Power said that "should the free world ever be attacked by the Soviet Union, rapid reaction would be vital. Having regard to Britain's closer proximity, we rely on her V-bombers to provide an important part of the first wave of the Allied retaliatory force".<sup>3</sup>

In addition to the co-ordination of war plans, with the US Joint Co-ordination Centre at Ruislip as the US Chiefs of Staff agency in the United Kingdom for co-ordinating atomic strike forces, other co-operative measures were studied: use by the two air forces of each other's bases, integration of Intelligence warning and post-strike recovery. SAC and V-force operations were to be dovetailed in terms of routes and timing and ECM tactics, and Thor strike capability co-ordinated between the RAF and USAF. These joint plans were to be effective from 1 October 1958.

During the next year the number of Bomber Command dispersal airfields continued to increase (there were eventually 36, including the six Class 1 bases)<sup>5</sup> and the time taken for V-bombers to get airborne

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<sup>1</sup> COS(57)224, 16 October 1957. <sup>2</sup> The first since the Combined Bomber Offensive of 1943-4. <sup>3</sup> Commons Hansard, 26 February 1959, Col 1419. <sup>4</sup> CoS Memorandum on Co-ordination of Anglo/American Nuclear Strike Plans, 5 June 1958 (COC(58)148). <sup>5</sup> Listed in an Air Ministry/Treasury communication of 21 October 1960 giving a figure of £2.079m as estimated cost of the works services required to provide requisite facilities.

to decrease. The Air Minister (Mr George Ward), referring to V-force operational readiness, told the Commons on 3 March 1960<sup>1</sup> that a year earlier he had spoken of "new techniques . . . being developed to enable four V-bombers to get airborne within six minutes", adding: "In the very next month we were able to show that we could get four aircraft into the air from one airfield<sup>2</sup> in less than four minutes, and this achievement has been repeated regularly in realistic exercises held throughout Bomber Command during the year . . . We are already working on the equipment and installations which will enable us to get this time down lower yet . . .".

The implications of the RAF-USAF Memorandum of Understanding of 24 July 1957 had been studied and reported on at a Bomber Command-Strategic Air Command conference held during 19-22 May 1958, the main purpose of which was to complete the co-ordination of atomic strike plans and combat operations for the period from 1 July 1958 to 30 June 1959. At this conference, each Command's operational plans were compared in detail, to eliminate possible conflicts; and procedures were considered for maintaining co-ordination as plans changed. There were also discussions on further action in certain areas, including reconnaissance, countermeasures and targets for the Thor force. There could hardly have been closer co-operation, in peacetime, between two bomber arms; and the plans made could hardly have failed to improve their combined and individual effectiveness, principally in eliminating the duplication of attacks and in ensuring the coverage of the greatest possible number of targets, some of which – those considered to be of high priority – were jointly assigned. In sum, co-ordination had resulted in an operational plan considered to be workable and to have a high probability for success – should its execution become necessary.

The subsequent implications of Anglo-American strategic bomber co-operation could be seen when the AOC-in-C Bomber Command (Air Marshal Sir Kenneth Cross) announced in the autumn of 1961 that from the beginning of the following year a permanent alert would be instituted in the Medium Bomber Force, and that this would provide the opportunity for "closer integration with the SAC Reflex forces" in the UK.

Writing to the VCAS (ACM Sir Edmund Hudleston) on 31 October 1961<sup>3</sup> the C-in-C said that it seemed only military commonsense to maintain some form of permanent alert concept, in the face of a growing threat and the need to build up experience to compete with greatly reduced warning time during the coming years. He added that it also gave the opportunity of closer integration with the SAC Reflex forces, "thus taking full advantage of our combined strengths and the combined effects of our ECM equipments, especially during the critical phase of penetrating the enemy's outer radar defences".

The C-in-C said he proposed to institute the permanent alert early in 1962, starting with one aircraft per squadron, or approximately 15 aircraft from the MBF. With the gradual reorganisation of servicing procedures it should be possible to build up the number of aircraft at standby gradually; by the end of 1962 he aimed to have two aircraft per squadron, or 30 aircraft in the force, permanently at 15 minutes' readiness. He added that the readiness of the Thor force had been improved; it was now possible for 65 per cent of the strategic missiles to be maintained permanently at 15 minutes' standby – a good average at permanent readiness was 45-50.<sup>4</sup> "This", he commented, "coupled with 30 aircraft, mostly armed with megaton-range weapons, would give a total force of 75-80 weapons systems at 15 minutes' readiness by the end of 1962" – adding that "such a force . . . poses a real deterrent".

At the end of 1961 the Air Council approved in principle<sup>5</sup> the proposal to maintain one aircraft in each medium bomber squadron at 15 minutes' readiness, though consideration of the proposal to increase this to two aircraft per squadron towards the end of 1962 was deferred, since there were many manpower, cost and other problems. This permanent readiness force, to be effective from the beginning of 1962, was subsequently referred to as the "QRA Commitment".<sup>6</sup>

USAF Strategic Air Command B-47 Reflex operations had begun in 1958 – at Fairford and Greenham Common during January of that year and at Brize Norton in April, succeeding the former "90-day

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<sup>1</sup> Commons Hansard, Col 1439. <sup>2</sup> There were four V-bombers at each dispersal. 'Scramble' times eventually improved to under two minutes. <sup>3</sup> BC/TSD.89347/CINC, in file of Operational Readiness in the RAF (90/18). <sup>4</sup> Out of 60. <sup>5</sup> 7 December 1961, Conclusions, 23(61), Secret Annex. <sup>6</sup> Minute, DGO/AMSO, 3 January 1962.

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rotational assignment". They continued until early in 1965, Brize Norton and Upper Heyford being the last two stations to support them, and 90 days later – on 30 June 1965 – the controlling SAC formation in the UK, HQ 7th Air Division at High Wycombe, was discontinued.

Thus, up to 1965, the V-force – and in particular that element of it which was on QRA – would have gone into action with the 'peripheral' forces of Strategic Air Command (that is, those based outside the continental United States) in the first wave of the nuclear deterrent bomber retaliatory force, together with the UK/Italy/Turkey-based Thor/Jupiter missiles, in the event of a Soviet bloc nuclear strike against the NATO Powers. This would have represented the practical end-product of the RAF-USAF co-ordination of nuclear strike plans, agreed in principle under the Memorandum of Understanding of 1957, and from 1958 – when Bomber Command-SAC co-ordination conferences were held – implemented in planning and training.

## CHAPTER 11

**The 'Second Generation' (B.2 Vulcan and Victor) V-bombers and their Significance (1961-1969)**

An Air Ministry/Ministry of Defence communication early in 1957 linked up neatly the question of co-ordination between RAF and USAF strategic bomber forces with that of the equipment which would be needed by the V-force to maintain its operational viability in subsequent years. The writer<sup>1</sup> made the points that Bomber Command was "only on the threshold of the development of joint operational plans . . . with Strategic Air Command"; that since it was accepted that the UK must possess a nuclear deterrent of its own, this must "as long as bombers are needed depend upon the highest quality of bomber"; and that the Mk 1 Victors and Vulcans would reach the limit of their operational roles sooner than the Mk 2s, "because of the improved aerodynamic performance of the latter".

What were the aspects of the Vulcan and Victor B.2s' improved performance which made them such a significant acquisition by the V-force from 1960-1962? (The first Vulcan B.2 went to No 230 OCU at Waddington on 1 July 1960 and the first squadron to receive the type was No 83 at Scampton on 23 December of that year; likewise the first Victor B.2s went to RAF Cottesmore for trials and crew conversion. First squadron to receive the type was No 139 at Wittering on 1 February 1962).

Long before both these types came into service a paper which had been put forward<sup>2</sup> arguing the case for having 120 of them in the V-force front line had pointed out their operational advantages over the Mk1s: greater (5,000-8,000ft) altitude, larger (some 200-350nm) radius of action, better (by about 1,000yd) take-off performance and ability to carry the Blue Steel stand-off bomb.<sup>3</sup> In specific terms, both the B.2 versions had a Service ceiling of about 60,000ft, maximum speed of Mach 0.98 (Vulcan) or 0.92 (Victor) and an unrefuelled range of 4,600 miles. The key factor in bringing about this greatly improved performance had been the increased thrust achieved by the manufacturers of their jet engines: thus the Bristol Siddeley Olympus powerplants in the Vulcan had gone up from 11,000lb thrust as originally installed to 20,000lb (Olympus 301s)<sup>4</sup> in the B.2, while the Victor's power had likewise increased from 11,000lb to 19,750lb thrust (Rolls-Royce Conway R.Co.17 Mk 201s) in its B.2 version. More power meant bigger engines, which meant considerable re-design work to accommodate them in the aircraft.

The transition from B.1 to B.2 Vulcans and Victors wasn't, however, a neat single-step progression; there was an extensive programme of B.1 improvement which resulted in the B.1A, and this went on concurrently with the production of B.2s: it was a reaction to the strategic situation and the availability of greater engine power. Once the B.1 Vulcans and Victors were in squadron service in significant numbers, by 1958, aircraft were progressively returned to the manufacturers for modification. Explaining the reason for this policy and how it affected the Vulcans, the then AOC No 1 Group (AVM D B Craig<sup>5</sup>) said in a lecture during 1980<sup>6</sup> that Intelligence estimates about continual improvements in the Soviet Union's air defence capabilities "meant that the Air Staff were strenuously pressing for improvements" to the B.1s, and their efforts had been "rewarded in two main ways":-

"First, from 1959 until March 1963 some 29 B.1s were individually withdrawn from the front line to be converted to B.1As. This involved fitting ECM equipments in order to improve the aircraft's ability to penetrate enemy air defences in safety. The bulk of the kit was carried in an enlarged and extended tail cone, and a flat ECM aerial plate was mounted between the two starboard jet pipes. Flight-refuelling equipment in the receiver role was also installed during this modification programme.

"Secondly, a dramatic increase in engine power became available as a result of further work by Bristol on their Olympus. The Mk 1 aircraft had only 11,000lb.s.t. per engine (Mk 101), and during 1957-1958 plans had been prepared to provide rocket-assisted take-off (RATO) for the MBF to ensure adequate

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<sup>1</sup> AUS(A)/TS217 - R G Melville, AM/F W Mottershead, T (24 April 1957). <sup>2</sup> To MoD from AM, 29 May 1957. <sup>3</sup> Which the B.1s could have carried, but only after "extensive and expensive" modification (*ibid*). <sup>4</sup> Precursor of the Concorde engine (Olympus 593). <sup>5</sup> Later Air Chief Marshal Sir David (see Foreword). <sup>6</sup> On *The Vulcan in RAF Service*, to the RAeS Manchester Branch, 19 March 1980.

runway performance at the smaller dispersal airfields. By mid-1959 these plans were abandoned in the light of engine developments”.

The manufacturers themselves thus described <sup>1</sup> the metamorphosis from B.1 to B.1A:-

“The 45th and last Vulcan B Mk 1, XH532, was delivered on 30 April 1959, but this aircraft was much improved over the earlier machines. These and later improvements were retrofitted into the early aircraft, with the main additions being a higher-powered version of the Olympus engine, a large probe to allow in-flight refuelling and what was probably the most important addition, a large tail fairing containing ECM equipment. This installation brought about the aircraft’s re-designation to B Mk 1A”.

A parallel Victor B.1 improvement programme was put in hand, the historian of Handley Page<sup>2</sup> commenting that

“The Air Staff had declined a suggestion in 1959 to re-engine Victor B.1s<sup>3</sup> with 10,000lb s.t. Rolls-Royce Avon RA.28s, but gave full priority to rapid conversion of the last B.1s to a new standard incorporating ECM, . . . ; the modified aircraft were to be known as Victor B.1A and XH613 was allotted for trial installation of the retrofit modification . . . , which entailed revisions to the crew stations as well as the ECM equipment itself . . .”.

There were modifications to other aspects of the Victor in this programme:-

“During 1959 the basic Victor B.1 underwent several important changes; these included the provision of a flight refuelling probe, the fitting of drooped leading-edges, tail-warning radar, new ECM equipment under the nose and in the rear fuselage, and the strengthening of the pressure cabin. This modified aircraft emerged as the Victor B.1A . . . .<sup>4</sup>

Both the B.1As and the B.2s started to enter V-force service during 1960: the first Vulcan B.2, XH558, was delivered to No 230 OCU at Waddington on 1 July, the first Victor B.1A, XH613, to Cottesmore (Nos 10 and XV Squadrons) on the 22nd of that month and the first Vulcan B.1A, XH500, to No 617 Squadron at Scampton on 29 September, the squadron’s ORB commenting on its return “from Bitteswell to base after long modification to Mk 1A”.

It was therefore clear, as AVM Craig pointed-out in his lecture, “when we consider the parallel work on B.1s and B.1As, that there was no clear-cut switch from procurement of the . . . Mk 1s to the Mk 2s”. While he was referring to the Vulcan programme the same was true of the Victors: “The fortieth B.1, XH619, was completed at Colney Street<sup>5</sup> in May [1959], with the second B.2, XH669, close behind”<sup>6</sup>. AVM Craig went on to comment that

“as Bomber Command received its new marks of V-bombers into service, conversion courses, IFTs<sup>7</sup> and the formation and re-formation of squadrons were telescoped into a very tight time-scale . . . . Bearing in mind the parallel introduction of the Mk 1 and Mk 2 Victors, there was clearly great urgency and determination to develop and maintain the credibility of our contribution to the West’s deterrent strategy of massive nuclear retaliation in the event of an attack by the Warsaw Pact . . .”.

Among the requirements in the Ministry of Supply specification issued for the B.2 Vulcan and Victor<sup>8</sup> were that Blue Steel and “a long range powered bomb”<sup>9</sup> should be carried by them, and that all four engines should be capable of being started within two minutes, using an external power supply. This was crucially important in view of the later ‘scramble’ techniques employed under Bomber Command’s Alert and Readiness Plan. Self-contained starting was also to be provided. The Vulcan was to have Olympus engines of up to 20,000lb thrust at sea level, the Victor to have Conways of approximately 20,300lb sea level static thrust.

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<sup>1</sup> *The Vulcan Story* (BAe, 1981). <sup>2</sup> C H Barnes, *Handley Page Aircraft since 1907* (Putnam, 1976). <sup>3</sup> Which had Armstrong Siddeley Sapphire Sa7s. <sup>4</sup> *V-bombers*, by R Jackson (Ian Allan, 1981). <sup>5</sup> The Handley Page factory at Radlett, Hertfordshire. <sup>6</sup> C H Barnes, *Handley Page Aircraft since 1907* (Putnam, 1976). <sup>7</sup> “The differences between the Mk 1 and 2 variants were . . . sufficiently great to justify further in-service intensive flying trials, although previously it had not been usual to hold IFTs on new marks of existing in-service aircraft” (AVM Craig lecture). <sup>8</sup> No B 129P Issue 2 for Vulcan (K) Mk 2, 7 January 1958; and No B 128P Issue 2, 27 February 1958, for Victor B Mk 2. <sup>9</sup> To OR1159.

The main change involved, in both aircraft, as a result of these bigger powerplants was to increase the wing span and area – the Vulcan's dramatically from an original span of 99ft and area of 3,554 sq ft to a span of 111ft and area of 3,964 sq ft, the Victor's from a span of 110ft and area of 2,406 sq ft to a span of 120ft and area of 2,597 sq ft. The Vulcan B.2 was also fitted with four full-span elevons in place of the conventional ailerons and elevators. Both types had larger engine intakes to provide for the more voracious appetites of their powerplants, and both were equipped with flight refuelling probes. The Victor B.2 had a bigger conventional bomb load than the Vulcan B.2 – 35,000lb as against 21,000lb – because of its larger bomb-bay.

The much greater power available to the B.2s on take-off obviated the need for equipping the V-bombers for rocket assistance, which had been seriously considered by the Air Staff.<sup>1</sup> The writer of the letter already quoted<sup>2</sup> made a telling comparison when he said that in average UK temperatures the Victor 1 with a 10,000lb store "takes 3,000yd to clear 50ft". The comparable Mk 2 take-off distance was 2,080yd – an improvement of some 1,000yd. This was an important factor, especially where some of the shorter dispersal airfields were concerned.

At a Prime Minister's meeting on 30 May 1957<sup>3</sup> the Secretary of State for Air and the Minister of Supply, in consultation with the Chancellor of the Exchequer,<sup>4</sup> were authorised "to place firm orders for further Mk 2 type bomber aircraft . . . up to a total of 120 aircraft in all". This would mean a front-line total of 184 V-bombers, but the order for Victor B.2s was later to be reduced under circumstances which aroused great controversy.

One of the papers circulated in advance of the decision to order up to 120 Mk 2s<sup>5</sup> advanced several operational reasons for having these more powerful types of Vulcan and Victor. The increased height they could attain was of particular importance during the period – up to 1960/1961 – when fighters would provide the main opposition. Their greater radius of action (some 200–350nm), though it might appear small, increased the percentage of targets that could be attacked by as much as 25 per cent; and an advantage of greater range was that the Mk 2s could be routed indirectly to their targets to avoid known defences. When, by 1960/1961, the Soviet Union had developed SAGW defences the V-bombers would need to carry the Blue Steel stand-off bomb which the Mk 2s had been designed to accommodate. This weapon would weigh approximately 16,500lb, and the long-range version was estimated at that time to be likely to weigh 22,000–25,000lb. Either of these loads (though the latter was never in fact carried), plus about 4,000lb for the RCM installation planned, needed the thrust of around 20,000lb conferred by the Olympus and Conway powerplants.

Two stages were therefore foreseen in the operational deployment of the Mk 2 V-bombers, according to a paper prepared in the Air Ministry during the autumn of 1957:<sup>6</sup> the first, from approximately 1960/1961 to 1963/1964, when Blue Steel would be carried; the second, from 1963/1964, when it was expected that a longer-range powered bomb, to be developed to OR1 149,<sup>7</sup> would be in service. Blue Steel would be needed to attack targets from outside the range of SAGW (surface-to-air guided weapon) defences, though carrying it would reduce operating altitude to about 50,000ft and ranges to 1,600–1,800nm. Increasing efficiency of the defences would force the bombers to use indirect routes and reduce the percentage of targets they would be likely to reach by 50 per cent. In the second stage – Blue Steel was at that time expected to come into operational use by 1960, and target date for the OR1 149 weapon was 1963 – the bigger powered bomb would reduce the bombers' operational ranges to 1,400–1,500nm, but it was itself designed to have a range of from 800 to 1,000 miles, which would give its carriers greater capability of making indirect approaches and skirting the defences. This MoD paper averred that the Air Ministry would expect to begin forming Mk 2 V-bomber squadrons in September 1959 and complete the build-up to a full force of 13 squadrons/104 aircraft by March 1962.

In the event, neither these dates nor numbers, nor indeed more than one kind of powered bomb, eventuated; and it is important to trace the stages of what actually happened in this second phase of V-force history.

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<sup>1</sup> In 1958–1959 RATO was a firm requirement but in 1960 was put into abeyance. <sup>2</sup> AUS(A), 24 April 1957. <sup>3</sup> GEN.570/2. <sup>4</sup> *ie*, G Ward, A Jones and P Thorneycroft. <sup>5</sup> Operational Reasons for 120 Mk 2 Bombers, 29 May 1957. <sup>6</sup> Capabilities of the Mk 2 Bomber and Powered Bombs, 17 October 1957. <sup>7</sup> Air Staff Target for a long-range guided bomb with a range of about 1,000nm, eventually due to be fulfilled by Skybolt.

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As has been already stated, there was no clear-cut step from procurement of the B Mk 1 versions of the Vulcan and Victor to that of the Mk 2s; contracts during 1955 and 1956 provided for both types. Thus on 27 May in the former year Handley Page were asked to produce 33 Mk 1s; then the order was amended, for the aircraft to be "completed to B.2 standard", then re-amended to cover the manufacture of 25 B.1s and eight B.2s. In the latter year A. V. Roe received a contract on 30 April for 17 B Mk 2 Vulcans, on 1 June another one to convert eight Mk 1s to B(K) Mk 2s, and yet a third – for 24 B Mk 1s to be completed as B(K) Mk 2s. In June also (on the 14th) Handley Page received a contract to build 21 Victor B Mk 2s with Mk II Rolls-Royce Conway engines (RCo.11s), of 17,250lb s.t. This powerplant was the pioneer by-pass turbojet type of engine.

What primarily motivated the development of the Mk 2 V-bombers was the installation of these more powerful engines – the Conway in the case of the Victor, the up-rated Bristol Siddeley Olympus (increased to 20,000lb s.t.) in the case of the Vulcan – which involved re-design of the bombers' wing. But on the back of this major change the opportunity was seized to introduce new equipment, and the total changes made the Mk 2s substantially different from their predecessors – and much more costly to produce, aptly reflected in an official's comment at the end of 1958, pointing out that "very substantial increases [in expenditure] took place after April 1957 in our estimates for the Vulcan . . . and the Victor Mk 2. As you know", he continued,

"the original proposals for the Mk 2 aircraft covered only a modified wing and engines of greater thrust. The concept has grown over the years, however, and now embraces a number of important items of equipment, including RCM, the AC electrical system, and the Mk 10A autopilot".<sup>1</sup>

This "growth over the years" of the concept of the Mk 2 V-bombers, from being just more powerful to being more sophisticated as well, was documentarily charted by the issue of new specifications by the Ministry of Supply – all based on the original Operational Requirement, OR229. The first specification, B.35/46, for development of the Mk 1s, was issued in 1947; then came Specs No 128P for the Victor and No 129P for the Vulcan – production specifications issued on 25 September and 21 November 1952 respectively. Specifications for the B Mk 2 versions were issued by the Ministry of Supply early in 1958 – No B 129P Issue 2 for the Vulcan on 7 January and No B 128P for the Victor on 27 February – with the proviso that the specification "neither cancels nor supersedes Specification Nos B.35/46 and B.129P which were based on OR229". In both cases, the aircraft were to be carriers of the Blue Steel stand-off bomb, with an assumed weight of 15,000lb.<sup>2</sup>

Another fact which distinguished the Vulcan and Victor B Mk 2s from other Mark 2 versions of aircraft already in service was their subjection to Intensive Flying Trials. "It is not usual for IFTs to be held on new marks of existing aircraft", DDEng Plans wrote to the AOC-in-C Bomber Command on 29 May 1959, "unless there are major differences which make such a course advisable". In this case there obviously were. "The differences between Victors Mk 1 and 2 have been studied by concerned Air Ministry branches and are generally considered to be of sufficient magnitude to justify holding Intensive Flying Trials on the Mk 2 aircraft".

The branches clearly came to the same conclusion in the case of the Vulcan, for DDEng Plans wrote a similar letter to the AOC-in-C a fortnight later, on 12 June, saying that it had been decided that "the differences between the [Vulcan B Mk 2] and the Vulcan B Mk 1 are of sufficient magnitude to justify holding IFTs on the Mk 2 aircraft . . .".<sup>3</sup>

A. V. Roe made their second Vulcan prototype, VX777, into a B Mk 2 aerodynamic test vehicle and this "first flew with the new wing and toed-out jet pipes for the later Olympus engines on 31 August 1957".<sup>4</sup> Handley Page got their first Victor B Mk 2 into the air on 20 February 1959, and final conferences on both new types were held later that year – on the Vulcan B Mk 2 from 20 April to 1 May, and on the Victor B Mk 2 from 28 September to 14 October, but the new Vulcans didn't reach Bomber Command until July 1960 and the new Victors not until November 1961.

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<sup>1</sup> Asst Sec, Air B.2/AM, 3 December 1958. <sup>2</sup> In actual terms, 16,000lb. <sup>3</sup> C.113945/59 Pt II Intensive Flying Trials – Victor Aircraft. <sup>4</sup> *Avro Aircraft since 1908*, by A J Jackson (Putnam & Co, 1965).

As the new marks of V-bomber were received in the V-force, conversion courses, IFTs and the formation of squadrons were telescoped into a tight time-scale, once acceptance checks had been done on the aircraft. The first Vulcan B.2 reached No 230 OCU, Waddington, on 1 July 1960 and from the 18th of that month was being used for conversion flying – first, of staff crews, then of crews being converted from B.1s. On 10 October the first Vulcan B Mk 2 squadron was formed – No 83, at Scampton. At Waddington, the IFTs began on 14 November, the day after the first conversion course was completed; the aim was to do 1,000hr flying in three months, to prove both the aircraft and its equipment. Before the end of the year, on 23 December, No 83 Squadron received the first of its B Mk 2s – which meant that, technically, the V-force had its second-generation aircraft capability from the beginning of 1961, although the new aircraft would still be carrying free-falling bombs, not the stand-off powered bombs for which they had been designed.

The Victor B Mk 2's entry into service followed a similar pattern, the first aircraft going to No 232 OCU – though not at Gaydon, but to 'C' Squadron, based at Cottesmore – on 1 November 1961 and the second on the 7th. There, once acceptance checks had been done, conversion courses began and the first crews to complete them went to Wittering to join No 139 (Jamaica) Squadron – officially re-formed on 1 February 1962 as the first Victor B Mk 2 squadron, receiving the first of its new aircraft, XL231 (photographs of which appear in No 139's Operations Record Book), on that day. During April and May Intensive Flying Trials were conducted from Cottesmore with the Victor B Mk 2.<sup>1</sup>

The build-up of the Vulcan B.2 force in No 1 Group (at Waddington, Scampton and Coningsby) and of the Victor B.2 force in No 3 Group (at Cottesmore and Wittering) were clearly defined, with the Vulcans a year and a quarter in advance, three squadrons of them having been formed before the new Victors came into service. The first of the Vulcan B.2 squadrons, No 83, has already been mentioned; it was followed by Nos 27 and 617, and all three were in being by August/September 1961.<sup>2</sup> They therefore made up a Vulcan B.2 force before the first Victor B.2 had reached Cottesmore.

The main embodiment of these Mark 2 V-bombers occurred during 1962, when the Vulcans increased to their total strength of six squadrons – Nos 9, 12, 27, 35, 83 and 617 – and the two Victor B.2 squadrons, Nos 100 and 139, were formed. Five of these squadrons subsequently made up the Blue Steel force, from 1963 onwards – Nos 617, 27 and 83 at Scampton being its Vulcan component and Nos 139 and 100 at Wittering (squadron numbers being given in the order in which they converted from the free-fall to the powered-bomb role) its Victor element.

The B Mk 2 V-bombers therefore equipped the front line of the V-force in its strategic nuclear deterrent role for seven years, from 1962 to 1969, during the QRA/Blue Steel/low-level periods of operations, when both policy and its implementation were at their most intense. The plans to have 120 Mk 2s, in 15 squadrons,<sup>3</sup> were never in fact fulfilled; the UE (unit establishment) for the six Vulcan squadrons and No 230 OCU in 1963 was 50 and for the two Victor squadrons and No 232 OCU in the same period 17 – a total of 67.<sup>4</sup>

The reason why, when the Mk 2 V-bomber force was established, there were so many fewer Victors than Vulcans was because an order for 57 of the former had been cut by nearly half in mid-1960. On 25 July 1960 the Cabinet Defence Committee had decided that 25 of the 57 Victor Mk 2s on order should be cancelled, resulting in a total capital saving of about £14m over the next five years.

This decision came in the wake of the adoption of Skybolt as the principal UK deterrent weapon – a major change in defence policy, involving the abandonment of Blue Streak as an MRBM, announced by the Minister of Defence (Mr Harold Watkinson) on 13 April 1960 – and the preference, on technical grounds, for Mk 2 Vulcans rather than Victors as Skybolt carriers. As the Vulcans were expected to carry two Skybolts each, the reasoning therefore was that 72 Mk 2 Vulcans so armed would represent the same deterrent power as that approved by the Government in August 1957, when the Cabinet Defence

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<sup>1</sup> Victor B.2 trials continued at Cottesmore, and subsequently at Wittering, until 1965. <sup>2</sup> A squadron sometimes formed, or re-formed, before it received any aircraft; thus No 617 Squadron was re-formed at Scampton on 10 October 1960 but did not receive its first B.2 until 23 December. <sup>3</sup> Decision taken at the Prime Minister's meeting on 30 May 1957. <sup>4</sup> In mid-1963 the Vulcan B.2 squadrons were at UE8 or UE6, the Victors at UE6.

Committee decided that the V-force should consist of 144 aircraft – 104 of them Mk 2s. The corollary was, therefore, that if this power could be achieved with fewer aircraft then some of those on order could be cancelled with a consequent saving in money. “We must be ready to review the strength of the V-bomber force in the light of the decision on Skybolt”, the Prime Minister (Mr Harold Macmillan) minuted the Minister of Defence on 16 June 1960. “Will we then want as many Victor Mk 2 aircraft as are at present on order? Might we save money by cancelling some of these? They will after all have a fairly limited life if they cannot carry Skybolt”.<sup>1</sup>

The original draft agreement on Skybolt, prepared by the Ministry of Aviation and dated 19 May 1960, had referred to the missile being “carried and used operationally by the Royal Air Force Mk 2 Victor and Vulcan bombers”; a Memorandum of Understanding had stated that it was proposed to carry two of the missiles on the V-bombers, one on each wing; but the Technical Agreement signed on 27 September 1960<sup>2</sup> referred to “compatibility with Vulcan Mk 2 bombers”, to missiles “carried and used operationally by Royal Air Force Vulcan Mk 2 bombers” and to “the necessary development program for the adaptation of the Vulcan Mk 2 bombers to enable them to carry the missiles and use them operationally”.<sup>3</sup>

Although it would have been technically feasible to modify Victor Mk 2s for the carriage of Skybolts (and Handley Page were keen to do this<sup>4</sup>), the policy decision was made to use Vulcan Mk 2s only as missile carriers. “Our policy”, wrote DCAS (Air Marshal R B Lees) to the Controller of Aircraft (Sir George Gardner) on 9 August 1960<sup>5</sup>, “which has been ratified by Ministers, is that only the Vulcan Mk 2 will be used in this role . . . . No development work should be put in hand to enable the Victor Mk 2 to be armed with Skybolt”.<sup>6</sup>

The Skybolt situation, and the USAF/Douglas ballistic missile's place in the Blue Steel – Skybolt – low-level operations sequence of events, will be described in more detail in a subsequent chapter: reference to it has been made here only to account for the sharply reduced number of Victor Mk 2s and the consequent forming of only two bomber squadrons with them.<sup>7</sup>

In support of the five Blue Steel squadrons in Bomber Command's front line from 1963 onwards were the three “free fall” Vulcan Mk 2 squadrons at Coningsby, Nos 9, 12 and 35.

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<sup>1</sup> File, Cost of the Deterrent – Victor Cancellations (95/03/033/60/ – Annex A). <sup>2</sup> The US Dept of the Air Force and UK Ministry of Aviation Technical and Financial Agreement (file, Bombs – Long Range Powered Guided Bomb – Skybolt – Compatibility with the V-bombers). <sup>3</sup> The Memorandum of Understanding (6 June 1960) between the UK Minister of Defence and US Secretary of Defense (Mr Thomas S Gates, Jr) had referred simply to “Royal Air Force Mk II V-bombers” or “Mk II V-bombers”. <sup>4</sup> In mid-1960 the company told the MoA that the Victor B Mk 2 was “able to carry two Skybolt missiles without modification to the aircraft or missile to improve ground clearance” (Minute, DOR(A)/DofOps(B&R), 15 July 1960). <sup>5</sup> DCAS 2927/60. <sup>6</sup> In 1962, however, use of the Victor Mk 2 in an airborne alert Skybolt role was considered (see subsequent chapter). <sup>7</sup> Also the strategic reconnaissance squadron, No 543 at Wyton, was equipped with Victor SR/B Mk 2s from mid-1965 onwards; and Victors, as will subsequently be told, fulfilled the tanker role from mid-1965 onwards.

## CHAPTER 12

**Flight Refuelling and the Setting-up of a Jet Tanker Force (1957-1962)**

"The Air Ministry have come to the conclusion that flight refuelling on future types of aircraft is not a paying proposition. Since flight refuelling fittings have already been ordered for the Shackleton, it has been decided to complete these and test the equipment on one aircraft. Thereafter it is not proposed to continue any further development of flight refuelling equipment, but to rely on the aircraft carrying internal fuel for the ranges required".

This categorical statement was made in the Air Ministry Quarterly Liaison Report No 2, for January-March 1947, when bomber aircraft in service were the Lincoln, Lancaster and Mosquito; but for nearly two years Sir Alan Cobham, pioneer of long-distance flights in the inter-war years and now head of Flight Refuelling Ltd, had been trying to persuade the Air Staff to adopt flight refuelling as an operational requirement - and was to persist in doing so through what was described as "a slow bombardment of letters"<sup>1</sup>, his chief target being the then ACAS(TR), AVM J N Boothman.<sup>2</sup>

Sir Alan's persistence was eventually rewarded; the turning-point probably came in 1949 when his company successfully developed the probe-and-drogue system<sup>3</sup> and the equipment they devised for it meant that a bomber could quickly be converted into a tanker, or vice-versa. Thus a tanker squadron would not be limited to a refuelling role; its aircraft could revert to bombing duties if so required.

Although in 1950 there was some encouragement for this development - DCAS (Air Marshal Sir Arthur Sanders) telling the Air Council that arrangements were being made to equip a squadron of Meteors for flight refuelling tests - the company had to request support in 1953 for the continuance of its activities, which included the administration and maintenance of an advanced flying school at Tarrant Rushton airfield<sup>4</sup>, in addition to the development of flight refuelling.

On 15 July in that year Sir Alan Cobham had sent the CAS (Air Chief Marshal Sir William Dickson) a brochure on flight refuelling, with particular reference to the bomber/tanker/receiver conversions. As a result, DCAS (Air Marshal Sir Ronald Ivelaw-Chapman) on 27 July asked ACAS(Ops) (AVM Sir Harry Broadhurst) to investigate the feasibility of flight refuelling with representatives of the Air Staff and of Bomber Command, from an operational point of view. Subsequently Sir Alan appealed to AMSO (Air Chief Marshal Sir John Whitworth Jones) about the forthcoming termination of the company's No 210 Jet AFS contract, and was told in reply that this could only be extended for a short period but that an alternative scheme might be available; further, that the Air Staff were "engaged in examining the potentialities of" flight refuelling "in relation to certain of our strategic requirements".

This letter was sent on 11 September and eight days later CAS minuted AMSO to say that he considered that everything possible should be done to avoid the break-up of the Flight Refuelling organisation; DCAS and he felt that there were "important operational possibilities in flight refuelling for the RAF" (CAS had previously told the Air Council Standing Committee that its potentialities "must not be underestimated" and that he had felt concern about "the possibility of making provision for it by adaptation in new types of aircraft")<sup>5</sup>.

The Air Staff's examination of the operational potentialities of flight refuelling came to fruition at the end of 1953 and on 8 January 1954 the new DCAS (Air Marshal T G Pike) told the Secretary of State for Air (Lord de l'Isle and Dudley) that they had decided that all Vulcans and Victors should be capable of flight refuelling, and that it was desirable that all Valiants should be similarly capable, though this might prove "economically impossible".

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<sup>1</sup> Letter from the AOC-in-C Fighter Command (Air Marshal Sir William Elliot) to ACAS(TR) (AVM C B R Pelly), 25 November 1948. Writing to Cobham on the same day he said he admired "the tenacity and determination with which you have pursued your beliefs in the face of such difficulties and adversities". <sup>2</sup> The 1931 Schneider Trophy winner. <sup>3</sup> Alternatives were the British looped hose (abandoned) and the American (Boeing) flying boom system, which gave way to the probe-and-drogue method. <sup>4</sup> Where Flight Refuelling Ltd was located from 1951 onwards. <sup>5</sup> Conclusions, AC Standing Committee 16(53), 7 September 1953.

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DCAS went on to point that there were some unsolved problems about the physical practicability of flight refuelling at high altitudes and low temperatures<sup>1</sup>, so three Valiants in the current production order were to be modified for trials as tankers/receivers. In the meantime, a Canberra had been loaned to Flight Refuelling and was being modified as a tanker, to carry out trials at up to 40,000ft. A Meteor would be co-operating with it under Ministry of Supply auspices.

During 1954 the implications of the Air Staff decision to make the V-bombers capable of flight refuelling were put into effect, though formal statement of a requirement to this end in June of that year was too late to enable the basic equipment to be fitted to approximately the first 50 Valiants. The precise figure was given by ACAS(OR) (AVM H V Satterly) in a report to CAS (Air Chief Marshal Sir Dermot Boyle) on 29 October,<sup>2</sup> when he said that of the 115 Valiants on order 81 would be modified for flight refuelling. Overall policy, he commented, was that as many V-bombers as possible should be capable of this, in the double (tanker/receiver) role. The aim had been to have the permanent fittings for both roles in as many aircraft as possible, while removeable equipment (like probes, hose and drogue units, etc) was calculated on the basis of 75 per cent of the V-force as receivers and 50 per cent acting as tankers. ACAS(OR) added that Valiant flight-refuelling trials were to take place during 1955 and three aircraft had been earmarked for these. Extrapolation from such a time-scale might have suggested an in-service date of 1956 or 1957, but things didn't run so smoothly as that; there were various difficulties, both technical and financial, which took time to resolve.

On 15 April 1955 the Air Staff had issued a Requirement (ASR3580) for an electronic positioning system for flight refuelling; this was to enable aircraft to position themselves for link-up from within 50nm of each other. Work on this rendezvous aid continued during that year and until the end of 1956, when development funds (which had been under-estimated) ran out. To avoid asking the Treasury for more money, the requirement was re-examined to see if concessions might be made to save costs; however, in April 1957 the Ministry of Supply were told that it must stand. Then the Treasury refused to authorise additional funding, on the ground that no flight refuelling policy had been financially approved for the RAF.

Such a policy was formulated by the Air Council in December 1957, and on the assurance of these intentions the Treasury authorised further development funds (£50,000) for the positioning system to OR3580; but its agreement to the use of Valiants to provide a tanker force took very much longer to obtain, and was finally given only in April 1959, after the Valiants of No 214 Squadron at Marham had done more than a year's trials and were beginning to make a series of spectacular long-distance flights.

Thus there were two aspects to the creation of this force – the political one, consisting of the case which had to be made to the Treasury for its sanction; and the operational one, represented by the work done in the air. Both these activities went on in parallel during 1958, and it is interesting to note that just before Treasury approval was finally given – on 27 April 1959<sup>3</sup> – to the establishment of a Valiant tanker force, Valiants of No 214 Squadron had made their first long-range overseas refuelled flights – to Nairobi on 10 April and then, six days later, to Salisbury.<sup>4</sup>

The political aspect of the setting-up of the force was represented by papers presented to, and discussed by, the Air Council from December 1957 onwards to define future plans in the light of the intended total number of V-bombers; and the efforts to secure the assent to these plans of the Minister of Defence, Cabinet Defence Committee and Treasury. Basically, the argument turned on the size of the eventual V-bomber front line as approved by the Defence Committee on 2 August 1957<sup>5</sup> – a total of 144 aircraft, of

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<sup>1</sup> There had as yet been no experience, on the UK side of the Atlantic, of flight refuelling at the heights and speeds at which the V-bombers would fly. DCAS (AVM G W Tuttle) reported in December 1957 that the RAF were hoping to use the techniques higher, faster and at a greater fuel transfer rate than had hitherto been attempted (94/8 (Pt 3) Flight Refuelling of Aircraft). <sup>2</sup> C.50980/ACAS(OR)/5228 in Flight Refuelling of Aircraft (1D/94/19 (Pt 1)). <sup>3</sup> Joint Permanent Secretary, Treasury (Sir Roger Makins)/Permanent Secretary, Ministry of Defence (Sir Richard Powell). <sup>4</sup> The second of these – 5,320 miles in 10hr 12min at an average speed of 522mph – was the longest non-stop flight by a jet aircraft undertaken to date by the RAF. The Valiant's captain was Wing Commander M J Beetham, later to become CAS. <sup>5</sup> D(57) 7th meeting.

which 104 would be Mark 2 Victors and Vulcans. It was estimated that this strength would be achieved in 1961, and that by then – with the Mark 1 element of the front line consisting of Vulcans and Victors – there would be surplus Valiants, to the tune of five squadrons. These Valiants, it was proposed (in a paper by VCAS (Air Marshal E C Hudleston) discussed by the Air Council on 20 December 1957), should be used to replace the Canberras assigned to Saceur – three squadrons (24 aircraft) replacing 64 Canberras – and to form a two-squadron tanker force.<sup>1</sup> The Council decided to look into all the logistic and financial implications of these proposals, having agreed that there was a requirement for Valiant tankers,<sup>2</sup> and also decided to seek Treasury approval for the completion of development work on these aircraft in the refuelling role – an approval given early in 1958.<sup>3</sup>

Throughout that year, however, the Treasury insisted that the tanker element of the V-force should come out of the 144 aircraft agreed to as its front line – at the expense of the Mark 1s – and this view was reiterated by the Chancellor (Mr D Heathcoat Amory) in a letter to the Minister of Defence (Mr Duncan Sandys) on 22 December 1958.

However, this situation was resolved early in 1959 by correspondence between top officials of the Ministry of Defence and the Treasury. On 6 April the Permanent Secretary, MoD (Sir Richard Powell), wrote to the Joint Permanent Secretary of the Treasury (Sir Roger Makins) to emphasise that a front line of 144 aircraft was the minimum required for the V-bomber force and that the proposal for tankers should be considered separately on its merits – which he considered to be “very substantial”, summarising them as follows:-

“increased flexibility to match the growing effectiveness of enemy defences and to make a wider choice of targets possible; concerting tactical plans more closely in some areas with Strategic Air Command; increasing the ability of V-bombers to reinforce overseas Commands in limited war by enabling them to take off from short runways and refuel in the air; extending the ferry range of the P.1B Lightning<sup>4</sup>, thus allowing it to be deployed to overseas theatres in an emergency; and providing a means for recovering other aircraft caught in bad weather without adequate fuel margins for diversion.”

The Ministry considered the tanker force a “relatively inexpensive” proposal and assured the Treasury that there were no current plans to increase its size beyond 16 aircraft – which seemed to the latter to be presented with a “formidable task” in coping with the refuelling commitment outlined in the Ministry’s letter. Did this not infer that the Air Ministry might be planning to establish a much larger tanker force?

In the light of assurances given that this was not so, however, the Treasury on 27 April 1959 gave its agreement to “the establishment of a tanker force of converted Valiants with a front-line strength of 16 aircraft in addition to the agreed front-line V-bomber strength of 144 aircraft”.<sup>5</sup>

The operational aspect of the creation of this force centred on No 214 Squadron, whose preparations for flight refuelling began in December 1957, when the forthcoming change met an unenthusiastic response: “‘A’ Flight are preparing to do the initial work converting the whole squadron to the tanker role – a gloomy and unpopular prospect”, the Operations Record Book commented.

No 214’s training for their new role began in earnest at the beginning of 1958: Squadron Leader J H Garstin and his crew were detached to Boscombe Down to gain experience in air-to-air refuelling and three ‘A’ Flight crews were sent to Flight Refuelling Ltd at Tarrant Rushton airfield for a week’s ground course on the equipment – some of which had been delivered to Marham, for the ORB noted that it was “building up in the hangar” and commented that it was possible that the first training flights would “take place towards the end of February”.

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<sup>1</sup> Paper dated 6 December 1957, in Use of V-bombers in the Tanker Role (1D3/901/11(Pt 1)). <sup>2</sup> Air Council mtg 20 December 1957 (Conclusions 28(57)). <sup>3</sup> Air Council – Note by VCAS and PUS (Paper No AC(58)28) – 27 March 1958. <sup>4</sup> The first RAF Mach 2 fighter, which entered service in December 1959 and reached its first squadron (No 74) in July 1960. Subsequently, in 1967, this squadron, equipped with F.6s, was deployed to the Far East with the aid of Victor tankers. <sup>5</sup> This correspondence is in Use of V-bombers in Tanker Role (1D3/901/11 (Pt 1)).

On 14 February the squadron gained a new CO, Wing Commander M J Beetham, DFC, taking over from Wing Commander L H Trent, VC, DFC<sup>1</sup>; and in that month the airborne training began – practice trailing, with no hook-ups as yet – and two of the Valiants (XD869 and XD870) were equipped with hose drum units. During March this training was formalised with the start of Trial 306 – Flight Refuelling, No 214's ORB noting that Phase 'A' involved "training 'A' Flight crews in positioning of the aircraft and making and maintaining dry contacts by day", adding that crews were "being trained in both the 'tanker' and 'receiver' roles" and that "during the initial training Squadron Leader P Bardon from A&AEE Boscombe Down and Mr B Trubshaw, deputy chief test pilot of Vickers-Armstrongs Ltd, assisted in the conversion of crews".

While this trial was going on the other half of the squadron, 'B' Flight, was operating as part of Bomber Command's Main Force – during April participating in a dispersal exercise designed to test V-force readiness, aircraft being bombed-up on the alert and crews brought to 40-minute readiness. The ORB recorded that "various practice scrambles took place during the exercise period, during which the efficiency of the ground and air crews and warning system reached such a pitch that on the final scramble . . . the time between the . . . siren and the first aircraft airborne was exactly 3min 20sec. The other three aircraft followed at intervals of 90sec . . .".

No 214 and the other two Valiant squadrons at Marham (Nos 148 and 207) were visited by *The Times* on 6 June 1958, its correspondent flying with Squadron Leader R Furze and his crew of No 214 on a five-hour exercise and reporting<sup>2</sup> that "without the apparently inexhaustible financial resources and flamboyance of their friends and allies the United States Strategic Air Command,<sup>3</sup> the RAF V-bomber force, in some three years of operation, have worked up first in their Valiants, and now also in the Vulcans and Victors, into a formidable weapon in their own right, well able to press home their attacks with superb efficiency".

Later in 1958 the Air Ministry demonstrated publicly its intentions as to flight refuelling by including No 214's Valiants in the year's major air shows – two tanker/receiver aircraft flying 'hooked up' at 1,000ft over Farnborough at the SBAC Display there early in September, and similar presentations being made later in the month when Marham was 'at home' for a Battle of Britain display and probe-and-drogue refuelling was shown off at 500ft over the home airfield and over Cottesmore, Upwood and Honington.

But these were 'dry swims', no fuel being transferred, giving practice in rendezvous techniques and hooking-up procedures, and from October onwards crews could also practise on the ground in the simulator at Marham. It was in January 1959 that the first 'wet hook-ups' were achieved, No 214's ORB recording that "two tanker aircraft were modified up to the standard required for day and night fuel transfer. The first transfers of fuel in the air . . . were carried out by crews captained by Squadron Leaders J Garstin and S Price and Flight Lieutenant B Fern" – the first of these being done simultaneously by Squadron Leader Garstin and Flight Lieutenant Fern on 23 January, an historic date for the RAF, and being described simply in the ORB as "Trial 306 Wet Transfers". Once this had been successfully achieved the air-to-air fuel flow was practised intensively: between 26 January and the end of the month Garstin, Price and Fern with their crews "completed 26 day and 17 night wet hook-ups".

The next stages were refuelled long-range and overseas flights, rising to a climax when a Vulcan of No 617 Squadron flew non-stop from Scampton to Sydney in 20hr 3min on 20-21 February 1961. For this operational achievement the Valiants of No 214 Squadron had pioneered the way, particularly during 1959. In February of that year these tankers made their first long-range sorties of 12 hours' duration, as preparation for long-distance overseas flights in April and June. On 10 April Flight Lieutenant Fern and his crew flew from UK to Kenya (Nairobi) in 7hr 40min at an average speed of 567mph, which constituted an unofficial record; and on 16 April the CO, Wing Commander Beetham, and his crew

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<sup>1</sup> A New Zealander, Wing Commander Trent had been awarded the VC for leading 11 Venturas of No 487 (RNZAF) Sqn in a daylight attack on a power station in Amsterdam on 3 May 1943 when the whole force was destroyed by Luftwaffe fighters. <sup>2</sup> *The Times* for 9 June 1958. <sup>3</sup> No 214 took part in the SAC Bombing Competition in October 1958.

made the longest non-stop flight by a jet aircraft yet undertaken by the RAF – 5,320 miles from Marham to Salisbury, Southern Rhodesia, RVs and refuelling taking place over Idris on the outward and over Lake Victoria and Idris on the homeward flights. Then on 18 June the CO set up an unofficial UK-South Africa record, overflying Jan Smuts airfield, Johannesburg, 11 hr 3 min after leaving Marham – covering a distance of 5,845 miles at an average speed of 529 mph in making the first-ever non-stop flight from the UK to South Africa.

These long flights were all combined squadron efforts, because of the number of aircraft involved; thus for the flights to Southern Rhodesia and South Africa tankers were based at Idris and also at Kano, Nigeria; and when the No 617 Squadron Vulcan (captained by Squadron Leader M G Beavis) flew non-stop from the UK to Australia it was refuelled four times – over Cyprus, Karachi, Singapore and 500 miles south of Singapore.

Such support for other V-bombers, or for fighters, to help them to reach overseas destinations quickly, was one of the ultimate operational objectives of flight refuelling – exemplified dramatically when 12 Javelin F(AW).9s of No 23 Squadron were deployed to Tengah, Singapore, early in 1963 (11–13 January), despite snow and ice at Coltishall when they left. They were refuelled en route by Valiants of No 214 and 90 Squadrons, the tanker force which had come into being with the conversion of the latter squadron to its new role during 1961.

For this conversion No 214 had been primarily responsible, as it had been for training the Vulcan and Javelin crews, in addition to its own long-range flights after pioneering the RAF use of flight-refuelling techniques.<sup>1</sup> In its ORB for August 1961 the squadron had noted that “there is now a requirement for No 90 (Valiant) Squadron to be a fully operational tanker squadron by the end of 1961. All the training of air and ground crews will be done by No 214 Squadron in conjunction with the Flight Refuelling Ground School . . .”.

At the same time No 90, based at Honington, recorded in its ORB that “the squadron learned [ during August 1961 ] that it is to convert to the tanker role, [ and ] to be operational in that role by 1 January 1962”. For a few weeks No 90 continued to practise bomber techniques, but that commitment ceased at the beginning of October, “in favour of conversion to flight refuelling”; and that conversion seems to have gone quickly and smoothly, for by mid-December the squadron was flight-refuelling Javelins en route UK–Malta and at that time had three Valiant B(K).1s, which increased to eight by January 1962.

Thus, by the beginning of 1962, the two-squadron jet tanker force which had been planned for since the end of 1957 had become an operational reality.

This Valiant tanker force was expected to continue in service until about 1968, when the aircraft were reckoned likely to become fatigue-expired, and early in 1962 the Air Council considered their replacement by Victor 1s and the establishment of a third flight-refuelling squadron.<sup>2</sup> The Victor's fatigue life was estimated to be ten years longer than that of the Valiant; it could carry more fuel,<sup>3</sup> had a better performance and greater range, and would be equipped with a three-point refuelling system as opposed to a single-point installation.

The need for a third tanker squadron was agreed to in principle by the Air Council in March 1962 and the potentialities of the Victor Mk 1/1 A in that role were examined during that year, with the result that it was recommended as a Valiant replacement – a recommendation which the Air Council accepted on 22 November 1962, at the same time agreeing that a third tanker squadron should be formed as soon as possible.<sup>4</sup> One factor influencing the decision to use Victors as future tankers was that they offered a

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<sup>1</sup> In November 1959 the squadron had noted in its ORB that “with the publication of the Final Report on the Flight Refuelling Trial dated 30 November 1959, Trial 306 – which has occupied the major portion of the squadron effort since January 1958 – came to an end”. Once the techniques and procedures had thus been established the pioneer RAF long-distance flight-refuelled flights followed, during 1960–61. <sup>2</sup> Conclusions of Meeting, 3(62), 1 March 1962. <sup>3</sup> Fuel capacity of the Victor 1/1A as a tanker was 98,500lb; the Valiant's was 80,815lb.

<sup>4</sup> Conclusions, 16(62). These papers are in 1D3/901/11 (Pt 1) Use of V-bombers in the Tanker Role. A comparison table in 94/8 (Pt 3) gives total transferable fuel as Valiant, 45,000lb; Victor, 98,500. This file is entitled Flight Refuelling of Aircraft.

performance more compatible with that of new aircraft entering or destined for RAF service and likely to be deployed to the Far East, like later marks of Lightning or the TSR.2.

But although the Air Council's policy decision on Victor tankers was supported by the Chiefs of Staff and the DRPC (Defence Research Policy Committee), there were industrial and financial difficulties – largely centring on the possibility of a merger at that time between Hawker Siddeley Aviation and Handley Page, and the question whether the work should be allocated to the latter company, and in view of all the uncertainties it was not until September 1964 that Treasury approval was finally given for work on the Victors. Subsequently, there were official doubts as to whether Handley Page should be given responsibility for the whole of it or whether some of it should be sub-contracted to HSA.

However, the substitution of Victors for Valiants in the tanker role is beyond the scope and time-scale of this chapter, which is concerned with the creation of the RAF jet tanker force. The phasing-out of Valiants and their replacement by Victors in that role will be referred to later. The point to be made here is that this change had been planned originally in 1962, but it was made in 1965 as a crash programme when the RAF suddenly found itself without a flight refuelling capability, rather than in about 1968 as envisaged in long-term plans.

For nearly three years, from January 1962 until all Valiants were grounded at the end of 1964, Nos 214 and 90 Squadrons formed the RAF jet tanker force – training other V-bomber, and Lightning and Javelin, squadrons in the receiver role and operating together to support major Fighter and Bomber Command deployments to the Middle and Far East. In addition to their flight refuelling preoccupations, each of these squadrons undertook some Bomber Command trials – No 214 doing No 448, which was designed to investigate the problems of maintaining an airborne alert for 14 days, three Vulcans flying sorties of 8hr duration in every 24 hours and being flight-refuelled once every eight hours. No 90 did Nos 467 – a silent rendezvous between Valiant tankers and Victor and Vulcan bombers – and 490, designed to test communications between an Airborne Command Post aircraft (a role which the squadron had played in Exercise 'Mayflight' during May 1963) and those of the Main Force.<sup>1</sup>

No 90 Squadron was still completing its pilot conversions when in March 1962 it co-operated with No 214 in a joint Bomber/Fighter Command exercise – escorting and refuelling 12 Javelins of No 23 Squadron en route Coltishall–Akrotiri, Cyprus. Thereafter the two squadrons worked together on many occasions – supporting four No 56 Squadron Lightning 1As non-stop from Wattisham to Akrotiri in October 1962; 12 No 23 Squadron Javelin F(AW).9s from Coltishall to Tengah, Singapore, and back in January 1963 (Exercise 'Canterlup'); Victors to Tengah (Exercise 'Chamfrom') and Vulcans to Perth, Western Australia (Exercise 'Walkabout') in July 1963; and four Javelin F(AW).9Rs from Binbrook to Butterworth, Malaya, in March 1964 (Operation 'Chive') – to mention a few of the more spectacular refuelling sorties. Referring to the last-mentioned in its ORB, No 90 Squadron remarked that "this operation was of particular interest from the flight refuelling aspect, as the legs Khormaksar–Gan and Gan–Butterworth were over the sea and diversion airfields, Masirah and Katunayake, Ceylon, long distances from the routes. Refuelling plans had to be carried out with great accuracy to ensure that, in the event of an emergency, the aircraft would have sufficient fuel to reach the diversions . . .". The ORB compiler's modest narrative underlines the problems faced by the tankers on Far East reinforcement flights in supporting their charges over the vast airspaces of the Indian Ocean.

Both Nos 214 and 90 Squadrons undertook the training of squadrons with which they were to operate – for example, in January 1962 the former started receiver training with No 101 Squadron, one of whose Vulcans flew non-stop Waddington–Luqa–Waddington in March that year, being refuelled over Malta by a No 214 Squadron tanker; while in April 1963 No 90 did flight refuelling exercises at RNAS Lossiemouth, which led to No 90/214 Squadron support for RN Scimitars in May flying direct from there to join HMS *Ark Royal* off Majorca.

On the evidence of these squadron records, the biggest emphasis in the operational employment of flight refuelling seems to have been placed on its use in supporting the reinforcement of the Middle and Far East with bombers or fighters. For this purpose, several squadrons in Bomber and Fighter Commands –

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<sup>1</sup> No 90 Sqn ORB.

of Vulcans, Victors, Javelins and Lightnings – were indoctrinated in the receiver role.<sup>1</sup> But there is no evidence that the tankers were used in conjunction with the V-bombers to give them added range on missions against enemy targets, thus giving them an increased flexibility to match the growing effectiveness of enemy defences, as had been suggested when the case for a tanker force was being argued.<sup>2</sup> No training profiles of this kind are mentioned in the ORBs; the only V-force exercise mentioned is Mayflight in May 1963 when No 90 Squadron put up a Valiant to act as an Airborne Command Post.<sup>3</sup> The chief purpose in life for these flight refuelling squadrons – to which their own continuation training, standardisation and categorisation, and instruction of other squadrons, all contributed – was to assist in the rapid reinforcement of overseas theatres with Lightnings, Javelins and V-bombers. When in October/November 1963 Nos 90 and 214 supported eight No 64 Squadron Javelins to India, the complications of such an operation were emphasised by the laconic description of their return in No 90 Squadron's ORB: "At Calcutta (Dum Dum) five tankers; at Calcutta (Kalaikunda) 11 Javelins. At Bombay (Santa Cruz) four tankers. At Luqa two tankers. Seven Javelins<sup>4</sup> were then flight-refuelled back to the UK using standard techniques, night-stopping at Bahrain and Akrotiri". Aside from the training needed for successful rendezvous and hook-ups,<sup>5</sup> there were considerable logistic implications in any such operations; for example, all the fuel the Valiants supplied had to be provided for them on the ground. But during the initial years of the jet tanker force, when the single-point Valiant B(K).1s were operating from Marham and Honington, operations seem to have been conducted with conspicuous success. So significant did they become in RAF training and deployments that, when all Valiants were withdrawn from service in December 1964 and Nos 214 and 90 Squadrons were disbanded early in 1965, urgent measures were taken to bring Victors in to perform the flight refuelling role – as will be described subsequently in referring to the phasing-out of Valiants.

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<sup>1</sup> No 214 Squadron also did some Hawker Siddeley Argosy flight refuelling. <sup>2</sup> In 1959, in MoD/Treasury correspondence. <sup>3</sup> In trials a year later, two ACP Valiants from No 90 Sqn broadcast messages to Main Force aircraft. <sup>4</sup> One had crashed in India. <sup>5</sup> There were occasional instances of broken probes.

## CHAPTER 13

**The Valiant Saceur-assigned TBF (Tactical Bomber Force)**

This force of 24 Valiants, each capable of carrying two nuclear weapons and therefore of striking two targets, was based at Marham from 1961 to the end of 1964 and had its origin in an Air Council decision of 1958<sup>1</sup> to substitute Valiants for Canberras in the bomber forces assigned to the Supreme Allied Commander Europe.

During 1957 it had been realised that by about 1960, with a planned front-line strength of 144 strategic bombers – 104 of which would be Mk 2 Vulcans and Victors, there would be a surplus of Mk 1 V-bombers – in fact of Valiants. The Air Council therefore decided in 1958, after considering papers which<sup>2</sup> had set out all the implications of such a step, that these Valiants should be re-employed in two new ways – as tankers, and as tactical bombers to replace the Saceur-assigned Canberra B.6 squadrons.

The creation of a Valiant tanker force, and the long arguments which the idea of using V-bombers in that role entailed, have been described in the previous chapter. The assignment of Valiants to Saceur was nothing like so contentious a matter; he agreed to it during 1958<sup>3</sup> – their all-weather capability and blind bombing aids independent of ground sources (qualities not possessed by the Canberras) were strong arguments in favour of doing so – on the condition that these assigned V-bombers should each carry two nuclear weapons. This was because to substitute 24 Valiants for up to 64 Canberras – these were the figures used in papers and discussions, although in fact three squadrons of Valiants at eight aircraft per squadron subsequently replaced three squadrons of Canberras at 16 aircraft per squadron – meant that only 24 targets would be covered instead of 64. Hence Saceur's insistence on two weapons per Valiant, enabling 48 targets to be covered.<sup>4</sup> These weapons would be American, supplied under the Project E arrangement which stemmed from the 1958 agreements (already referred to) on the co-ordination of USAF-RAF atomic strike plans and the supply of US atomic weapons to the RAF.<sup>5</sup>

What resulted from these plans was the three-squadron (Nos 207, 49 and 148) tactical medium bomber force built up at Marham from 1960 onwards, with a Saceur QRA (quick reaction alert) capability, and lasting until the Valiants were grounded at the end of 1964.

No 207 Squadron, already at Marham, was the first to undergo this metamorphosis; from 1 January 1960, its ORB recorded, it was "operationally at the disposal of Saceur, but for training and administration will continue to come under the control of Bomber Command". Then on 10 October it was "incorporated in the Saceur Quick Reaction Alert System", the ORB commenting: "this necessitates the maintaining of one aircraft and crew at 15 minutes' readiness at all times in addition to the normal generation standby system. Each tour of duty as QRA crew is for 24 hours, starting at 0900hr. The crew is housed during the day in a suitably equipped Rest Room in the Operations Block and at night in a five-berth caravan; meals are provided in the Aircrew Buffet".

Three days later Saceur himself, General Lauris Norstad, visited Marham to review the Bomber Command squadrons assigned to NATO. After inspecting aircraft and crews of Nos 207, 9, 12, 35 and 58 Squadrons<sup>6</sup> he watched a demonstration simultaneous start<sup>7</sup> and scramble take-off by four of No 207's Valiants, which were airborne within 1.25min.

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<sup>1</sup> Conclusions, 11(58), 15 May 1958. <sup>2</sup> *Eg*, Note by VCAS and PUS, Valiant Tanker and Tactical Bomber Force, AC58(28). <sup>3</sup> Air Council meeting, 3 July 1958. <sup>4</sup> "Unless the Valiants were capable of this, Saceur was likely to press for the assignment of more aircraft" (AC Conclusions 5(60), 4 April 1960). <sup>5</sup> Anglo-US co-operation in work on modifying RAF aircraft to carry US nuclear weapons had in fact started much earlier. A Progress Report on the Contribution of the RAE to the Nuclear Weapons Programme, dated April 1957 (Report ARM.NW 1/57), said in referring to Project E that work had been going on for "just under two years". It had been directed initially towards the carriage of a US weapon in Canberras; the second stage of the work was the design of an installation for a US weapon in the V-bombers (initially Valiants). <sup>6</sup> No 58, a medium-range PR squadron, was based at Wyton and had a UE of eight PR.7s and eight PR.9s. <sup>7</sup> In July 1960 work had started on modifying No 207's Valiants for simultaneous starting of all four engines, and on the 21st the squadron demonstrated to visiting IDC students the improved scrambling ability which this made possible.

Nos 9, 12 and 35 Canberra squadrons remained in service until the latter half of 1961 and in that time formed the Saceur-assigned force with No 207. When they were disbanded – Nos 9 and 12 (B.6s) on 13 July 1961 and No 35 (B.2s) on 12 September – they were replaced by two Valiant squadrons, Nos 49 and 148. The former moved from Wittering to Marham at the end of June 1961 and from 1 July was “placed at the operational disposal of Saceur”; the latter, already at Marham, was Saceur-assigned from 13 July. All three Valiant squadrons at Marham were committed to keeping an aircraft and crew at 15 minutes’ readiness in the QRA dispersal, a compound guarded by a 6ft wire fence.<sup>1</sup>

It was this factor – the QRA aircraft armed with American weapons (the 1,900lb and subsequently<sup>2</sup> the 2,100lb bombs) which were guarded day and night by USAF personnel – which physically differentiated the Saceur-assigned TMBs from the medium bombers of the Main Force, plus the fact that the former were allotted NATO targets in addition to their national ones. These targets were continually up-dated according to Intelligence information, and no crew would ever know the target allotted to another crew.

Marham was also during this period, because of its Saceur-assigned squadrons, subject to NATO tactical evaluation. On 25-26 March 1963 (to quote from No 207’s ORB) “the station was visited by a team of officers from SHAPE<sup>3</sup> HQ and Bomber Command, including both USAF and RAF personnel. The purpose of the visit was to see whether the station was fit to carry out its NATO assignment and [it] was termed Tactical Evaluation. This evaluation was in the form of an Exercise Mick<sup>4</sup> using both live and dummy weapons for loading . . .” Members of the Taceval team flew with selected crews of Nos 207 and 49 Squadrons, and there were oral tests, principally on knowledge of the war targets and of the US weapons. No 207’s ORB recorded with pride: “Marham did well in this evaluation and was accorded an A1 category, which is the topmost assessment . . .”

In other respects the three TBF squadrons trained, were crew-categorised, evaluated, exercised, competed and deployed in the same ways as the rest of the V-force; in fact No 49, defining its new role in August 1961, said that “the squadron is a Main Force bomber squadron and since 1 July 1961 has been placed at the operational disposal of Saceur”. The names of exercises, deployments and competitions which occur in their records were common to all the medium bomber squadrons – Kinsman, Mayflight, Mick, Mickey Finn, Co-op, Grouper, Compex etc; Western Rangers, Lone Rangers and Sunspots; and the Group and Command navigation and bombing competitions.<sup>5</sup> While there seems to have been some confusion about it initially, the TBF squadrons were still involved in Bomber Command’s Alert and Readiness Plan. Thus in July 1960, after six months’ assignment to Saceur, No 207 recorded its participation in “another alert and readiness exercise, code-named Mayflight 3”, commenting that “during previous exercises of this nature, part of the squadron has been deployed to a diversion airfield in accordance with the Bomber Command Alert and Readiness Plan, [but] now that operational control of the squadron has been transferred to Saceur, this deployment is no longer required and for Mayflight 3 all No 207 Squadron aircraft operated from Marham”. However, deployment seems to have been the rule in subsequent Mayflights: in May 1961 four of 207’s aircraft dispersed to Cranwell; and while No 49 Squadron reported in May 1962 that it was “not involved in dispersal”, No 148 sent its aircraft off to Tarrant Rushton. Then during Exercise Kinsman in June 1964 No 49 dispersed three crews to Leconfield.

Two major changes in Bomber Command policy in the early 1960s, however, applied to the TBF squadrons equally with those of the Main Force: these were the introductions of the low-level role during 1962 and of centralised servicing early in 1964.

No 49 Squadron set out clearly the implications of the low-level role when this was initiated during August 1962, its ORB commenting that the new role “followed the decision by Bomber Command that the probability of penetration of enemy defences by Valiant aircraft would be considerably increased by the employment of the high-low-high technique” and adding that “training on UK routes has commenced”. On the 22nd a lecture was given by Bomber Command Development Unit staff on “low-level procedures and considerations” and the squadron put matters to the test by flying four low-level sorties that month. BCDU also lectured to No 207 Squadron, whose ORB remarked that low-level

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<sup>1</sup> Like the Thor bases, Marham was a target for the Campaign for Nuclear Disarmament demonstrators. <sup>2</sup> Early in 1964. <sup>3</sup> Supreme Headquarters Allied Powers Europe, then in Paris. <sup>4</sup> To give aircrew and Operations staff practice in Alert and Readiness procedures. <sup>5</sup> The form of the 1962 competition, No 207 Sqn recorded, was “a scramble take-off followed by a short primary navigation stage, a night secondary navigation stage and three NBS/RBS attacks . . .”

flying routes in the UK had been laid down for crew training, and noted in its comments for September 1962: "It appears that it is now the policy to include a low-level phase in some of our major exercises . . ."

Perhaps one of the best practical expressions of this policy was provided by Exercise Co-op in June 1963 when 15 of the Marham-based Valiants participated. The object was to test the defences and communications of the NATO air forces in Europe and (according to No 207's chronicler) "the main part of the flight was a low-level route coasting in over Holland and penetrating deep into France, to be flown at 1,500ft" – the CO of No 49 Squadron (Wing Commander J. Langston) commenting enthusiastically that the exercise "gave participating crews invaluable experience in low-level flying over a Continental route and provided a pleasant change from the now all-too-familiar UK routes".

No 49 had apparently made good progress in the new role, for in November 1962 the ORB noted that "in the low-level training the squadron now has seven crews who have completed the combat crew checks after five navigation sorties. Authority has been given for selected crews to fly at 500ft above ground level within five miles of track during daylight and at 1,000ft during night hours. 'Pop-up' bombing runs are now being carried out on selected targets".

The introduction of low-level flying had two consequences – a new classification scheme for crews and a new camouflage scheme for their Valiants, while the low-level flight profile had a new dimension added to it early in 1964, a high-speed run known as the "fast dash". These developments were succinctly noted by No 207 Squadron in its ORB, which commented in August 1963 that "the new classification scheme has arrived on the squadron" and that the principal change was "the addition of low-level bombing for pilots", which took two forms: "firstly, the pilot makes some simulated releases on targets during low-level sorties and his accuracy is measured by taking an NBS photograph at his designated point of release. After he has proved proficient at this form of release he is let loose on Wainfleet range to drop 25lb practice bombs at low level . . ."

The new camouflage scheme and the high-speed run both came in at the beginning of 1964, as No 207's ORB recorded in its January entry: "this month has . . . seen the introduction of the Fast Dash to the low-level profile. This provided for each crew to do six high-speed runs per classification period. These runs are at 320kt, and are limited to the last four minutes of the operational routes. This means that crews get experience in handling the aircraft and attacking targets at operational speeds".

Of the new camouflage, the first example of which reached the squadron during that month, the ORB had this to say – referring to what it called "the 'new look' in Valiants": "WZ403 was returned to the squadron from St Athan<sup>1</sup> and arrived resplendent in the new camouflage colour scheme. This is gray and green in the traditional style, with the exception that the under-surfaces are still white. It is to be used on all low-level bomber aircraft and should prove effective".<sup>2</sup>

When centralised servicing was introduced in February 1964 it meant that aircraft and groundcrew were taken away from the squadrons; the OC No 49 Squadron (Wing Commander J. Langston) remarked in the ORB: "it seems strange operating without our own aircraft and technical organisation; but the change-over to centralised servicing and its associated pooling of aircraft<sup>3</sup> has been comparatively smooth".

No 207 Squadron had explained in its January ORB entry what the change implied, and in February expressed some disenchantment with it. Explaining the implications, it said that "a centralised organisation" was being introduced "under which the three Tactical Bomber Force squadrons' airmen and aircraft go over to Technical Wing. A Planning Cell in Operations Wing compiles a weekly flying programme, in conjunction with the squadron commanders and aircraft are then allotted daily to squadrons . . ." There were some pejorative remarks, however, in February's entry – which said that "the squadron has now suffered under centralised servicing for one month and, as suspected, there have been a considerable number of teething troubles. The most noticeable of these have been frequent last-minute aircraft changes and delayed take-off times".

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<sup>1</sup> No 32 MU, where major servicing was done. <sup>2</sup> Frequent quotation from the ORB of No 207 Squadron does not imply any denigration of the activities of the other two squadrons at Marham; but it was particularly well compiled at this period (by Flying Officer P. J. Dummer) and provides a useful source of background information on the TBF squadrons. <sup>3</sup> Thus No 49 Squadron noted under "Aircraft Strength" in March 1964: Establishment 8UE Valiant B. (K)1 transferred to RAF Marham. Strength 9UE Valiant B.(K)1 held by RAF Marham".

However, these policy changes affecting both flying techniques and the maintenance of aircraft were to have only seven months' application to Marham; for by mid-August its Valiants had been grounded and thereafter did only limited flying until they were withdrawn from service in January 1965. The No 207 Squadron ORB remarked in its August 1964 entry that the dominant feature of the month's training had been a shortage of aircraft in its final week, explaining that early in August "an aircraft from No 232 OCU suffered a failure of the rear spar in flight" and that because of this "all Marham aircraft were grounded on 12 August for the afternoon". However, in the evening they were cleared to fly at high level only and by next day "low level was back in, but a restriction of 15kt surface wind was imposed as a maximum. In addition to this all 'fast dashes' were prohibited".

What had happened at No 232 OCU, Gaydon, was that on 6 August a Valiant on a training flight had suffered the fracture of its rear spar. As a result of this, and following an examination by the RAE and by Vickers-Armstrongs (Aircraft), it was decided on the 25th that all Valiants which had consumed as much of their fatigue life as the one with a cracked rear spar should be grounded and inspected – an inspection subsequently applied to the whole of the Valiant force.<sup>1</sup>

The effect of these decisions upon Marham (as, inevitably, upon the other Valiant bases – Honington and Gaydon, though Marham was the only one by that date to be operating Valiants exclusively) was to cause an extreme shortage of aircraft. After the 25 August directive there were only five available (out of a total of 21) and on the 26th this had dropped to two. During September, the No 207 Squadron ORB reported, "the dominant feature was the continued lack of aircraft"; and the problem was to see how much flying could be done with such as there were – which led to some interesting arithmetical calculations. "In the early part of the month it had been calculated that maximum utilisation of the four aircraft on the station would give each squadron approximately 100hr per month. This gave each crew approximately 10hr per month, split into one four-hour trip and three two-hour trips. Halfway through the month, however, there was some re-calculation of fatigue life of the available aircraft and the flying time allotted to each squadron was halved. All sorties became two hours, . . . emphasis being placed on continuation training. Co-pilots were planned to fly once per month, and captains to fly together, the object being to keep captains current and 'safe'".

The Valiant investigation during the latter half of 1964, and the resulting decision to withdraw the aircraft from service, will be referred to again in a later chapter; here the references are confined to the three squadrons of the Tactical Bomber Force, their disbandment early in 1965 and the proposal – considered but rejected – to replace them with Vulcan B.1s.

While the Valiants at Marham were being examined for signs of fatigue the squadrons did their best to keep going, despite the limited amount of flying they were able to do, and even this subject to restrictions. The ORB entries reflected the difficulties and frustrations. During October 1964 No 49's CO (Wing Commander J. Langston) commented that "the paucity of flying and the large ground training and sporting programme combine to tell their own story of the continued grounding of the TBF pending a wing spar repair programme"; while No 207 noted in the same month that the situation regarding the numbers of aircraft available had been clarified: after being examined they were put into three categories – A, fit to fly; B, grounded as being in need of repair and worth repairing; C, grounded and "may be written off". In the early part of October, Marham had nine category A Valiants. No 148 Squadron, reporting on its crew situation, seemed to be still optimistic that the aircraft would be put right: "due to an extensive modification programme to be carried out on the Valiant aircraft", the ORB noted, "the number of crews on the squadron's establishment was reduced from 11 to eight". In his November comments No 49's CO still seemed to be hopeful about the future: while referring to "continued severe restrictions on low-level flying", he said he looked forward to "the completion of the Valiant repair scheme". But this was not to be.

On 9 December a further inspection of one aircraft had revealed much more extensive cracks than had hitherto been found: No 207 noted in its ORB for this date that, as a result, all Valiants had been

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<sup>1</sup> From a chronology drawn up for the CAS (ACM Sir Charles Elworthy) following a request from the S of S (Lord Shackleton), in State of Readiness of the V Bomber Force (MO 3/5/1 Pt 2).

grounded – when defects were found in the front main spar of a Valiant under investigation for rear spar defects; and No 49's record was on much the same lines – the Valiant force had been grounded “pending further examination of both front and rear spars of the aircraft”. The QRA commitment was being maintained, but flying was discontinued for the rest of the month, so that all the Valiants could be checked.

This new development, which was to mark the beginning of the end for the Valiant, was reported to the Minister of Defence for the RAF (Lord Shackleton), who told the Secretary of State for Defence (Mr Denis Healey); and as the possible loss of the Valiants affected Britain's contribution to NATO, the UK NMR (National Military Representative) at SHAPE (Air Commodore C.B.E. Burt-Andrews) was instructed on 11 December to tell Saceur the latest position.

Meanwhile the fatigue problems – affecting not only the Marham Valiants but those in service throughout the RAF (61 all told)<sup>1</sup> – were being investigated, which took several weeks. On 8 January 1965 the Minister for the RAF was informed<sup>2</sup> that after the fleet had been grounded on 9 December a “thoroughgoing assessment of the wing structure” had been started, and that this was not yet complete; results were expected by 15 January. When these were known it could only be said that, at best, some of the aircraft might have some more flying hours left without major repairs; at worst, the whole fleet might have to be written off.

In the event, the worst of these situations eventuated, and on 19 January 1965 the Valiants were withdrawn from service. The Minister of Defence was told by the Chief of the Defence Staff (Earl Mountbatten) on the following day<sup>3</sup> that the Air Force Board Standing Committee had been unanimous in their opinion about this, and that the Chiefs of Staff had agreed when they discussed the matter on 19 January. The implications as far as the Saceur-assigned Valiants were concerned were that the 24 aircraft which comprised his Tactical Bomber Force would no longer be available to him, and his QRA and target coverage would be reduced accordingly. A political decision would have to be taken as to whether this force should be replaced; and if the Minister agreed that the Valiants should be withdrawn from service an early public statement would be necessary.

The Secretary of State immediately informed the Prime Minister (Mr Harold Wilson),<sup>4</sup> saying that the fatigue problem had had a thorough technical investigation by the Ministry of Aviation; that the only safe course was a major repair programme which would take about 18 months and cost about £2m, in addition to at least £½m for R&D; and that the damage had occurred at random throughout the Valiant tanker and reconnaissance as well as bomber force, and thus was “in no way attributable to the low-level role of the Tactical Bomber Force”. He saw no alternative to grounding the Valiants.

As a corollary to his proposal – which the Prime Minister accepted – that the Valiant force should be grounded, the Minister of Defence said he considered that the aircraft should not be repaired; that Saceur should be told, in confidence; that a statement should be made in Parliament; and that any possible ways of reducing the seriousness of the loss should be examined.

The only way in which the loss of the TBF Valiants could be made good was by replacing them, on a one-for-one basis, with 24 Vulcan Mk 1s – due to become surplus from September 1965 onwards as more squadrons received Vulcan Mk 2s – which would in due course be modified for dual carriage of US nuclear weapons. This possibility was discussed from 22 January, when the Air Force Department produced a paper setting out the implication of it, until March – when the UK Government decided not to replace the Valiants by Vulcans and Saceur was so informed, with reasons which will subsequently be mentioned.

In the meantime a more urgent action was taken – that of informing Saceur that the Valiants would no longer be available to him, and this was done by a personal visit from the AOC-in-C Bomber Command (Air Marshal Sir John Grandy),<sup>5</sup> who gave General Lemnitzer an up-to-date report on the situation.

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<sup>1</sup> Of this total, 24 were assigned to Saceur, 16 were used as tankers and eight on strategic reconnaissance, the rest being used for training or held in reserve. <sup>2</sup> Note by PUS(RAF). <sup>3</sup> Minute from CDS to S of S for Defence, 20 January 1965. <sup>4</sup> Minute, 20 January 1965. <sup>5</sup> On 25 January 1965, shortly before he relinquished that appointment to become C-in-C British Forces, Far East, and UK Military Adviser to SEATO.

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When pressed as to possible alternatives, the AOC-in-C mentioned that a number of Vulcan 1s would be going out of service later in the year and that there was a possibility of them being retained – but that this was subject to the decisions by the Chiefs of Staff and the Government.

The other urgent requirement was for a public statement, and this was made by the Ministry of Defence on 26 January 1965 – the day which marked the ending of QRA duties for the Valiant TB force at Marham. No reference was made in this statement to the TB force, because no decision had been made as to whether it would be re-formed with Vulcans, but plans to replace tanker and PR Valiants with Victors were announced. Fatigue failure had occurred “throughout the Valiant force”, the statement said; it was not “in any way connected with low-level flying”.

For the squadrons at Marham that statement sounded the death-knell of their role in Bomber Command. No 49 Squadron’s ORB succinctly described the sudden change: “Until 26 January 1965 the squadron was part of the Tactical Bomber Force, . . . operating in the low-level role and placed at the disposal of Saceur”. On that date it had been announced that “the cost, both monetary and in time, of a major repair to the aircraft main spars was prohibitive and the Valiant has been withdrawn from service” – “from 0001hr on 27 January 1965”.

The three Marham squadrons were wound down during the three months February-April 1965, their Valiants disposed of and their personnel posted. On 28 April No 148 Squadron was disbanded and Nos 207 and 49 on 1 May.

Although the disbandment decision was technically inevitable, there was considerable bitterness at Marham about the way in which it was made known, judging by the final entry in the station’s ORB for January 1965. This said that on the 26th

“the long-awaited and much-postponed announcement was received at Marham – by permission of BBC radio and television. Not until 1730hr, when most personnel had gone home for the night, was an official signal received. This authorised the disbandment of No 214 Squadron, cessation of QRA and the ending of all Valiant training.

“The official news and the MoD announcement was numbing in both its effect on Marham and its matter-of-factness. Marham’s contribution to NATO, which was by far the most powerful and reliable of any RAF station, was dismissed, and great play was made about the loss of tankers. There was no doubt at Marham or at Shape which was the greater loss”.

## CHAPTER 14

## QRA and Overseas Deployments

QRA (Quick Reaction Alert) was introduced into Bomber Command at the beginning of 1962 and continued until the end of June 1969 when the duties were handed-over by the V-force to the Royal Navy's Polaris-armed nuclear-powered submarine force, which became responsible thereafter for the strategic nuclear deterrent role. In RAF terms, QRA meant that each V-bomber squadron would have one aircraft at 15 minutes' readiness throughout the 24 hours of every day during the year, weekends and public holidays notwithstanding. It was the ultimate expression of strategic nuclear deterrence by bombers and the operational embodiment of an alert and readiness policy. While the Thor IRBMs were deployed in the UK, QRA also applied to them.

When QRA duties ended for the V-force squadrons, at midnight on 30 June 1969, the Chief of the Air Staff (Air Chief Marshal Sir John Grandy) sent the following message to the AOC-in-C Strike Command (Air Chief Marshal Sir Denis Spotswood):-

"As you know, the last White Paper announced that this year the Royal Air Force will transfer to the Royal Navy the responsibility of providing Britain's contribution to the strategic nuclear deterrent. I think it appropriate to remember that this task has meant maintaining, at all times throughout seven years, the highest state of readiness which the Royal Air Force has known in peacetime. The way in which QRA (quick reaction alert) has been performed and the reaction of the force to the operational demands of our plans and those of Saceur (Supreme Allied Commander, Europe)<sup>1</sup> has been an unsurpassed demonstration of professional skill, dedication and tenacity.

"The long hours of arduous duty in cockpits, crew rooms, dispersal, hangars and operations rooms have brought the reward of knowing that a vital task has been successfully completed . . . ."

QRA evolved from the Alert and Readiness plans which were drawn up in 1957. These applied to all Commands of the Royal Air Force, who were asked to provide them; but there was a special significance about these for the V-force in Bomber Command, particularly with the threat in the 1960s of attacks on the bomber bases by missiles fired on low trajectories from Soviet satellite territories. If the V-force were to be regarded as a credible deterrent, it had to demonstrate its ability to generate its weapon systems, to disperse them in order to decrease their vulnerability and to get airborne in the minimum time possible on retaliatory missions. The highest state of readiness was an airborne alert – which was considered for the Skybolt era.

During 1957 the Defence Committee had invited the Minister of Defence,<sup>2</sup> in consultation with the Secretary of State for Air, to consider arrangements for improving the state of readiness of Bomber Command. The Air Ministry noted in response to this request<sup>3</sup> that the offensive purpose of such readiness was to uphold the deterrent by providing for the maximum speed of retaliation, and that its defensive purpose was to prevent the Soviet Union from readily assuming that the V-force could be easily destroyed by surprise attack, and to mitigate the effect of any surprise. It was considered that adequate dispersal of the force was an essential part of readiness.

The Air Ministry pointed out that policy and principles were well developed. Works services had been completed or begun at seven dispersal airfields (there were eventually to be 36, including the six Class I bases) and plans provided for two degrees of alert for the V-force. At the first, the whole force was required to come to 40 minutes' readiness as quickly as possible on its main bases; at the second the force (including its reconnaissance element) was to be dispersed over its dispersal airfields when the full programme for these had been completed. It was thus stressed from the outset that adequate dispersal was an integral part of V-force readiness. In the Air Ministry view, this concept ought to be developed further in anticipation of the time when the manned aircraft threat to the V-force was supplemented by

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<sup>1</sup> From 23 May 1963 the whole of the V-force was assigned to Saceur (Memorandum on Assignment of V-bombers, from the Chief of the Defence Staff to Saceur, in Nassau Agreements Size and Form of Assignment of British Element to a NATO Nuclear Force 847/071/63). <sup>2</sup> D(57)14th meeting. <sup>3</sup> VCAS Note to S of S, 4 February 1958.

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one from ballistic missiles. It was estimated at that time – the Air Ministry paper was put forward to the Minister of Defence in February 1958 – that there would be 24 dispersal airfields in addition to the six main bases.

Meanwhile, Bomber Command had itself drawn up a Readiness Plan, dated 15 January 1958, based on a paper on Readiness of 19 October 1957; and this defined two kinds of Alert – ‘A’, declared when war was considered a possibility or for training; and ‘B’, when there was thought to be a risk of war. In the latter case, measures included the dispersal of two-thirds of the squadrons, and bringing the maximum possible number of aircraft to armed readiness. Referring during April 1958 to RAF readiness and to the Bomber Command Readiness Plan, VCAS (Air Marshal Sir Edmund Hudleston) commented<sup>1</sup> that there had been three separate approaches to these questions during the last few months – the Minister of Defence’s request for Air Ministry’s proposals on improved bomber readiness; an ACAS (Ops) Working Party which had produced a paper on RAF readiness, seen by staffs at all operational Commands; and Bomber Command’s Readiness Plan. VCAS said that ACAS(Ops) (AVM R.B. Lees) was attempting to harmonise the Bomber Command and his own Working Party proposals.

The formulating and approval of such important proposals was a long and complex business, especially in the days before a centralised Ministry of Defence. Thus the Air Ministry proposals had been sent to the MoD on 21 February 1958; the Minister discussed them on the 27th with S of S, and asked for greater detail as to what steps could be taken to improve the readiness of Bomber Command. What resulted, after much examination by the Air Staff of the logistic factors involved – such as additional manpower, increased costs and further dispersal airfields, was a paper sent by S of S to the Minister on 21 May.<sup>2</sup>

In this he set out what was involved in rising scales of readiness. Thus, assuming that there were to be seven days’ strategic warning of attack, achieving the same degree of readiness at weekends and holidays as during the working week would involve some 60 extra airmen and about £50,000 a year in cost. Keeping aircraft at continuous readiness for 24 hours a day would involve over 2,800 technical, administrative and aircrew personnel, a capital expenditure of up to £9 million and running costs of nearly £7 million p.a.<sup>3</sup> While existing plans for dispersal meant that eight out of 24 bombers at each main base remained there while the rest were dispersed in groups of four, to reduce the number remaining at each main base to four would require six additional dispersal airfields – at a capital cost of about £2.5 million with additional running costs of about £1 million.

The readiness of Bomber Command, and what could be done to improve it in the light of the S of S paper describing what was involved, was discussed by the Minister of Defence on 21 July 1958 at a meeting attended by the S of S, Chief of the Air Staff and C-in-C Bomber Command.<sup>4</sup> At its conclusion the Minister approved proposals to enable the MBF to come to readiness at weekends and holidays no less rapidly than during the week, to make it possible to bring the force to 15 minutes’ readiness for a week in an emergency and to provide six more dispersal airfields. The Ministry also asked the S of S to report on what could be done to keep part of the force at 15 minutes’ readiness for longer than one week in an emergency. These decisions meant that, by mid-1958, plans were being made to bring about “the highest state of readiness which the Royal Air Force had ever known in peacetime”.

On 7 July in that year Bomber Command had been directed to introduce into the medium bomber squadrons a readiness capability which would meet the conditions of strategic and tactical warning – the former, 24 hours’ notice, after which 75 per cent of the force should be at readiness, armed and dispersed; the latter, 40 minutes, capable of being sustained for a month, and/or 15 minutes, capable of being sustained for a week. On notification of an emergency, the generation rate of all MBF aircraft on stations was to be 20 per cent in two hours, 40 per cent in four hours, 60 per cent in eight hours and 75 per cent in 24 hours. These conditions were to be met at any time of the day, at weekends or on holidays throughout the year. Six additional airfields were to be provided, bringing the total number, including the six Class 1 bases, up to 36.

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<sup>1</sup> Draft Minute to CAS, April 1958. <sup>2</sup> Measures to Improve the Operational Readiness of Bomber Command, in file on Operational Readiness of the RAF. <sup>3</sup> At that time, with the running-down of National Service, there was a shortage of manpower in the RAF and Bomber Command was under-manned by about 2,000 personnel.

<sup>4</sup> Respectively Mr George Ward, ACM Sir Dermot Boyle and ACM Sir Harry Broadhurst.

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"These instructions", said an Air Ministry progress report to the MoD a year later (on 2 July 1959), "were confirmed at a meeting called by the Minister of Defence with the Secretary of State for Air on 21 July 1958". But "it was soon evident", the report added, "that the main problem would be providing men, particularly aircraft servicing chiefs and technicians for servicing of the navigation and bombing system". So a station-by-station programme for providing the manpower necessary to meet the readiness requirement, including the introduction of a two-shift/18hr working day, was drawn up. In addition to more ASCs and radar servicing technicians, some increases in non-technical tradesmen were required.

These plans for Bomber Command alert and readiness, with the demands they made on manpower and the capital and running costs they involved, showed how much the V-force required in sustained effort and financial support to bring it to, and maintain it at, a high pitch of operational efficiency – so that it could be called to readiness at any hour of the day or night throughout the year.

Early in 1959 – on 5 March – Bomber Command issued its medium bomber force alert and readiness plan, the operational corollary to the logistic plans which had been made in the previous year. This BC plan established the alert phases, operational procedures and requirements for the MBF stations, and the procedures and support required from other RAF Commands. It was to come into force on the squadrons as soon as their technical manpower requirements for the two-shift/18hr day establishment were 100 per cent fulfilled.

An important facet of the alert and readiness plan was the Bomber Command Operations Centre, which was re-organised for this purpose, and its facilities, communications and manning approved by the Air Ministry. This re-organisation enabled it to undertake the direction of the conversion of the strike forces from peacetime to emergency readiness conditions, and of controlling a nuclear strike, should that ever be required. During May 1959 there was a full-scale practice of the Bomber Command alert and readiness plan, to test all the procedures involved, and the facilities provided at Class 1 and dispersal airfields. The progress report sent by the Air Ministry to the Minister of Defence on 2 July that year (and in which this description of the Operations Centre occurs) opined that this plan, "subject to minor amendment", was feasible.

Looking at the "receiving end" of this full-scale plan, it is interesting to see what went on at (for example) RAF Cottesmore, first of the Victor stations, which housed Nos 10 and 15 Squadrons.<sup>1</sup> Its ORB for May 1959 recorded that

"Exercise 'Mayflight' was a Bomber Command alert and readiness exercise held between 0700hr on 4 May and 2300hr on 8 May. This exercise included a dispersal of four aircraft of 10 Squadron to Boscombe Down and four aircraft of 15 Squadron to St Mawgan. On a signal from Bomber Command all these aircraft and as many others as were serviceable at Cottesmore were to scramble and carry out a normal Bomber Command exercise making NBS attacks against selected Continental targets.

"Alert 'Alpha' occurred at 0810hr on 4 May. On this alert 12 aircraft were bombed-up, and advance parties sent to St Mawgan and Boscombe Down by Transport Command airlift.<sup>2</sup> The bombing-up was completed in three hours at 1110hr, and all transport movements were completed by 1248hr. The de-bombing of the aircraft which began at 1321hr was completed by 1545hr, that is 2hr 24min.

"Alert 'Bravo' was given at 0935hr on 5 May. The eight aircraft going away took off as soon as possible at two-minute intervals, and the last was airborne after 24min at 0959. The airlift of the main parties to Boscombe Down and St Mawgan was completed by 1201hr. Aircraft and support parties having arrived at their exercise bases, all the aircraft were serviced and all Cottesmore's aircraft were ready for flight by 1515hr, which was 5hr 40min after alert 'Bravo'.

"There were three practice scrambles during the exercise. The first an alert 'Orange' which required a scramble up to and including engine start occurred at 1040hr on 6 May 1959. This alert was completed in seven minutes, Wing Commander C.B. Owen of 10 Squadron taking only 5min 20sec. An alert 'Yellow', which required scrambling up to and including taxi to the take-off point, came at 1420hr on the 6th.

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<sup>1</sup> In April it had been visited by the Prime Minister (Mr Harold Macmillan) and King Hussein of Jordan, and in May by the Shah of Iran. <sup>2</sup> An example of "the support required from other RAF Commands".

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All crews completed this alert within 9min 40sec, Squadron Leader W.B.C. Young of 10 Squadron taking only 4min 35sec. A further alert 'Yellow', this time at night, came at 2215hr on 6 May. This alert was completed in 8min 5sec, Wing Commander Owen first again with 5min 10sec.

"The scramble itself came at 1035½hr on 7 May. All the dispersed aircraft and three from Cottesmore were airborne . . . .

"All the aircraft successfully completed the exercise and the last one landed back at Cottesmore at 1544hr. The exercise was declared over at 1636hr on 7 May".

Exercise Mayflight which the Victor squadrons were performing involved, as was evident from the Cottesmore ORB description, dispersal, alert and readiness procedures and scrambles. It was defined<sup>1</sup> as "virtually a preplanned Mick plus the actual dispersing of aircraft". Exercise Mick was designed to test the ability of V-force personnel to generate aircraft and weapons on the main bases, and to practise aircrew and operations staff in alert and readiness procedures. Posing an even greater test was Exercise Mickey Finn – the first of which was held on 5 December 1961 – the annual no-notice dispersal exercise whose purpose was to test the readiness capability of the V-force, whose dispersal was supported by all the home Commands. This first Mickey Finn was to be followed shortly by the introduction of Quick Reaction Alert, the highest form of readiness achieved by the MBF, at the beginning of 1962. QRA was already practised by the Saceur-assigned Valiant squadrons at Marham and by the B-47s of the USAF Strategic Air Command on Reflex deployment to the UK.<sup>2</sup> The steps by which readiness was increased, to the pitch achieved in the 1962-69 period, dated from the end of 1959 when the British Nuclear Deterrent Study Group made its first report.<sup>3</sup>

The BNDSG had been set up in July 1959 by the Minister of Defence "to consider how the British-controlled contribution to the nuclear deterrent can most effectively be maintained in the future and to make recommendations"; and one of the opinions expressed in its long interim report of 23 December 1959 was that the effective time for evasive action by the V-bombers might be as short as three minutes – if missiles were to be fired on low trajectories from East Germany. The report commented that the Air Ministry believed that "with improved techniques it should be possible to reduce the V-bombers' reaction time" from the four minutes then required for them to take off from dispersal airfields and fly clear of a nuclear attack. How was this reduction to be achieved? In other words, what could be done more than was being done to get the MBF off the ground even more quickly?

There were two main improvements to existing techniques, and these were examined and put into effect by the Air Ministry in co-operation with the Ministry of Aviation during 1960-61.

The Air Ministry reported to the Treasury in March 1961<sup>4</sup> that the "improved techniques" mentioned in the British Nuclear Deterrent Study Group report were revised dispersal plans, including the provision of operational readiness platforms, and simultaneous engine starting. It emphasised that this was "no new policy and no new operational concept"; that readiness plans since the BNDSG first reported over a year ago had been "consistently directed to enabling the V-force to escape a hypothetical Soviet attack with MRBMs fired on low trajectories from satellite territories" – as postulated in the group's report.

The dispersal plans had already been approved in principle by the Treasury, which had expressed concern at the high costs involved at some of the airfields – particularly those in the west, which the Air Ministry argued were less vulnerable because they offered a longer warning period.<sup>5</sup> A refinement to their facilities in the revised plans was the provision of ORPs (operational readiness platforms) – areas big enough for four V-bombers to stand side-by-side within a few feet of the runway, so that they could start up, roll forward and line up for take-off – cutting out any time which would be wasted by taxiing. Simultaneous engine starting, however, the other improved technique, was a much more complicated matter. As the Air Ministry told the Treasury, in advancing estimated costs:

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<sup>1</sup> In a minute of 6 June 1961. <sup>2</sup> No 207, one of the Saceur-assigned squadrons at Marham, reported in its ORB that on 21 August 1963 Majors Louslier and Rose of the USAF visited the squadron "under a new scheme whereby USAF aircrew members visit the squadron . . . during their time off from Reflex . . . at Upper Heyford. These two officers flew with the squadron". <sup>3</sup> Ref BND(SG)(59)19(Final). <sup>4</sup> AUS(A)/9680, 15 March 1961. <sup>5</sup> Bishops Court, NI, was the most expensive in estimated works costs (£231,000) and Dyce, Aberdeenshire, the second at £192,000. <sup>6</sup> AUS(A)/9680.

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"Now that the Mk 2 V-bombers are being introduced, they must be fitted with simultaneous engine starting in order to achieve a speed of reaction comparable with that already demonstrated in the case of the Mk 1s. The compressed-air starting system of the Mk 2s is not susceptible to the improvements within Service resources possible in the case of the electrical starting system of the Mk 1 . . . ."

— in other words, modification would have to be done by the manufacturers. The "simplest and most effective scheme", the Ministry explained, involved installing compressed-air bottles in the Mk 2s; there would also have to be modifications to the engines to enable them to stand up to the high torque of high-speed starting.

Other engineering implications of equipping the Mk 2s for scramble take-offs were cabin air-conditioning and air-ventilated suits worn by the crews, both supplied from air-supply trolleys, which had to have "snatch disconnections" for quick release as the aircraft rolled forward; conditioning for the nuclear stores; and high-voltage power for the flight instruments to enable them to function accurately during rapid take-offs.

The Minister of Defence (Mr Harold Watkinson) on 13 July 1961 approved the proposals for improving the readiness of the Mk 2 V-bombers by equipping them for simultaneous engine starting, in reply to a minute of the Secretary of State for Air on 12 June. The full cost of the modification programme was estimated to be nearly £5½ million (£4.5m plus an R&D element of £0.9m).<sup>1</sup>

Later that year the AOC-in-C Bomber Command (Air Marshal Sir Kenneth Cross), with the operational apparatus thus at his disposal for achieving the highest state of readiness his Command had ever achieved in peacetime, decided to introduce a permanent alert concept — having one aircraft per squadron in the MBF always at 15-minute readiness. Writing to the VCAS (Air Chief Marshal Sir Edmund Hudleston) on 31 October 1961<sup>2</sup> he said that it seemed "only military commonsense to maintain a permanent alert concept of some form" in the face of a growing Soviet threat and because of the need to build up experience to compete with a greatly reduced warning time during the coming years. He added that a permanent alert force also provided the opportunity of closer integration with the SAC Reflex forces in the UK<sup>3</sup> — taking full advantage of their combined strengths and the total effect of the forces' ECM equipment in penetrating the enemy's outer radar defences.

The C-in-C said he proposed to institute a permanent alert early in the New Year, initially with one aircraft per squadron, or approximately 15 aircraft from the MBF. With the re-organisation of servicing procedures<sup>4</sup> it should be possible to build up the number of aircraft at standby, until by the end of 1962 he aimed at having two aircraft per squadron — or 30 aircraft in the force — permanently at 15 minutes' readiness.

He added that during the past month the readiness of the Thor force had been improved and it was now possible to maintain 65 per cent of it at 15 minutes' standby. That was "a minimum figure" and was often exceeded; a "good average" of Thors at permanent readiness was 45-50. This total, coupled with 30 aircraft — "mostly armed with megaton-range weapons", would give a total force of 75-80 weapons systems at 15 minutes' readiness by the end of 1962. "Such a force", said the C-in-C, "poses a real deterrent".

The V-force also played a deterrent role during its overseas deployments in the 1959-69 period, particularly in the Far East when Confrontation occurred (1963-66) between Malaysia and Indonesia. The Directives given to the AOC-in-C Bomber Command by the Chief of the Air Staff spelt this out clearly. In 1959<sup>5</sup> two of the main tasks for the medium bomber force were "to provide reinforcements for limited war or other operations in the overseas Commands of the Royal Air Force as instructed by the Air Ministry", and "to support British interests overseas by operational training detachments".

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<sup>1</sup> Minute to Minister, SZ/702/61, 29 June 1961. <sup>2</sup> BC/TS.89347/CINC. <sup>3</sup> USAF Strategic Air Command B-47 Reflex operations began at Greenham Common and Fairford in January 1958 and at Brize Norton (succeeding a "90-day rotational assignment") in April that year. <sup>4</sup> *I.e.* the introduction of progressive and then of centralised servicing. <sup>5</sup> ACAS(Ops)/C-in-C, 15 July 1959.

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These tasks remained unaltered in principle, while allowing for some differences in wording, in directives throughout the period. Thus in 1963<sup>1</sup> the C-in-C was told that one of the main tasks of the MBF was "to provide reinforcements for limited war or other operations in the overseas Commands of the Royal Air Force", and that MBF aircraft "should make flights to overseas destinations to exercise reinforcement plans". In 1965<sup>2</sup> the C-in-C was told that the MBF was "to provide reinforcements for limited war or other operations in the overseas Commands . . ." and that "aircraft of the force should make flights to overseas destinations to exercise reinforcement plans"; additionally, "flights should be made to carry out operational training and to support British interests abroad, in so far as such flights can be made without detriment to the main tasks of the force" – the prime task, of course, being "to serve as the principal national deterrent to general war by maintaining a capability to meet aggression with immediate nuclear retaliation" (as the 1965 Directive put it).

The qualification about overseas flights being made "without detriment to the main tasks of the force" was an important one, and during this period squadrons sent detachments overseas when reinforcement was required, retaining their position in the front line – so that its strength wasn't impaired, in terms of numbers of medium-bomber squadrons<sup>3</sup>.

During this period the Far East provided a perfect scenario for V-bomber overseas deployment. It could be reached quickly, with three refuelling stops (El Adem or Akrotiri, Bahrain and Gan), or even more quickly with flight-refuelling; and the Firedog operations in Malaysia, which ended in July 1960, and the Malaysia-Indonesia Confrontation, provided the need for a medium-bomber presence which could be fulfilled by rapid reinforcement.

In effect, with these detachments, Bomber Command was supplying the Far East Air Force with a medium bomber capability and the V-bombers were operating there in a conventional role - a potentiality which had been foreseen some years earlier. In a paper of 23 March 1955 on the size of the V-force the Air Minister (Lord De L'Isle and Dudley, VC) had said that in the Far East theatre the V-bomber "could use its large HE-carrying capacity to great advantage". The Victor, with its exceptionally large bomb-bay, had a 35x1,000lb bomb load and the Vulcan one of 21x1,000lb. The former's capacity was dramatically demonstrated before the Tungku of Malaysia, Abdul Rahman, on 27 March 1965 when one of No 57 Squadron's aircraft dropped 35 1,000lb bombs in the vicinity of HMS *Eagle* which had the Tungku aboard as a guest. Some years earlier, when one of No 83 Squadron's Vulcan B.1s on detachment to RAAF Butterworth had dropped six 1,000lb bombs on the Song Song range, the ORB noted that its crew were "the first . . . to prove the Vulcan in squadron service in the non-nuclear bombing role".<sup>4</sup>

At that date – 21 June 1960 – No 83 Squadron's four aircraft and six crews plus supporting groundcrew were at Butterworth on Exercise Profiteer, the object of which their ORB described as "to operate four Vulcans at RAAF Butterworth and exercise crews in the rapid reinforcement of the Far East Air Force, and to provide them with operating experience in the Far East theatre".<sup>5</sup> This exercise had been going on since 1957; it provided V-bomber support for the Firedog operations against Communist terrorists in Malaya (1948-1960) and was first undertaken by No 214 Squadron, three of whose Valiants went out from Marham to Changi at the end of October 1957, remaining there for nearly three weeks. Two other Valiant squadrons, Nos 90 (March 1958) and 148 (February 1959), subsequently provided Profiteer detachments. Though these occurred within the period of Firedog operations, which ended on 31 July 1960, the V-bombers were not used for offensive air support. No 214's training flights from Changi included a flag-showing visit to Vientiane in Laos (where they were the first jets to be seen), landing at Bangkok on the way back. No 90 Squadron in its report<sup>6</sup> said that "the operation was instructive to aircrews and groundcrews in reinforcement problems and operations in tropical areas. It also enabled

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<sup>1</sup> ACAS(Ops)/C-in-C, 22 October 1963. Both in file BC Directive (ID9/901/3 Pt 2). <sup>2</sup> 18 February 1965 (ID9/901/3 Pt 3). <sup>3</sup> A Minute of 24 April 1961 in "V" Bombers General (AF/CT 857/66) refers to Operation Mastodon, saying that *wef* 1 July 1962 this commitment would be fulfilled by one squadron of Victor B.1As operating from Butterworth and another operating from Tengah, but there is no sign of it in their ORBs. <sup>4</sup> ORB, June 1960. <sup>5</sup> Ditto. <sup>6</sup> Report on Operation Profiteer, 8 January – 8 February 1961.

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the squadron to complete a large number of visual bombing exercises. It was valuable in proving items of armament equipment, and in exercising armament personnel and facilities at RAAF Butterworth". No 148 commented that after the initial familiarisation flights around Malaya on 10 February 1959 "all crews then completed two long sorties over Borneo and Malaya taking radar photographs of airfields and towns at the request of Headquarters, FEAF".

Although Exercise Profiteer started during the period of Firedog operations<sup>1</sup> it was not associated exclusively with them and continued in fact until 1962, being performed by the two Victor B.1 squadrons from Cottesmore, Nos 10 and 15. With the object of the exercise being "to exercise medium-bomber crews in the reinforcement of FEAF, and to provide operating experience in the Far East theatre", in a situation wherein the crews were "required to operate in the Far East and to adapt their techniques to the conditions prevailing in that area", No 10 Squadron sent out four Victor B.1s to Butterworth in July 1960 – succeeding No 83 Squadron, who had had four Vulcan B.1s there from 9 June to the beginning of July. No 10 said in its report<sup>2</sup> that the Victor "performed satisfactorily under tropical conditions, although for operations at or near maximum all-up weight a Class 1 airfield would be an advantage"<sup>3</sup> and that valuable experience had been gained by all crew members; in particular the radar operators were "aware of the problems of using their equipment over hilly jungle terrain". As to serviceability, "electrical defects were numerous – in particular, inverter control panels seemed to suffer in the humid atmosphere", and "contactors in various circuits overheated and welded". The Victors visited Clark AFB, Manila, in the Philippines;<sup>4</sup> took part with RAAF aircraft in a 250kt/800ft fly-past over Kuala Lumpur; and did operational exercises at above 45,000ft.<sup>5</sup>

No 15 Squadron did the next Profiteer, from 5 June to 9 July 1961, with three of its Victor B.1As and five crews, and confirmed No 10's comments about some of the problems caused by higher temperatures. "From the pilot's point of view", the ORB recorded, "the detachment provided valuable experience in operating our aircraft in different climatic conditions and from runways of varying lengths. Take-off data, as always, was carefully computed; but with higher ground temperatures and shorter runways its importance was emphasised, and co-pilots were heard muttering such things as "if the temperature gets up to . . .", "if we weighed so much . . ." and Operating Data handbooks found themselves computing many hypothetical situations . . ." From this experience the conclusion was drawn that "the heavier Mk 1A aircraft is strictly limited in weapon loads that can be lifted on a midday take-off; night take-offs, when the temperature is lower, become an important factor when operational planning is considered".

There was to be one more Profiteer – early in 1962; this was performed by four Victors from Cottesmore – two No 10 Squadron Mk 1s and two No 15 Squadron Mk 1As.<sup>6</sup> But before it occurred there was a light bomber overseas deployment, of Canberras from RAF Germany to the Persian Gulf, which had a more emergency character.

The Canberras – four B(I).8s of No 88 Squadron from Wildenrath and eight B(I).6s of 213 Squadron from Bruggen – went to Sharjah on 1/2 July for possible operations against Iraq in the event of that country invading Kuwait, to whose Ruler the British Government had promised assistance. These were LABS squadrons, and had to be converted at short notice to the conventional role. No 88 recorded in its ORB that "the move . . . was achieved with the minimum of fuss, despite the fact that very little warning was received", and that it "demonstrated again just how quickly a squadron of this kind can be deployed to another continent in emergency". No 213 described graphically how "throughout the night of 29 June, work continued" on modifying the Canberras: "the squadron hangar was a hive of activity, with a long succession of aircraft being towed in to be fitted with gun packs and tip tanks" – these two "major operations" being followed by "gun harmonisation, fuel flow tests and compass swings".

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<sup>1</sup> The Official History (*The Malayan Emergency 1948-1960* (MoD, June 1970)) described it as "intermittent detachments of V-bombers for two weeks every three months". <sup>2</sup> Report on No 10 Squadron Exercise "Profiteer" Detachment, July-August 1960. <sup>3</sup> The Class 1 airfields had 9,000ft runways with 150ft overruns; Butterworth had 8,000ft. <sup>4</sup> "No SAC aircraft were present at Clark, and there did not seem to be the usual interest shown in 'V' aircraft". <sup>5</sup> Report, ORB Appendices. <sup>6</sup> No 15 Squadron had been premature in saying, in its ORB for July 1961, that on the 15th "the last detached aircraft returned to Cottesmore and Ex Profiteer was officially over".

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Both squadrons commented on the roughness of the airfield surface at Sharjah – No 88's ORB compiler remarking that it "still has only rolled sand for its runways" and No 213's that "the extremely rough surface . . . came as a rude shock" – but despite the unfamiliarity of desert conditions the crews got down to their operational task. "By 1800hr on Sunday, 2 July", No 88 noted laconically, "planning was complete for targets in Iraq, and on the 3rd the squadron was brought to two hours' readiness. By the 6th the crisis had passed, readiness fell to 24hr and remained so until the squadron's release from NEAF". Referring to operational conditions, it commented that "flying . . . was restricted by lack of range facilities etc, but several high-low-high profiles were flown to Kuwait and provided experience in working with forward controllers". No 213's ORB compiler was a good deal more loquacious and descriptive:-

"The navigators had a busy day planning likely targets in the event of hostilities", he noted on 4 July; then on the 5th: "the navigators continued target planning throughout the day. What had at first appeared to be a fairly simple task rapidly became more confused by a steady influx of signals from JOC (Joint Operations Centre) changing priorities and routes, etc. . . ." Noting that "a signal was received each day giving a brief Intelligence summary of the political and military situation affecting Kuwait", he commented on the training flights – first take-off, 0600hr local time – and the effects of climatic conditions: "These aircraft were taking-off with full tip tanks plus a gun pack, so practically the whole of the 2,000yd runway was needed. At that time of the morning the temperature was usually around 85°F, but a couple of hours later rose sufficiently for it to become a critical factor in deciding whether or not a fully laden aircraft could get airborne".

On 6 July the SASO, Air Forces, Middle East (Aden) (Air Commodore T.B. de la P Beresford), visited Sharjah and gave the squadrons "some idea of how the military build-up was going" and it appeared that the whole operation – by then almost complete – had been "an unqualified success. The Iraqis . . . were taken aback by the speed with which we occupied Kuwait and were seriously doubting their ability to carry out their threat". The SASO was unable to give any idea how long the Canberras would be at Sharjah; they "had to prepare for a stay of anything up to three months".

In the event, after the readiness state had decreased from 2hr on 13 July (the day preceding the anniversary of the revolution in Iraq which had brought General Kassem to power, when it was thought that a move might be made against Kuwait), to 12hr on the 15th, the squadrons were told on the 19th that they would be returning to Germany the following weekend – No 88's four B(I).8s leaving on the 20th and No 213's B(I).6s starting their return on the 21st, the latter's ORB compiler (Flying Officer T.A. Pearson) commenting that the Sharjah deployment had been "the first time the squadron had been called upon to fulfil its primary commitment – to the RAF, as opposed to NATO". He added that although "we did not actually go to war, the rest of the operation was an unqualified success"; and – paralleling the comment made in No 213's ORB – that "it demonstrated that the squadron has the ability to move very quickly to a likely trouble-spot".

Two other Canberra squadrons, Nos 9 and 12, were also involved – though not so directly – in the Kuwait operations, as were three V-force Valiant squadrons – Nos 7, 90 and 138. These were the three out of the seven Valiant bomber squadrons not in the Tactical Bomber Force (Nos 49, 148 and 207) or on flight refuelling (No 214).

The Canberra squadrons, both Coningsby-based with B.6s and on the eve of disbandment prior to reformation with Vulcan B.2s<sup>1</sup>, were given back-up duties. No 9 recorded in its ORB for 4 July 1961, under the heading Operation Vantage, that "three aircraft flew as courier aircraft on this operation, which was the movement of British forces to Kuwait. The squadron's role was to back up Transport Command aircraft by ferrying spares and materials to staging points in the Middle East". Likewise No 12 noted briefly that it was "called upon to perform special courier flights to Luqa on five occasions between 4 and 11 July . . .".

The three Valiant squadrons acted under the orders of Operation Tornado, which – as No 138 explained in its ORB – stated "that, during periods of tension [such/ as limited war in the Near East, Bomber

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<sup>1</sup> No 9 became a V-force squadron on 1 March 1962 and No 12 on 1 July 1962.

Command may be required to reinforce the NEAF by the deployment of V-bombers in the conventional role. No 138, being already . . . at Malta for Operation Sunspot<sup>1</sup>, were placed on an alert for Operation Tornado . . . .”

No 7, at Wittering, “stood by to reinforce in the Middle East from 1 July until 13 July under the Exercise Tornado commitment” (to quote its brief ORB reference to the Kuwait operation). No 90, at Honington, sent out a Valiant to Malta: “Wing Commander Miller [the CO]<sup>2</sup> and crew were detached to Luqa for staff duties in connection with a military alert in Kuwait”. This detachment was in two periods – 3-14 July, during which they went to Akrotiri and did some continuation training, and 15-20 July after a one-day return visit to Honington.

No 138, also Wittering-based, being in Malta when the crisis occurred, had the most realistic involvement in the Kuwait support operation when its Valiants were armed for their conventional role. When the squadron was put on alert,

“immediate preparations were made to ready the aircraft for operations. Initially [they] were to be loaded with 18x1,000lb bombs, but this was found to be an incorrect load for a midday summer take-off and the load was changed to 15x1,000lb. Later the load was again changed to 12x1,000lb, before being finally settled at 15x1,000lb. Several difficulties and delays were encountered in the bombing-up of aircraft”.

The ORB frankly enumerated some of the difficulties of changing from a practice to a warlike bombing role. Being on a Sunspot detachment, the squadron lacked some of the equipment necessary for Operation Tornado, notably bomb carriers and pylons. The scale and type of equipment for bomb loading was different from that available in the UK and “because of inadequate facilities at Luqa it was impossible to provide the bomb-loading pattern called for”. There were delays in obtaining the correct fuzes, which had to be modified before they could be used; and 60 per cent of the tail units available were unserviceable as a result of having been stored in the open. However, despite the difficulties and the permutations of load, four Valiants were bombed-up on the 5th with 15 1,000lb bombs and two more on the 6th.

Commenting in retrospect on Tornado, the No 138 Squadron ORB said that “the fact that it was an operation in earnest rather than an exercise is immaterial, and many lessons were learnt again concerning the operation of V-force aircraft from the island of Malta”.

The Kuwait activity of July 1961<sup>3</sup> was a self-contained operation of limited duration; but the Far East situation provided a continuing commitment for the V-force throughout the whole of the 1960s and also involved a Canberra B(I).8 squadron from RAF Germany, No 16, being sent on detachment to Kuantan in Malaysia from February to June 1965 during the confrontation with Indonesia.

V-bomber deployments to the Far East continued under the code-name Exercise Profiteer, as has been said, until early in 1962, the last one being done jointly by Nos 10 and 15 Squadrons (Victor 1s and 1As respectively), from 11 January to 4 March. Each squadron sent two aircraft and three crews, No 15 commenting in its ORB that “the exercise was part of the normal squadron overseas training commitment, but also combined an assessment of the alert and readiness facilities available in the Far East”. No 15 further commented, from Butterworth in February, that “the second half of Exercise Profiteer provided plenty of good Far Eastern navigational experience for the squadron plotters. In addition, eight other Opexes were flown, from which, particular value was gained from the Lone Rangers to Clark Field”. The final (joint) report on Profiteer made practical suggestions for the facilities which would be required were a Mastodon detachment to be carried out – that is, by eight aircraft and ten crews.

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<sup>1</sup> Mediterranean-area training detachments which had been going on since Lincoln days. <sup>2</sup> Wing Commander J. Miller, DFC, AFC. <sup>3</sup> The Chronology in the Royal Air Force Briefing Book has the following entry against the date 1 July 1961:- “Following request from ruler of Kuwait for British assistance, RAF Hunter ground-attack fighters and transport aircraft, with troops, sent to Kuwait. Canberra squadrons concentrated in Persian Gulf area and V-bombers at readiness in Malta. Build-up of forces substantially complete by July 6. By then, 7,000 men and 720 tons of stores had been moved in to Persian Gulf area”.

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Profiteer deployments, the first having been by Valiants in 1957 and the last by Victors in 1962, were succeeded by Chamfrom detachments – which occurred from December 1963 until August 1966, against the operational background of the Borneo campaign (December 1962 to January 1964) and Indonesian confrontation with Malaysia (December 1963 to August 1966).

The V-bombers which initiated Chamfrom were from Honington, the situation which defined their role being thus described in the Operation Order:<sup>1</sup>

“Victor squadrons of Bomber Command may be required to reinforce the Far East Air Force in limited war. To give practice in staging to and operating in the Far East theatre, a force of eight aircraft and ten aircrews from Nos 15 and 57 Squadrons, together with support personnel, will be detached to RAF Tengah. The No 57 Squadron element will consist of four aircraft and five aircrews together with their own support personnel from RAF Honington. No 57 Squadron aircraft will be flight-refuelled on the outward journey<sup>2</sup> staging through Khormaksar only. They will depart in pairs from Honington on 5 and 6 December 1963”.

Four Victor 1As from Honington and four from Cottesmore left for Tengah on these dates; they were supported en route by No 90 Squadron Valiant tankers deployed to El Adem and Gan, and the No 57 Squadron aircraft made their one-stop flight. As their ORB stated, this demonstrated their ability “to reach the Far East quickly, after a limited warning, by flying two stages with in-flight refuelling”. No 15’s Victors went out via Akrotiri, Khormaksar and Gan. This meant that by 8 December, when the latter aircraft had arrived, the Far East Air Force had eight V-bombers in its Order of Battle – a formidable accession of strength.

The Victors’ arrival coincided with the beginning of confrontation between Indonesia and Malaysia, the new State which had been inaugurated on 16 September 1963 and which affronted the ambitions of Indonesia’s president Sukarno for an Indonesian hegemony in the area. The V-bombers were there in a deterrent role, armed with conventional weapons; they were also operating, as in the UK, at low level. No 15 Squadron moved up to Butterworth early in January, and noted that “during the month priority was given to the training of crews in the technique of ‘popping up’ to 3,000ft at the end of a low-level leg to make an attack with 1,000lb bombs”. No 57, involved in an alert at the end of January when they and the Javelins of No 60 Squadron were “scrambled”, also emphasised the low-level role: “During the month a second low-level route was flown by crews, this time up the west coast of Malaya, terminating with low-level bombing at Song Song range”.

No 15 Squadron also recorded flying sorties for a special trial “to prove the reliability of certain modifications to the Victor conventional bombing system under the conditions of temperature and humidity encountered in the Far East”. This trial “consisted of the dropping of four loads of bombs – one stick of 35x1,000lb, two sticks of 21x1,000lb and one stick of six 1,000lb bombs”.

V-bombers were deployed in the Far East throughout the confrontation period – that is, until 16 August 1966 – with No 57 Squadron achieving the longest service in the theatre, from December 1963 until August/September 1965, when their commitment was taken over by No 9 Squadron with Vulcan B.2s from RAF Cottesmore.<sup>3</sup> In its ORB the No 57 Squadron detachment unequivocally described its role as “part of the strike force, Far East Air Force”. The Commander-in-Chief, Far East,<sup>4</sup> said in his *Report on Operations in Malaysia 1 April - 31 December 1965* that “four reinforcement medium bombers (Victor or Vulcan) were retained in the Command throughout the period . . . This ensured that all principal targets under contingency plans were covered with forces immediately available. There is little doubt that this force has provided a valuable deterrent to confrontation being conducted on a larger scale . . .”.

More picturesquely, the aviation journal *Flight International* thus described<sup>5</sup> the type of flying done by the V-bombers in the Far East and summed-up their role there, after a sortie with No 57 Squadron on 13 April 1965:-<sup>6</sup>

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<sup>1</sup> HQ Bomber Command Operation Order No 4/63 “Chamfrom”. <sup>2</sup> The No 15 Sqn Victors, making three stops, were not flight-refuelled. <sup>3</sup> The first of the B.2s arrived at Tengah on 9 August 1965 but the last of 57’s Victors to leave the Far East did not arrive back at Honington until 23 September. <sup>4</sup> Air Chief Marshal Sir John Grandy. <sup>5</sup> In a feature, *Lo-hi Victor Mixed Mission over Malaya*, by Robert Rodwell. <sup>6</sup> In Victor B1A XH621 (capt, Flt Lt E.J. Filing).

"Bomber Command's claims to low-level capability [it reported] were received with some reserve, not least by this journal, when they were first made in February last year.<sup>1</sup> This brief experience of low-level flight, thrown in during a medium-level visual bombing mission over the Song Song range off the coast of north-west Malaya, was to prove adequately that a large V-bomber *can* be flown through a contour-hugging pattern at a moderate speed; and it left one ready to accept that the contours would be even more closely hugged, and the speed somewhat less moderate, in an operational mission or even a realistic training sortie. It could not, however, be conclusive about the tactical value, for Bomber Command is very cagey about showing-off its low-level techniques and capabilities or even talking very much about low-level attack. . . ."

Summing-up the V-bombers' Far East role, the journal commented that

"There is always a V-bomber detachment at Tengah, maintaining a Bomber Command commitment to provide long-range bombing forces in the Far East which dates from years before the start of Indonesian confrontation – back, in fact, to when Lincolns equipped the long-range bombing arm. No 57 Squadron . . . provides the current detachment and alternates the duty with its sister squadron, No 55 . . . Crews are rotated between England and Singapore more frequently than aircraft, which tend to remain east and be flown by successive crews arriving from England. The usual length of a crew's detachment is 2½-3 months and the duty, a popular one, may come up twice a year. Groundcrews . . . are detached for the same length of time, save for some volunteers who choose to serve for about a year in Singapore.

"Apart from being an obvious deterrent against any Indonesian temptation to increase the temperature of the present low-key but niggling war, the V-bombers detached in the Far East have a strategic commitment in the larger context for which they are targeted by FEAF, with whose operations their own are well dovetailed".

The contingency plans referred to by the C-in-C were those made in concert with the RAAF and RNZAF for retaliatory actions should Indonesia mount operations against Singapore and/or Malaysia (Singapore having separated from Malaysia on 9 August 1965). These plans were graded and were designed to meet different situations which might arise. Thus, if the Indonesians made further attempts to land infiltrating forces by sea or air on Malaysian or Singaporean territory, then it might be decided to attack selected Indonesian para-military bases. If, as a riposte, the Indonesian Air Force<sup>2</sup> then mounted air strikes against targets in any parts of Malaysia and/or Singapore it would be necessary to eliminate IAF capability. There was also the possibility that Indonesia might mount a pre-emptive air attack, with or without warning, on targets in West Malaysia and/or Singapore.

To counter such possible actions by Indonesia, strike operations were planned which took account of two different circumstances – one, when there was agreement with the Governments concerned for the use of Australian and New Zealand forces and of RAAF Darwin as a strike base; the other, when such forces in the theatre were only available in a defensive role and RAAF Darwin was unavailable. Both sets of plans, however, involved the use of V-bombers – in the first case operating from Darwin and in the second from Labuan.<sup>3</sup>

While the V-bombers maintained a continuous presence in the Far East throughout the confrontation period – Nos 10, 15, 57, 55, 9 and 35 Squadrons all taking their turn – there was a "one off" detachment at Kuantan on the east coast of Malaysia by a Canberra B(I).8 squadron from Laarbruch in RAF Germany, No 16, from mid-February to early June, 1965.

No 16 became the only bomber squadron in the Far East theatre to fire ammunition on an actual operation, when on 30 March three of its aircraft attacked the reported positions of possible Indonesian infiltrators in East Johore. The ORB commented that "after training hard to develop tactics for ground-attack operations the squadron was rewarded by being given an actual strike against positions believed to be occupied by Indonesian infiltrators".

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<sup>1</sup> When the role of Bomber Command was presented at Wittering on 4 February 1964 by S of S (Mr Hugh Fraser) and the AOC-in-C (AM Sir John Grandy).<sup>2</sup> Which at this time had MiG-21s, Tu-16s, B-25s and P-51s. Its CAS, Air Marshal Omar Dhani, said that it could destroy Singapore if the Indonesian conflict should grow.<sup>3</sup> This was the substance of Operation Mason and Addington One and Two (FEAF/TS1303/Air Plans and FEAF ORB Appendices, April 1965).

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During February 1965 No 16 had been on a four-day standby for deployment to the Far East, with training concentrated on the conventional role. This meant that there were no LABS sorties; instead, air-to-ground firing, shallow dive bombing and pop-up low-level bomb release. The actual deployment (Operation Nico) began on 12 February and the flight was made in five legs taking a day apiece – Laarbruch-Akrotiri-Masirah-Gan-Butterworth-Kuantan – with a Transport Command Britannia in close support. Once in Malaysia the squadron got busy with training – air-to-ground firing at China Rock, low-and high-low-level navigation exercises, close and battle formation at both high and low levels, and dummy attacks on Kuantan airfield. During March the Commander, Far East Air Force (Air Marshal P.G. Wykeham), “flying his own Meteor F.8, visited the squadron and addressed the groundcrew about its role. He then lunched with the aircrew and gave advice on possible ground-attack targets in the event of war with Indonesia”.

A stay of about 90 days in Malaysia had been anticipated, but during April No 16 were advised of an extension of about one month. In April the squadron flew sorties in a fleet exercise with HMS *Eagle* in the South China Sea, did night flare-dropping exercises at the China Rock range and night continuation training at Kuantan and Tengah, and Ranger flights to Kuching and Hong Kong. Early in May it participated in a joint rendezvous exercise with No 14 Squadron, RNZAF, and provided simulated strikes against a convoy in the Gulf of Siam. When the eight deployed Canberras returned to Laarbruch on 7 June the squadron, having been operating in a conventional mode for four months in the Far East, “worked hard to regain [its] operational capability in the nuclear role” (to quote the ORB) and resumed its QRA commitment as a Nato-assigned unit.

The V-force squadrons, by contrast, formed a loose-link chain of deployment to the Far East in the Chamfrom detachments which succeeded those of Profiteer. These squadrons relieved each other as punctiliously as sentries taking-over duty from one another.

Operation Chamfrom was pioneered by No 10 Squadron with four Victor B.1s and five aircrews at Butterworth from 21 January to 20 February 1963. The operation had been ordered by Bomber Command HQ “to practise an element of No 10 Squadron in operating in the Far East theatre”. There was also a requirement to conduct trials dropping 1,000lb bombs.<sup>1</sup> This happened to be the only Chamfrom the squadron did; it was disbanded at the end of February 1964 and subsequently (1 July 1966) became a VC10 squadron.

No 57, with Victor B.1As, was the second V-force squadron to go out on Chamfrom, at Tengah for the month of July 1963; then it went to the Far East again at the end of that year, on detachment in conjunction with No 15 Squadron from 5 December. No 57 were there until 21 February 1964, their commitment being taken over (from the end of January) by No 55 Squadron with four Victor B.1As and five crews from Honington. These crews were “rotated” during May and in September a crisis period occurred, when (as the ORB put it) “relations between Indonesia and Malaysia deteriorated”. The operational generation of aircraft was started and all crews brought to one hour’s readiness. Then, towards the end of September, this state of readiness was relaxed to 48hr.

No 15 Squadron continued its Chamfrom detachment until the end of that month, prior to its disbandment;<sup>2</sup> its commitment was taken over by the first Vulcan squadron to do this operation – No 12, with B.2s, based at Cottesmore. Noting the last arrivals at Butterworth on 2 October bringing the detachment strength to four aircraft and five crews, the ORB said dramatically that “at midnight in the officers’ mess No 15 Squadron’s plaque came down and the fox’s mask of No 12 Squadron took its place”.

Later in that month – October 1964 – No 57 Squadron relieved No 55 at Tengah with five crews, and at the end of 1964 decided to keep one aircraft and crew at Butterworth – to which the whole detachment moved on 29 April 1965. It is notable that at that time the squadron’s policy was defined in its ORB as “part of the strike force, FEAF”. No 57 moved back to Tengah on 7 July and by 16 August had returned to the UK.<sup>3</sup> It was succeeded on the Far East detachment by No 9 Squadron from 13 August, bringing

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<sup>1</sup> Report on Operation Chamfrom. <sup>2</sup> It re-formed as a Buccaneer S.2 squadron on 1 October 1970. <sup>3</sup> It subsequently (early in 1966) became a tanker squadron at Marham.

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five Vulcan B.2s and five crews from Cottesmore to Tengah. Theirs was to be the last-but-one V-bomber deployment of this kind: the last (now code-named Operation Matterhorn) was by No 35 Squadron, from 14 February 1966, until orders were received on 14 August covering the withdrawal of the medium bombers to the UK following the signing of the Bangkok agreement by Malaysia and Indonesia – ending confrontation.

On their detachments, which provided the Far East Air Force with a medium bomber capability, the V-force squadrons trained much as they would have done in the UK (especially after the introduction of a low-level role early in 1963) – allowing for the differences in climate and terrain, facilities and opportunities and bearing in mind that their weapons were conventional bombs.<sup>1</sup> They practised live bombing (with 100lb bombs) on the Song Song and China Rock ranges; they did low-level cross-countries, ending a leg with a pop-up manoeuvre to 3,000ft; they exercised the FEAF Alert and Readiness system and tested the air defences of Butterworth and Singapore, as well as those of aircraft carriers in the South China Sea; they participated in exercises with the RAAF and RNZAF, as well as with the Royal Navy and Royal Australian Navy; they sent single V-bombers on Ranger flights to bases in south-east Asia; and all the time they acted as a deterrent force – as in Europe, being seen to be ready to act, but never being called upon to so.

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<sup>1</sup> The Specification for the V-bombers (B.35/46) had asked for “a medium-range bomber for world-wide use in the Royal Air Force” and the Requirement (OR/229) said that it should have the capacity for a total bomb load of 20,000lb.

## CHAPTER 15

**Bomber Command-Strategic Air Command Co-operation (1959-1969)**

"Although its total strength never numbered much more than 180 V-bombers plus tankers,<sup>1</sup> Bomber Command was readily accepted by the United States as an organic part of an Anglo-American nuclear deterrent force that realised a high degree of integration through co-ordination of targets and operational plans". So wrote the USAF Senior Historian Alfred Goldberg in 1964.<sup>2</sup> The acceptance to which he refers was based both on a written agreement – the 1957 USAF/RAF Memorandum of Understanding – and on co-operation at several levels between the two air forces: in the co-ordination of atomic strike plans and the supply of American weapons to the RAF (the main purposes of the Understanding), in the exchange of information on alerts, in the preparation of Operational Requirements, in the Bomber Command integration with SAC Reflex forces in the UK, in the Thor IRBM deployment, in BC/SAC participation in each other's bombing competitions, and in the Western Rangers which were a feature of V-force squadron training.<sup>3</sup>

The start of the co-ordination of RAF/USAF nuclear strike plans has already been referred to: what should be stressed here is that the close association of the two air forces' bomber arms – disparate in size though they were<sup>4</sup> – did much to influence the conduct of the V-force during the 1960s, particularly in the establishment of a permanent alert concept. Strategic Air Command had achieved a one-third alert by May 1960 – maintaining a third of its bombers and tankers on 15-minute ground alert<sup>5</sup> – and Bomber Command followed suit by instituting a permanent alert at the beginning of 1962, with one aircraft per squadron, or approximately 15 aircraft from the Medium Bomber Force. In declaring his intention to institute a permanent alert force, the AOC-in-C Bomber Command (Air Marshal Sir Kenneth Cross) had said<sup>6</sup> that it would provide an opportunity for closer integration with the SAC Reflex forces in the UK<sup>7</sup>, thus taking advantage of the combined bomber strengths and joint effects of their ECM equipment.

This alert concept was to lead to "the highest state of readiness which the Royal Air Force has known in peacetime"<sup>8</sup> – the medium bomber force QRA (quick reaction alert) which was instituted from 1 January 1962 after the AOC-in-C's proposal had been approved by the Air Council<sup>9</sup>, though it deferred approval of his further proposal to increase the alert force to two aircraft per squadron towards the end of 1962. He also envisaged an airborne alert in the Skybolt era, from 1966 onwards. With an average of 45-50 Thors at permanent readiness, and assuming 30 aircraft mostly armed with megaton-range weapons, he estimated that his Command could have a total force of 75-80 weapon systems at 15 minutes' readiness by the end of 1962 – such a force posing "a real deterrent". For the V-bomber squadrons, such a plan involved a re-organisation of training routines, to keep an increased number of crews in full operational training with a reduced number of aircraft.

During 1962, with one aircraft per squadron on QRA and at least 45 Thors, the MBF constituted a deterrent of approximately 60 megaton-range weapon systems as part of the Western strategic nuclear forces; and in October of that year, when the United States requested the removal of Soviet missiles emplaced in Cuba and announced that any further shipments there would be inhibited, the increased alert status of SAC's aircraft and ICBMs was reflected in an intensified preparedness by the V-force squadrons.

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<sup>1</sup> At 30 June 1964 (Stats 603) Bomber Command had 181 V-bombers (159 on operational strength, 22 non-operational) including tankers. <sup>2</sup> Articles in *International Affairs* for July and October 1964 on "The Military Origins of the British Nuclear Deterrent". <sup>3</sup> The 500th was flown on 14 December 1965. <sup>4</sup> In February 1963 the AOC-in-C said there were 23,216 personnel in Bomber Command, 10,620 of them in the V-force. At that time there were 188 V-bombers on strength (operational and non-operational). Strategic Air Command then had (December 1963) 247,688 Service personnel and 2,419 aircraft. <sup>5</sup> *The Development of Strategic Air Command 1946-1971* (HQ SAC). <sup>6</sup> Letter to VCAS, 31 October 1961. <sup>7</sup> B-47 Reflex operations began at Greenham Common and Fairford in January 1958. <sup>8</sup> Message from the CAS (ACM Sir John Grandy) to the AOC-in-C Strike Command (ACM Sir Denis Spotswood) when the V-force QRA ended on 30 June 1969. <sup>9</sup> On 7 December 1961 (Conclusions, 23(61), Secret Annex).

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On 22 October, Strategic Air Command's history recounts<sup>1</sup>, President Kennedy "announced the arms quarantine against shipments destined for Cuba and demanded the removal of missiles already situated there". It continues:-

"On the same day as the President's speech, SAC further intensified its readiness posture. Battle staffs were placed on 24hr alert duty, leaves were cancelled and personnel recalled to duty. B-47s were dispersed to several widely separated and pre-selected civilian and military airfields, additional bombers and tankers were placed on ground alert, and the B-52 airborne alert indoctrination program was immediately expanded into an actual airborne alert involving 24hr flights and immediate replacement of every aircraft that landed. The growing intercontinental ballistic missile force, numbering around 200 operational missiles, was rapidly brought into alert configuration. All bombers and missiles were armed with nuclear weapons. SAC was ready".

At about 0100hr on 23 October HQ Bomber Command were notified by 7th Air Division (SAC's controlling formation in the UK) that Strategic Air Command were adopting their Defcon Three alert state. This meant that all personnel had to be on telephone call and within 15 minutes' reach of their bases, and that overseas flights by SAC aircraft were restricted. The AOC-in-C (Air Marshal Sir Kenneth Cross) was informed and decided not to put his forces on a higher state of readiness, pending further instructions from the Air Ministry; he felt satisfied that the established alert and readiness procedures would cater for possible developments<sup>2</sup>. However, he ordered that no further aircraft were to leave the country on training flights; otherwise, normal training would continue and all operations rooms were manned.

The situation in the crisis area continued to intensify: on 25 October, "with the arms quarantine in effect" (the official history records) "SAC RB-47s and KC-97s joined other forces in the gigantic sea-search for Soviet ships bound for Cuba". Bomber Command's reaction was an increased alert status: at one of the Vulcan B.2 stations, Coningsby, the squadrons (Nos 9 and 12<sup>3</sup>) were put on Alert Condition Three<sup>4</sup> on 27 October; leave for all personnel was cancelled, a restriction was placed on the number of aircraft that could fly at any one time and the QRA commitment was doubled. At Scampton, which also had Vulcan B.2s, No 27 Squadron put two aircraft on permanent readiness and provided two standby crews for every two days in three: as the ORB put it, "the days of intense diplomatic and military activity" following the Cuban crisis "resulted in the doubling-up of all standby commitments". In addition to the doubling of standby duties from 29 October, leave for aircrew personnel was cancelled and essential air- and groundcrew confined to their quarters or residences. At this time the two other Vulcan B.2 squadrons at Scampton, Nos 83 and 617, were converting to the Blue Steel role, which No 27 didn't begin to assume until towards the end of 1962.

"The first major break in the crisis [SAC's history recorded] came on 28 October: Russia agreed to remove its offensive missiles from Cuba, subject to verification by the United Nations. Throughout the next few days, SAC aircraft maintained close aerial surveillance while the missiles were dismantled, loaded on ships and sent back through the quarantine to Russia".

At the V-force stations, alert conditions were relaxed from early November onwards:

Scampton's No 27 Squadron noted in its ORB that on 5 November "conditions were relaxed and from that date onwards the squadron provided one aircraft at permanent readiness and one crew for two days out of three. Leave was re-instituted and essential personnel were not confined to their quarters in off-duty periods". At Cottesmore a No 10 Squadron ORB summary of the Cuban crisis, recalling that on 29 October a second aircraft and crew had been brought to 15 minutes' readiness and other squadron aircraft and crews held at 2hr, 3hr, 4hr, 5hr and 12 hr readiness, noted that this alert condition had been held until 5 November "when the Command reverted to Alert Condition 4 once more".

This crisis also activated Bomber Command's recall procedure for its aircraft at overseas airfields - as No 50 Squadron, whose Vulcans then happened to be at Luqa, noted in an ORB entry for 28 October: "at

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<sup>1</sup> *The Development of Strategic Air Command* - already referred to. <sup>2</sup> VCAS file, Co-ordination US/UK Bomber Forces (Alerts) (ID9/240/6 Pt 5). <sup>3</sup> A third, No 35, was not re-formed as a Vulcan B.2 squadron until 1 November 1962. <sup>4</sup> Bomber Command had introduced new nomenclature for Alert and Readiness States on 20 June 1961: they became Alert Conditions 5 - 1 and Readiness States 40, 15, 05 and 02 minutes.

1000hr a 'White Cliffs' – the patriotic code-word used – “recall signal ordered the squadron to return to Waddington on 29 October. The return was one day earlier than planned; this was caused by increasing political tension accompanying events in Cuba”.

For Strategic Air Command, the alert condition continued until late in November, its history recording that on the 20th, “when the Russians agreed to remove their medium bombers from Cuba, the quarantine was lifted and SAC began shifting back to normal operations. Medium bombers<sup>1</sup> returned to their home bases, the ground alert force dropped back to the normal 50 per cent standard, and routine B-52 airborne alert indoctrination flights commenced once more”.

The Cuban crisis was not the first occasion on which an increased SAC alert status had caused repercussions in the United Kingdom; for on 16 May 1960 – in the wake of the shooting-down of the U-2 near Sverdlovsk<sup>2</sup> and consequent US-USSR confrontation – SAC ordered a worldwide increase in readiness (thus including its units in the UK) to Alert 3, from Alert 5, the normal and lowest state. This information was passed to Bomber Command through special confidential SAC-BC planning channels.<sup>3</sup> There was, however, no automatic obligation on Bomber Command to follow suit and no action was taken. The Pentagon, in answer to enquiries, issued a statement saying that “on Sunday evening the Joint Chiefs of Staff conducted a worldwide communications readiness exercise”.

There was also no formal obligation on the US Government to inform the British Government about its alert measures, though 7th Air Division might let Bomber Command know informally what was taking place.<sup>4</sup> But as a result of SAC's increased readiness in May 1960, and of subsequent questions in Parliament about a “worldwide 24 hours-a-day joint patrol by US and UK aircraft carrying hydrogen bombs”,<sup>5</sup> the Minister of Defence (Mr Harold Watkinson) took the matter up with his opposite number in Washington the US Secretary of Defense (Mr Tom Gates), who said in reply that alerts affecting SAC forces in the United Kingdom could only be directed by the Commander-in-Chief of Strategic Air Command – and that he would be happy to ensure that the Minister was notified of any such decision. However, the Prime Minister (Mr Harold Macmillan) thought that “somewhat firmer arrangements” should be sought – an assurance of prior notification of both alerts and “random readiness drills”<sup>6</sup> when these concerned the UK. Such notification should be “as early as possible” – before any public announcement was made.<sup>7</sup>

As a result, the Air Ministry held a discussion with the Commander, 7th Air Division (General Westover), about the types of random readiness drills – the upshot of which, the Ministry said, was that arrangements had been made “for all that is necessary and practicable to be done to achieve the Prime Minister's requirements”. The Prime Minister agreed, and on 31 August 1960 Mr Watkinson wrote to Mr Gates to say that his offer to “notify me of any decision to alert US forces in the United Kingdom and its territories . . . will meet our difficulties very well”.<sup>8</sup>

The scale of USAF bomber deployments to the United Kingdom reflected the size of Strategic Air Command: far more aircraft were involved in them than the RAF V-force would ever have. Early in 1958, for example, post-strike recovery exercises on which landings were made at UK bases after profile bombing missions from the United States involved 152 B-47s and 22 B-52s – using Mildenhall, Chelveston, Greenham Common and Brize Norton, where they were turned-round for their return flights. That was in February; and in March 188 B-47s landed at Fairford, Bruntingthorpe, Chelveston, Greenham Common, Lakenheath and Mildenhall. Other aircraft taking part, bringing the total number up to about 280, did not land in the UK.<sup>9</sup>

Such bomber traffic across the Atlantic was two-way (though not on so large a scale), for during 1959 six V-bombers – four Valiants of No 148 Squadron and two Vulcans of No 83 Squadron – took part in a large-scale no-notice exercise of the Eastern Air Defence Region, code-named Eye Washer, and earned

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<sup>1</sup> SAC's medium bombers were B-47s and B-58s. <sup>2</sup> Flown by Francis Gary Powers, who was subsequently tried on charges of spying, it was hit by a SAM at approximately 68,000ft. <sup>3</sup> File on Co-ordination of UK/US Strategic Bomber Force, 1959-60 (ID9/240/16 Pt 4). <sup>4</sup> Notes for Minister, AM to MoD, 23 June 1960. <sup>5</sup> Commons Hansard, 22 June 1960, Cols 407-408. <sup>6</sup> The US Secretary of Defense had said that his use of the term “alert” did not include random readiness drills – “which take place fairly frequently and which may be directed at any command echelon to test established procedures and communications”. <sup>7</sup> Letters. Downing Street/MoD, 29 July 1960. <sup>8</sup> Letter, 31 August 1960. <sup>9</sup> Facilities for USAF in UK (ID3/240/3 Pt 1).

plaudits for their performance. After landing at RCAF Goose Bay on 24 April the V-force detachment, commanded by the OC No 83 Squadron (Wing Commander L.F. Banks), participated in a near-simultaneous mass penetration of the entire eastern halves of the United States and populous Canada – the object of the exercise being to subject the DEW (distant early warning) line to “a realistic physical test”, according to a letter from the Commander, HQ Eastern Air Defence Force, Stewart AFB, New York, to the AOC-in-C Bomber Command (ACM Sir Harry Broadhurst) on 11 May. He added: “You may be interested to know that your aircraft were accurately tracked throughout the parts of their routes which lay within radar coverage of the DEW line stations. Wing Commander Banks and his crews gave a truly professional display of navigation, their time-keeping particularly being impeccable . . . .”<sup>1</sup>

This kind of cross-operating – reflecting the occasion three years earlier when SAC B-36s,<sup>2</sup> B-45s<sup>3</sup> B-47s and RB-57s<sup>4</sup> had formed part of the attacking forces in the 1956 major air defence exercise, code-named Stronghold – represented SAC/BC co-operation of a practical kind, like the joint planning on Skybolt, designed to ensure that this air-to-ground ballistic missile could be launched by both B-52s and Vulcans. In the case of the latter aircraft the US weapon would fulfil the OR1149 requirement for a flying bomb with 1,000nm range.

This proposed compatibility resulted from an early British expression of interest in the weapon, initial contacts having been made during 1957 through the RIO (Requirements Interchange Officers) scheme, which led to the USAF operational requirement specifying that the design of the missile should fit it for use on the V-bombers as well as the B-52s. Thus the RAF were “in on the ground floor” at the inception of Skybolt.

The plans made for, and the hopes pinned on, this air-launched ballistic missile with a 1,000-mile range are described subsequently in this history: here the emphasis is on the degree and duration of RAF-USAF co-operation that went into the programme following the initial British expression of interest, which had been written-in to the proposals invited in early 1959 from the US aircraft industry, specifying that GOR/177 (as the requirement was then known) should be compatible with the B-58, B-52, Victor B.2, Vulcan B.2 and if possible also with the B-70 and KC-135. This General Operational Requirement (No 177) was issued on 22 January 1959; then, three months later, a design competition was held for XGAM-87A – the strategic air-to-surface ballistic missile that was required – and after a few weeks’ deliberation Douglas Aircraft Co were announced as the successful one of the 15 contractors who had entered. That was in June 1959, and as a consequence of British involvement in the programme – which then made a bad start with cancellation of the B-58B, which was to have been the weapon’s prime carrier, and technical and financial difficulties – RAF representatives in the United States suggested that personnel should be sent out there to participate in it. Such participation should be in four areas: with the British Joint Services Mission, whose staff would be augmented; at the US Project Office at Wright Air Development Division, where a small RAF team would be located; at Douglas Aircraft Co, where about 15 RAF personnel would be trained; and at Eglin Field, where some 65 engineers and ground crew would be needed to support the two Victors and two Vulcans which would be participating with USAF B-52s in a launching programme.

At a progress meeting in London on 22 December 1959 it was stated that it was “a US policy requirement to have the missile in service use in the B-52 by the end of 1963”; and in a report of 8 February 1960 the RAF RIO (Group Captain G V. Fryer) said that on 1 February the deputy Secretary of Defense had approved the programme, and that XGAM-87A “finally earned a clean bill of health”, had been funded to the tune of \$95m through FY1961 and should lead to the production of a “devastating addition to the West’s deterrent inventory”.<sup>5</sup>

While the international character of the Skybolt programme derived its Governmental authority from three Anglo-American documents exchanged during 1960 – an Understanding of 29 March between the President<sup>6</sup> and the Prime Minister, another one of 6 June between the Secretary of Defense and the

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<sup>1</sup> HQBC (Ops) Ex Eyewasher IIH/272/3/14A. <sup>2</sup> SAC’s last piston-engined bomber, being phased-out at this time: it originally had six piston engines, but subsequently four jet engines were added. <sup>3</sup> North American B-45 Tornado, first US heavy jet aircraft. <sup>4</sup> Martin-built EE Canberra. <sup>5</sup> Reports from Group Captain S.H. Bonser (DD of Weapons Engineering 4) of 10 August 1959 and from Group Captain Fryer in Skybolt Policy (ID/47/297 Pt 1). <sup>6</sup> Eisenhower.

Minister of Defence, and a Department of the Air Force/Ministry of Aviation Technical Agreement of 27 September – there had been a good deal of transAtlantic coming-and-going before such formal authorisation.

At an Air Ministry meeting in mid-February, when it was stated that “the weapon hitherto described as WS138A would in future be known as the GAM 87A”. the deployment of British representatives in the United States was discussed. RAF aircrew and groundcrew would be attached to Douglas Aircraft Co for periods of three months and nine/12 months respectively prior to going to Eglin Air Force Base for firing trials; there would be a Service team at the USAF Weapon System Project Office<sup>1</sup> at Wright-Patterson AFB; and the BJSM (British Joint Services Mission) staff in Washington would be augmented. Subsequently<sup>2</sup> the Ministry of Aviation recommended a time-scale “if the RAF is to take advantage of the USAF invitation to participate in the . . . programme”: this time-scale was for two Vulcans to be positioned at Eglin AFB in February 1963; to begin flight trials there in May and to end them in January 1964.

March 1960 was an epochal month as far as Skybolt was concerned – not only because of the President/PM Understanding at the end of it, but also because at the beginning of it (on the 2nd) three USAF colonels gave a presentation on what was still referred to as WS138A at the Air Ministry<sup>3</sup>; and on 28 March an Air Ministry/RAF/MoA/Avro team left for the United States to find out all they could about Skybolt – “to obtain the latest information on GAM 87A insofar as its application to the V-bombers is concerned”.

Thus by the spring of 1960 British interest in this new American air-to-ground strategic missile had been officially expressed – the Minister of Defence having made an “encouraging statement” at the Air Ministry presentation – and the USAF had invited UK representation in their development programme<sup>4</sup>. Then, on 13 April (the day after the “survey” team returned from the United States), the UK Government cancelled Blue Streak – thus pinning its future deterrent plans on the acquisition of Skybolt.

This was the political-military-industrial background against which RAF-USA/Bomber Command-Strategic Air Command co-operation on Skybolt proceeded from early 1960 until the weapon was cancelled in December 1962. The Minister of Defence had signed a Letter of Intent, expressing formally to the US Secretary of Defense the UK Government’s desire to participate in the Skybolt programme and to purchase operational rounds for use by the RAF; and British representation in the United States was broadly of two kinds: a design team from the Ministry of Aviation and A.V. Roe, and a Royal Air Force project team.<sup>5</sup> Two Vulcan B.2s, XH537 and XH538, were provided for flying trials.<sup>6</sup>

An Anglo-American planning conference on the Skybolt GAM-87A programme was held in mid-September (14-20) 1960 at the Wright Air Development Division of Air Research and Development Command, USAF, at Wright-Patterson AFB, Ohio, to co-ordinate the American and British programmes, and several sub-committees considered every aspect of these – development, testing, training, ground support equipment, logistics and finance/contracts. In the ensuing months there were many visits by individual RAF officers to US facilities and firms connected with the Skybolt project, then during September 1961 a visit by a joint Royal Air Force/MoA team (18-28 September) to assess Skybolt aircrew training requirements – their itinerary including discussions at HQ Strategic Air Command at Offut AFB, Omaha, Nebraska. Then in November representatives of Douglas Aircraft Co, prime contractors for the missile, came to the Air Ministry for a meeting on the 22nd to discuss its operational implications. At the same time plans were being drawn up by the British Joint Project Office at Wright-Patterson for the flying aspects of the British Joint Trials Force task at Eglin AFB. One suggestion in this outline programme, later approved by the Operational Requirements Branch in the Air Ministry, was that a Western Ranger should be diverted to Eglin so as to keep the aircrew in Vulcan

<sup>1</sup> Which controlled the development of Skybolt. <sup>2</sup> LM, 26 February 1960, DOR(A)/D of Ops, DAirPlans.

<sup>3</sup> Colonels Clausen, Dewitt and Tenant, respectively of the Directorate of R&D, USAF; Head of the Weapons System Project Office; and of Air Materiel Command. <sup>4</sup> LM, ACAS(OR)/DCAS on UK participation in Skybolt devlt. There is no record of the USAF presentation. <sup>5</sup> LM DDOR1/DOR(A), 9 May 1960 (Skybolt policy file, ID/47/297 Pt 1). <sup>6</sup> Approved May 1960 (LM DOR(A)/DRAF/B - MoA in Skybolt Policy, Pt 1).

flying practice prior to the start of Skybolt/Vulcan trials during 1963 – two crews being scheduled to arrive there during March of that year. During 1961, a total of 200 UK personnel at Eglin for the trials was referred to when the question of their accommodation was discussed.<sup>1</sup>

On 14 June 1962 a second issue of the Air Staff Requirement OR1187 for an air-launched ballistic missile system, to be compatible with the USAF B-52 and RAF Vulcan B.2, was circulated: the system was required to be in RAF operational service in the last quarter of 1964.<sup>2</sup> On 9 July the Cabinet Defence Committee decided that 100 Skybolts should be ordered.

Meanwhile a British Joint Trials Force Commander had been appointed: he was Wing Commander C.E. Ness,<sup>3</sup> who arrived in the US on 19 May; and on 12 September the British Joint Project Office at Douglas Aircraft Co took the opportunity of reiterating that the correct nomenclature for Skybolt was GAM-87A – the term WS138A, “used frequently in the past”, it said, was “an internal USAF description only”.

Skybolts were launched from B-52s during 1962 with only moderate success: on the first occasion (19 April) the second stage motor failed to ignite; on the second (29 June) the first stage motor didn't ignite correctly and the missile was destroyed by the range safety officer; on the third (13 September) the missile again had to be destroyed, after veering off course; and on the fourth live launch (25 September) its second stage burned for only 15 seconds.

However there seemed to be confidence, at least on the British side, that the Skybolt programme was proceeding satisfactorily. AMQLR (the Air Ministry Quarterly Liaison Report) for July-September 1962 commented buoyantly that “both in the USA and UK, trials of Skybolt and associated missile and aircraft equipment are proceeding well, and are generally on schedule . . .” It said that in the UK a Vulcan B.2 had been carrying out trials with a Skybolt, and that in the US four missiles had been fired from a B-52: the first was “a partial success”, the second “unsuccessful”, the third again “a partial success” and the fourth “almost completely successful”. It added that the BJTF was continuing its build-up at Eglin AFB, Florida, where all RAF administrative staff were now in position; and that an advance party of technical staff would arrive there in mid-October.

But despite this official optimism there were dark clouds on the horizon. In talks with the Minister of Defence (Mr P. Thorneycroft) during September 1962 the US Secretary of Defense (Mr R. McNamara) had referred to further increases in Skybolt costs; then at a meeting between them on 11 December the Secretary of Defense presented an aide-memoire setting-out the reasons which had led the US Government to a tentative conclusion that the Skybolt programme should be abandoned as far as the United States was concerned. This said that R&D costs had doubled over three years; that “all five” live test launches so far made had been unsuccessful; and that the complexity of a Skybolt system under a B-52 was such that approximately 60,000 components had to function (out of 150,000 that the system contained) in order to accomplish the launch of a single missile.

Just two days before the McNamara-Thorneycroft meeting – on Sunday, 9 December – three Vulcan B.2s, one from each of the Scampton squadrons (Nos 27, 83 and 617), landed at Eglin AFB for a one-night stop on a round-the-world flight. Under the command of the AOC No 1 Group (AVM P.H. Dunn) and with the OC Scampton (Group Captain H. Burton) as deputy force commander,<sup>4</sup> the Vulcans had left the UK on 14 November with a Britannia in support. Their main purpose was to do a ceremonial low-level flypast at the opening by the Duke of Edinburgh of the British Empire and Commonwealth Games at Perth, Western Australia, on 22 November. They did a similar flypast (again accompanied by nine RAAF Sabres) at the Games' closing ceremonies on 1 December.

From Australia the Vulcans and Britannia went to New Zealand, where they “showed the flag” at RNZAF Ohakea and over several cities, then left for Pago Pago in American Samoa – landing there on 5 December, having flown across the International Date Line on the 6th. From the Samoan island<sup>5</sup> the

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<sup>1</sup> Skybolt Weapon System Steering Group meeting, 24 April (SP, Pt III). <sup>2</sup> OR1187 superseded OR1159 for Blue Steel Mk 2. <sup>3</sup> Later Air Marshal Sir Charles Ness, Air Member for Personnel. <sup>4</sup> A history of No 1 Group says that the AOC “captained a fourth Vulcan from Singapore to Perth and took over as Force Commander for the rest of the tour”. <sup>5</sup> Where (the ORB of No 27 Sqn noted) “all the RAF personnel were accommodated in the Rainmaker Hotel, made famous in the novels of Somerset Maugham”.

V-bombers and their escort proceeded eastwards via Hickam AFB near Honolulu (6 and 7 December) and Travis AFB near San Francisco (8 December) before reaching Eglin AFB, where – to quote from No 27 Squadron's ORB – “there were many friendly reunions with members of the Joint Services Trials team based there in connection with the Skybolt programme”. A Skybolt was lined up beside one of the aircraft and, in the words of the local paper,<sup>1</sup> “the long, white-painted missile looked remarkably at home beside the elegant lines of the white-painted Vulcans”. Its report went on to say that “some of the Vulcans are planned to arrive at Eglin early next year to be equipped to carry the American missile”.

This plan, involving the deployment to Eglin of the two Vulcan B.2s previously mentioned (XH537 and XH538), was not destined to be fulfilled. The three Scampton-based Vulcans flew from Florida in formation to Nassau in the Bahamas on 10 December; and it was there, in a three-day meeting which began just over a week later (18-21 December), that President Kennedy told Prime Minister MacMillan that he had decided to cancel plans for the production of Skybolt and offered various alternatives – which, with their implications, will be delineated in the chapter on Skybolt.

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<sup>1</sup> *Playground Daily News*, Fort Walton Beach, Florida.

## CHAPTER 16

**Blue Steel, Blue Streak and Skybolt (1954–1970)**

This 16-year period, bounded by the initiation of Blue Steel development in 1954 and by its phasing-out of service in 1970, was marked by two types of weapon technology – an air-launched bomb which would fly to its target and a surface-to-surface medium-range missile – which became linked when the latter project was cancelled in favour of an American successor (itself cancelled) to the former. The consistent link between these developments was Britain's endeavour to maintain an airborne strategic nuclear deterrent force in the 1970s and '80s. The technologies involved were ones which had never previously been attempted in the UK.

Although the Blue Steel story began formally with the issue of an operational requirement (ASR No OR/1132) on 3 September 1954, its origins went back to 1946 when the Air Staff first had the idea of a controlled bomb. Their thinking eventuated in a Requirement (ASR No OR/1059), which was issued on 19 June 1947 but described as a "re-statement" – with some amendments – of a paper with the same reference number but dated 29 March 1946. The burden of these thoughts was that, with future aircraft flying much faster and much higher, some means of improving bombing accuracy needed to be found. "With the object, therefore (the OR stated), of achieving the greatest possible economy of effort in bombing operations . . . the Air Staff require the development of a means of controlling the trajectory of bombs, during their fall from the release point predicted by bombsight, so that a very high standard of bombing accuracy can be attained". The actual means of control – whether guiding or homing – was left open in the OR, and a new code name was requested for the project, which became known as 'Blue Boar'.<sup>1</sup> This was a bomb with television guidance, as defined in a further ASR (No OR/1089, titled Control of Bombs – Television), issued on 11 October 1949, which superseded OR/1059. Its object was "the development of a bomb capable of displaying to a parent aircraft by television, the target in relation to the flight path of the bomb". The Air Staff further required "a system of control of the flight path of the bomb, whereby apparent errors may be progressively eliminated". This new OR was issued because OR/1059 was "no longer considered capable of early solution".

Blue Boar was not itself a type of bomb; it was a means of controlling a bomb after release from an aircraft, and of guiding it to a target (which the bomb-aimer could "see") by means of a joystick control.<sup>2</sup> The TV system<sup>3</sup> in the nose of the bomb, transmitting a picture to the aircraft, needed a clear sky during the later stages of the drop – which proved to be a limitation in the practical realisation of Blue Boar.

It was this and other operational limitations, rather than technical difficulties of design (for which RAE Farnborough were responsible, with Vickers-Armstrongs as contractors), which caused the Blue Boar project to be abandoned after nearly five years' work on it. During early development it had been described<sup>4</sup> as "a bomb having control surfaces and 'flip-out' wings which will enable it to be guided to its target. It will be interchangeable with the conventional 5,000lb and 10,000 HC stores and with the 'special bomb'<sup>5</sup>. It will be capable of being released from altitudes up to 60,000ft and speeds up to 600kt. A television camera in the nose of the bomb will transmit a picture of the area on the ground, towards which the bomb is travelling, on to a screen in front of the bomb-aimer. The latter will be provided with a suitable control – probably a 'joystick' . . .".

Such was the concept, and Blue Boar was being developed in three sizes – 1,000lb for use as a practice bomb, 5,000lb and 10,000lb as operational bombs<sup>6</sup>. Aircraft being designed to the B.9/48 (Valiant)

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<sup>1</sup> "In 1946 the Air Staff stated a requirement for a guided bomb with the object of improving the accuracy of bombing from high altitude at high speed. This resulted in the TV/command control development Blue Boar" (DCAS/CGWL, 24 March 1953). <sup>2</sup> Cf the joystick control of the Hs 293A radio-controlled rocket-boosted bomb launched from Do 217s. It was also produced in a TV-guided version (Hs 293D) for trials: see *German Guided Missiles* by R F Pocock and *Heinkel He 111* by Heinz Nowarra. <sup>3</sup> Television camera and transmitter. Sketches of the proposed layout for Blue Boar and of its method of operation were published in *Future Aircraft and Equipment* (SD573 – Air Ministry, March 1949). <sup>4</sup> OR6, 27 October 1949. <sup>5</sup> Blue Danube. <sup>6</sup> Director RAE/Sec, MoS, 27 October 1949.

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and B.35/46 (Vulcan and Victor) Specifications were required to be prepared for the installation of this weapon; but despite its potential accuracy, at the high speeds and high altitudes envisaged, doubts were being expressed by 1951<sup>1</sup> as to its operational value. These doubts arose from its limitations – its “daylight only” use, requiring clear conditions below 10,000ft; the facts that only one bomb could be controlled from one aircraft at a time, and that sizes were limited to 5,000lb and 10,000lb; and that its use might be confined to well-defined targets except when guided by highly skilled operators.

During 1952 it was decided to limit the use of Blue Boar, initially to four squadrons of Valiants and then to only eight aircraft<sup>2</sup>.

When, early in 1953, a decision was made not to go ahead with development of a television version of Blue Boar<sup>3</sup> it was clear that the original enthusiasm for this project was waning; and matters came to a head after the Secretary of State for Air (Lord De L'Isle and Dudley) visited Vickers' Weybridge factory in September of that year and subsequently wished to know the Air Staff reasons for their decision “to abandon the development of Blue Boar as an operational weapon”.<sup>4</sup>

He was told<sup>5</sup> how the requirement had originated in 1946 “with the object of improving the accuracy of bombing from high altitude at high speed” when it had become apparent that adequate accuracy would be difficult to obtain with free-falling bombs; and that consultation with the MoS had revealed that television/command control by day was the only practicable system of guidance that could be undertaken at that time. Though the operational limitations were well known, it was considered necessary to build up teams and experience both in industry and in MoS establishments to deal with all the problems involved in the control, guidance and aerodynamic performance of bombs. Thus when a more operationally suitable system of guidance became available, time would be saved by having a controllable vehicle in which to instal it. Because of the disadvantages of Blue Boar (as already enumerated) its development as an operational weapon could no longer be justified; but it was clear that “homing or controlled missiles” were the only means by which accurate bombing could be achieved.

The Secretary of State, however, expressed his concern to the CAS (ACM Sir William Dickson) that Blue Boar was to be dropped without any guarantee that another project with the same object could be developed and made available to the RAF on a satisfactory time-scale. He had discussed the matter with the Minister of Supply (Mr Duncan Sandys) and had drafted a minute to him; but CAS, who had himself visited Vickers-Armstrongs at Weybridge on 9 October, urged him not to send it until he could be given the facts. Subsequently, as a result of a “detailed investigation” by the Air Staff, CAS advised the S of S (on 3 March 1954) of their conclusion that they were “not justified in continuing with this project”.

The Air Staff took their final decision to abandon Blue Boar (a decision with which the S of S concurred) on 17 June 1954, at the same time reviewing bombing policy in the light of the V-force and its new aircraft which were shortly to start entering service.

This review prognosticated that the potential enemy would by 1960 be operating a short-range surface-to-air guided-missile defensive system around major vulnerable areas, and that in order to keep down losses in the V-force, any controlled bomb for it should be capable of being launched up to 100nm from a target. This weapon would need to be powered, to give it the speed and height to avoid enemy defences; thus the requirement for it involved a complete re-design, not resembling the Blue Boar type of configuration. In the light of this requirement, said the policy review (dated 15 June 1954), it was proposed to produce a weapon with an atomic warhead and capable of being launched 100nm away from a target, using an inertia guidance system. This powered, guided bomb should be in service by 1960. Comparing its potential value with that of Blue Boar, the review said that the reinstatement of the former in the programme would lead to “a weapon of limited operational use and with a . . . short Service life”,

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<sup>1</sup> DDOR5/DDPol(AS) and DDOps(B), July 1951. <sup>2</sup> AM meeting, 9 January 1952, and DDOR5/DDWp LM on 20 October: “it is the present Air Staff policy to provide one squadron of eight aircraft equipped for using Blue Boar missiles by the end of 1956 . . .”. <sup>3</sup> GW Progress Meeting, 13 April 1953. <sup>4</sup> ACAS(OR)/DCAS, 3 September 1953. <sup>5</sup> Blue Boar – Policy DCAS/SofS, 16 September 1953.

while the development of a propelled inertia-controlled all-weather missile "should result in the extension of the life of the V-bomber force and should be in service by 1960 . . .".

This wasn't the first mention of the type of weapon concept which resulted in Blue Steel, for in January 1954 CGWL (Controller, Guided Weapons and Electronics - Sir Stuart Mitchell) had expressed reservations about the design of Blue Boar and proposed a modified form that would be "powered and inertia controlled".<sup>1</sup> This proposal had, it was claimed, two advantages: greater accuracy than an unguided bomb, when weather prevented the use of a TV head; and the possibility of stand-off bombing through the use of propulsion.

It seems that these exchanges of ideas between the Air Staff and the MoS during the early months of 1954 led to the metamorphosis of the controlled bomb Blue Boar into the propelled controlled missile Blue Steel, an Air Staff Requirement for which (OR1132) was issued on 3 September 1954. This weapon, to be carried by the V-bombers, was required to be in service by 1960. It was to be capable of being launched by day or night, in any weather conditions, up to 100nm away from its target - so as to minimise losses from surface-to-air guided-weapon defensive systems and to achieve accuracy against specific targets. The missile was to have an atomic warhead, and its stand-off capability would extend the operational life of the V-bombers. A specification based on this OR was issued on 30 January 1956 and A V Roe & Co, makers of the Vulcan, were awarded a development contract on 9 March.

Although there would seem to be a long period between the issue of an OR and a specification for Blue Steel (September 1954 - January 1956), studies had been done by RAE and Avro from 1954 onwards, and the company's Weapons Research Division had issued a brochure on the projected missile - *Weapon to OR1132* - in August 1955.<sup>2</sup>

In the same mid-fifties period the Air Staff issued another requirement for a major nuclear weapon which was to enter service in the 1960s. On 8 August 1955 ASR No OR1139 was issued: this was for a medium-range (that is, up to 2,000nm)<sup>3</sup> ballistic missile system to fulfil a strategic bombardment role. Its purpose was to complement the manned bombers, as a deterrent and as a means of delivery, and to provide an alternative means of delivery of nuclear warheads when ground-launched guided weapons of increasing range, speed and lethality would inflict prohibitive losses upon the bomber forces. This ground-launched system, which Bomber Command crews were to operate from underground sites, was developed in parallel with Blue Steel. Code-named Blue Streak, its deployment was intended to benefit from the experience gained in the Thor squadrons, and with the manned bombers it was to provide a "balanced deterrent" in the 1965-70 period.<sup>4</sup> However, as will be related, its development was stopped in 1960 in favour of an order for American Skybolt air-launched ballistic missiles - whose cancellation at the end of 1962 led to the modification of Blue Steel for low-level launching.

These missile systems initiated during the 1950s had one common element: if an atomic blow were to be struck (assuming that the deterrent had failed), giving the means of delivery as great a degree of invulnerability as possible. Thus Blue Steel, launched when its "parent" V-bomber<sup>5</sup> was 100nm from its target; Blue Streak, fired from underground at a target 2,000nm away; and Skybolt, launched from under the wing of a Vulcan B.2, fulfilling (it was hoped) an Air Staff Target OR1149 for a long-range guided bomb which could reach a target 1,000nm away. - an OR issued on 7 May 1956, with the purpose of maintaining the deterrent force through the 1962-65 period.

In recounting the Blue Steel, Blue Streak and Skybolt story, with its complications and cancellations, it is important to stick to a strictly chronological order so as to show how one event led to another.

The background to these weapons, which were all designed to have megaton warheads, was the emergence of the hydrogen bomb in the spring of 1954. The Americans had exploded a large

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<sup>1</sup> DCAS/CAS minute, 30 January 1954. <sup>2</sup> WRB 1, August 1955, a design study made by A V Roe & Co Ltd. <sup>3</sup> By contrast, an IRBM (intermediate-range ballistic missile) like Thor had a range of 1,500nm and ICBMs like Minuteman and Titan ranges of over 6,000 miles. <sup>4</sup> "... a balance must be struck between the parts to be played by the missile and manned bomber weapon systems" (paper *A Preliminary Study of a Balanced Deterrent in the Period up to 1970* (DofOps (B&R), 4 June 1959). <sup>5</sup> Avro regarded Blue Steel as a "two-stage" aircraft concept.

thermonuclear device at Eniwetok Atoll in the Marshall Islands on 1 November 1952; but this device was "very far from being a practical deliverable weapon".<sup>1</sup> The first test of a "superbomb" – and "in a form readily adaptable for delivery by aircraft, and thus . . . the first large American hydrogen bomb"<sup>2</sup> – took place at Bikini Atoll (also in the Marshall Islands) on 1 March 1954 and was the first, and largest, of six megaton-range explosions in that series of US Atomic Energy Commission tests.<sup>3</sup> The political and military reverberations of this event were felt throughout the world; and Prime Minister Winston Churchill, with his unerring gift for expressing the significance of such an occurrence, said in the House of Commons at the end of that year: "The advance of the hydrogen bomb has fundamentally altered the entire problems of defence, and considerations founded even upon the atom bomb have become obsolescent, almost old-fashioned".<sup>4</sup>

These problems of defence were looked at afresh by the UK Chiefs of Staff "in the light of changes in the political and military spheres which have taken place during the last two years", as their 1954 *Memorandum on United Kingdom Defence Policy* put it. This was their response to an invitation from the Minister of Defence (Earl Alexander of Tunis) to review defence policy in the light of these changes, and the paper came before the Cabinet Committee on Defence Policy on 16 and 24 June 1954.<sup>5</sup> Its main theme was the effect on the world situation of progress in the development of nuclear weapons, which was the subject of another CoS paper presented to the Cabinet Committee on Defence Policy at this time: a memorandum covering a Report by a Working Party on the Operational Use of Atomic Weapons, which had examined the technical, financial and military implications of manufacturing H-bombs in the United Kingdom.<sup>6</sup>

This Working Party, under the chairmanship of Sir Frederick Brundrett (Scientific Adviser, MoD, and chairman of the Defence Policy Research Committee), consisted of those most closely associated with the development of atomic weapons in the UK – Sir John Cockcroft (Director, AERE, Harwell), Sir William Penney (Director, AWRE, Aldermaston) and General Sir Frederick Morgan (Controller of Atomic Energy, MoS) – plus the Deputy Chiefs of Staff and the Scientific Advisers to the three Service Ministries. Their report concluded that it was possible for the UK to make an adequate number of H-bombs annually, and that one course of action would be to increase the staff at AWRE and begin work at once, with the object of producing a test explosion in 1958 and the manufacture of Service weapons thereafter.

The Chiefs of Staff, in putting the Working Party's report to the Cabinet Committee on Defence Policy,<sup>7</sup> referred to the conclusion they had reached in their memorandum on UK Defence Policy – that this policy must be "to possess the means of waging war with the most up-to-date nuclear weapons" – and therefore recommended that approval should be given to putting in hand a programme for the production of ten hydrogen bombs a year for five years, starting not later than 1959. If such a programme "were started now and sufficient staff . . . recruited, a test of two weapons in 1958 should be possible".

This was the scientific and military advice thus given to the Cabinet Committee on Defence Policy, which had to consider political and financial factors, which it discussed at its 16 June 1954 meeting. Its decision was to authorise the Lord President (the Marquess of Salisbury) and the Minister of Supply (Mr Duncan Sandys) to initiate a programme for the production of hydrogen bombs – on the lines suggested in the Working Party's report (that is, work starting at once, with the object of producing a test explosion in 1958 and the manufacture of Service weapons thereafter).

This decision, which linked Britain's future defence policy to "second-generation" atomic weapons and which was as momentous in its implications as the Ministerial meeting of 8 January 1947 which originally authorised the production of atomic bombs in the UK, was subsequently confirmed by the

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<sup>1</sup> Professor Herbert York, *The Advisors, Oppenheimer, Teller & the Superbomb* (W H Freeman & Co, 1976). <sup>2</sup> *Ibid.* <sup>3</sup> These were the Operation Castle nuclear tests, the first of which – and the largest (Bravo – 14.8MT) – took place on 1 March 1954 and the sixth on 14 May. The fifth (Yankee – 13.5MT) was the second largest. These figures are given in *The Advisors*. <sup>4</sup> Queen's Speech debate, 1 December 1954 (Commons Hansard, Cols 170–178). <sup>5</sup> DP(54)6, 1 June 1954. <sup>6</sup> DP(54)7, 9 June 1954. <sup>7</sup> Signatories were the First Sea Lord (Admiral of the Fleet Sir Rhoderick McGrigor), CAS (ACM Sir William Dickson) and VCIGS (Lt-Gen Sir Harold Redman).

Cabinet – after discussions at two meetings, on 8 and 26 July 1954. At the latter meeting (to which the matter had been referred because some Ministers felt that they ought to have more time to reflect upon it before making a decision) the Cabinet eventually approved in principle the proposal that the current UK atomic weapons programme should be adjusted to allow for the production of thermonuclear bombs, and authorised the Lord President to proceed with his plans for their production.

Government approval of an enhanced UK nuclear-weapons programme, to include the development, testing and production of hydrogen bombs, opened the way for the issue of Air Staff Operational Requirements for new weapons with megaton warheads. Two of these were weapons of an entirely new kind in British military technology – a propelled air-to-surface missile (Blue Steel) and a medium-range (2,000nm) surface-to-surface ballistic missile (Blue Streak). A third was a free-falling bomb (Yellow Sun). Further Requirements were issued for warheads for these weapons – of two kinds: one for Blue Steel and Yellow Sun and another for Blue Streak. These warheads<sup>1</sup> were tested in live drops in the Operation 'Grapple' trials at Christmas Island in May–June 1957<sup>2</sup> made from Valiants of No 49 Squadron, whose ORB recorded that its aircraft and crews had “after months of specialised training . . . occupied a section of coral strip in the Pacific and successfully dropped the first three H-bombs of British design . . . .”. Of the three weapons, two went into service with the V-force – Yellow Sun (initially in an interim version, but nevertheless the first megaton bomb in the RAF inventory) in March 1958, and Blue Steel in the autumn of 1962.<sup>3</sup> Blue Streak was cancelled as a military weapon on 13 April 1960<sup>4</sup> though it was subsequently to be employed as a European space launcher. However, before its demise in favour of Skybolt, a good deal of thinking had been done as to how it should be deployed.

Blue Streaks, sited underground, were to form part of what was referred to as a “balanced deterrent” – that is, consisting of manned bombers and MRBMs – from the mid-1960s onwards, the missiles being expected to enter service “in significant quantities” from 1965 onwards. They were to result (if the programme had reached the production stage) from development of this pioneer British ballistic missile system by a group of companies under the co-ordination of de Havilland Propellers: it was to have a Rolls-Royce liquid-propellant rocket engine and a Sperry inertial guidance system. Development of a megaton warhead has already been referred to, and a Ballistic Missile Division had been created at RAE Farnborough to exercise technical supervision and assist the project.<sup>5</sup>

Quite apart from the design and testing problems involved in creating an entirely new (as far as Britain was concerned) weapon of this kind, however, Blue Streak seems to have been dogged by financial stringencies. An Air Council paper in mid-1957<sup>6</sup> referred to “recent economy measures” which had “necessitated a readjustment of the Blue Streak R&D programme”. This readjustment had resulted in cancelling contracts for the Marconi radar guidance system and the English Electric “insurance” inertial guidance system,<sup>7</sup> and also in extending the R&D time-scale – so that the first firing was scheduled for November 1960 and the first operational capability date became 1965.<sup>8</sup>

By the time Blue Streak had thus been slowed down, development of the other two megaton weapons was well under way. The Air Staff's Operational Requirement for Blue Steel, having been accepted by the Ministry of Supply in November 1954, had led (as has been said) to the award of a development contract to A V Roe, who worked on the design in co-operation with RAE Farnborough and AWRE, Aldermaston, the two Government establishments being responsible for the warhead. Blue Steel was expected to weigh about 17,000lb when fully fuelled, and attain speeds of up to about M2.5 and heights approaching 75,000ft, which should give it immunity from target defences. With a rear-mounted wing of 13ft span, it was 35ft long, made mainly of stainless steel and propelled by a hydrogen peroxide/kerosine

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<sup>1</sup> Code-names for the warheads tested in the Grapple trials were 'Green Bamboo' (for a bomb) and 'Orange Herald' (for the ballistic missile). <sup>2</sup> This was the first in a series of three Grapple trials – the others were held in November 1957 (Grapple-X) and April–May 1958 (Grapple-Y). <sup>3</sup> In August–September No 617 Squadron became “emergency operational” with Blue Steel. <sup>4</sup> This was announced by the Minister of Defence (Mr Harold Watkinson) in the House of Commons. <sup>5</sup> DRPC Memoranda 1957 – DRP/P(57)31 – 6 August 1957. <sup>6</sup> AC(57)57 – Progress Report on New Weapons. <sup>7</sup> Sperry Gyroscope Co were responsible for Blue Streak inertial guidance. <sup>8</sup> The ASR of 1954 had asked for the missile to be in Service use by 1960.

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rocket motor, and since it was to be carried under, and then launched from, a V-bomber the complications of design and construction hardly need to be stressed. These became more apparent in the second stage of development, when full-scale models of varying degrees of complexity were flown. Formulating techniques for the manufacture of stainless-steel airframes "took longer than expected, and more development was found necessary on some of the internal systems than had been planned".<sup>1</sup>

The first public announcement that Britain was to make weapons with megaton warheads came in the 1955 *Statement on Defence*,<sup>2</sup> which said that the US Government had announced that they were proceeding with full-scale production of thermonuclear weapons and that the Soviet Government were "clearly following the same policy". The United Kingdom also had the ability to produce such weapons, and "after fully considering all the implications of this step", the Government had "thought it their duty to proceed with their development and production".

Some two months after the public announcement of British thermonuclear weapons had been made the Chiefs of Staff decided that, as first priority, a weapon with a yield of about one megaton should be developed; and in the wake of this decision the Air Staff issued a Requirement (ASR No 1136) on 6 June 1955 for a thermonuclear bomb – that is, for Yellow Sun Mk 1, destined to be the first megaton-range weapon in Bomber Command's inventory. This Requirement was accepted by the Ministry of Supply on 28 July that year: the warhead, when developed, was to be used for both Yellow Sun and Blue Steel. Then, on 8 August, the third in the British 'triad' of megaton weapons was inaugurated when the Air Staff Requirement for Blue Streak was issued – ASR No OR1139, for a medium-range ballistic missile system.

The Blue Steel development programme was confirmed early in 1956, this propelled controlled missile and its megaton warhead installation (OR1141) being accepted as requirements during January and a development contract for the missile being awarded to A V Roe on 9 March. Then, on 7 May, an extrapolation of the stand-off bomb concept occurred with the issue of an Air Staff Target (AST1149) for a long-range guided bomb. This asked for a detailed technical study of such a weapon to determine whether certain characteristics could be met – an operating speed of not less than M2.5/3; operating height of not less than 80,000ft; and a range of about 1,000nm. The missile envisaged should be capable of carrying a nuclear warhead similar in yield to that being developed for Blue Steel; it had to be suitable for carriage by, and launching from, the developed (*ie*, Mk 2) V-bombers; and this aircraft/missile combination was to be capable of attacking targets up to 2,500nm distant from the take-off point. The Air Staff wished to have this weapon in service by 1962.

The parameters requested in this AST of mid-1956 (when as yet only the first of the V-bombers was in service) are important to note, for two reasons: they represented a 25 per cent increase in range and more than an 11 per cent increase in operating height over Blue Steel, which was still on the Avro drawing-boards; and subsequently (1958) the US Air Force wrote a comparable Operational Requirement (GOR 177) for a 1,000nm ballistic or boost glide air-to-surface vehicle with a speed of more than M5. These RAF and USAF requirements were to come together in 1959 when the US aircraft industry was invited to make proposals for meeting a new requirement – a new GOR 177, for a weapon which had to be compatible with the Victor and the Vulcan.

OR1149, the Air Staff Requirement for a long-range powered guided bomb, was in fact cancelled late in 1958 as the result of a review of defence expenditure; but on 3 February that year a draft ASR – OR1159 – had been circulated, asking for an extended-range air-to-surface missile: it was issued on 28 May 1958, and was for an extended-range (Mk 2) Blue Steel. It was to carry a megaton warhead (for which an ASR – No 1160 – was issued on 11 June 1958), and the main contractors were to be Avro for the missile and Bristol Siddeley for the engine. Later that year, when there was considerable discussion about continuing the contracts for this weapon, it was described as "essential to maintenance in years to come of the UK deterrent by the V-bomber,"<sup>3</sup> the requirement for it had been based on OR1149, and the new project was considered to be a kind of insurance against the possibility of an American weapon in the

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<sup>1</sup> RAeS lecture by R H Francis, formerly Chief Engineer, Weapons Research Division, A V Roe (6 November 1963). <sup>2</sup> Cmnd 9391 – February 1955. <sup>3</sup> AUS(A)/Treasury, 20 July 1959.

same category not being developed or not being made available to the RAF. OR1159 had to be proceeded with (it was considered during 1959)<sup>1</sup> until the Americans had made a decision on whether or not to develop a long-range powered guided bomb, and until it was possible to decide whether the RAF might be supplied with such a weapon on terms compatible with UK defence policy.

The RAF had been "in the know" (as described in the previous chapter, on Bomber Command – Strategic Air Command co-operation) on the USAF air-to-ground ballistic missile project since 1957, through the Requirements Interchange Officers scheme, and the two air forces' mutual interest in such a weapon had subsequently been formalised in the joint RAF/USAF Requirement GOR No 177 which was put out to the US aircraft industry on 22 January 1959. This asked for an air-launched ballistic missile which could be carried by B-52s, B-58s and Mk 2 V-bombers, which would weigh 10,000lb and could be fired 1,000nm from its target; and it was against this background that work on OR1159 was kept going – to ensure a second-generation Blue Steel for the V-force, should the American weapon not materialise. The view was expressed that a choice between the two weapons could not be made before the end of 1959.<sup>2</sup>

During 1960 RAF/USAF co-operation on the air-launched ballistic missile system – known originally as WS138A but from early that year as GAM87A – was formalised by Understandings between the President and the Prime Minister (29 March) and the Secretary of Defense and the Minister of Defence (6 June), and a Technical Agreement between the Department of the Air Force and the Ministry of Aviation (27 September): no international weapon acquisition could have been more well founded.

So well founded in fact was British confidence in Skybolt as a weapon which would maintain the operational viability of the V-force in the face of increasingly severe and longer-range enemy SAGW defences that Blue Streak – the medium-range ballistic missile system intended to supplement the V-bombers – was abandoned as a military weapon early in 1960. Announcing this in the House of Commons on 13 April, just two weeks after the first Understanding on Skybolt, the Minister of Defence (Mr Harold Watkinson) said that the Government had concluded that it ought not to continue to develop a missile that could be launched only from a fixed site. He went on:-

"Today, our strategic nuclear force is an effective and significant contribution to the deterrent power of the free world. The Government do not intend to give up this independent contribution, and therefore some other vehicle will in due course be needed in place of Blue Streak to carry British-manufactured nuclear warheads. The need for this is not immediately urgent, since the effectiveness of the V-bomber force as the vehicle for these warheads will remain unimpaired for several years to come, nor is it possible at the moment to say with certainty which of several possibilities or combinations of them would be technically the most suitable. On present information, there appears much to be said for prolonging the effectiveness of the V-bombers by buying supplies of the airborne ballistic missile Skybolt which is being developed in the United States. Her Majesty's Government understand that the United States Government will be favourably disposed to the purchase by the United Kingdom at the appropriate time of supplies of this vehicle"<sup>3</sup>.

This was a guarded reference to a possible buy of Skybolts for the V-force; the Minister made no reference to US-UK co-operation in the missile's development, which was to be confirmed by the USAF/MoA Technical Agreement later that year.

Not only was OR1139 (Blue Streak), and the work which had been done on the project, dropped in the wake of the Skybolt Understanding; so was OR1159 for the Mk 2 Blue Steel – being superseded by OR 1187 for an air-launched ballistic missile system to be carried by the Mk 2 Vulcans, to be as stated in US SOR177 and to have a performance at least equal to that accepted for the Skybolt/B-52 weapon system. This was the RAF Requirement for Skybolt and it eliminated any further development of Blue Steel<sup>4</sup>. OR1187 was issued on 26 April 1961, following the Skybolt agreements.

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<sup>1</sup> AM/T. <sup>2</sup> MoD/Treasury, 27 July 1959. <sup>3</sup> Hansard Cols 1265-6. <sup>4</sup> "During this time (the early 1960s) the UK guided-weapon industry . . . virtually opted out of the strategic missile field. This was a consequence of the decisions by the UK to cancel Blue Streak and Blue Steel Mk 2, the decision not to develop large solid-fuel motors and the ill-advised decision to adopt the US Skybolt, which was to be cancelled only a few years later" (RAeS paper on *The Place of Guided Weapons in the UK Aerospace Industry*, by G R Jefferson, Chairman and Chief Executive, British Aerospace Dynamics Group, published in *Aerospace* for April 1980).

Skybolt was intended to be in RAF operational service in the last quarter of 1964, and when UK interest in it had been confirmed during 1960 the Air Ministry hoped that its precursor, Blue Steel, would be in service by 1961/62. Originally all the Mk 2 V-bombers (a UE of 104) were to be equipped to carry the British guided bomb, but these plans were re-appraised during May 1960 to take account of Skybolt, the upshot being that the early Vulcan B.2s would not be modified to carry Blue Steel but would be armed with free-falling bombs until Skybolts came into service.

Thus the two new weapons for the V-force - the short-range powered guided bomb Blue Steel and the long-range ballistic missile system Skybolt - were in parallel development from June 1959, when Douglas Aircraft were selected as prime contractor for GAM-87A, and both projects were dogged by technical difficulties. In the case of Blue Steel, these led to a delay in its entry into service; in the case of Skybolt, they led to its cancellation - though had the Department of Defense really wanted the missile in the USAF inventory they would have been overcome.

By 1959, when Blue Steel had been under development for five years, there was a lack of confidence about its operational viability by the time it would enter service. A view expressed in October of that year, on the basis of an estimate by the Ministry of Supply that it would be in service early in 1962, was that by 1963 the V-bomber/Blue Steel Mk 1 weapon system was unlikely to constitute a valid deterrent owing to the reducing ability of the aircraft to penetrate to the weapon's required release point.<sup>1</sup>

However, there was never any question of cancelling the project, whatever the doubts about it or delays in its fulfilment, and on 15 December 1960 a production order was placed - originally for 75 Blue Steels, a total subsequently reduced (because of the cut in the Victor B.2 order on 25 July 1960 from 57 to 32) to 57. This reduction was also due to Treasury insistence on savings following a sharp increase in costs. In October 1960 the Air Minister (Mr George Ward) had been told that the estimated cost of a Blue Steel (exclusive of warhead) had gone up from £150,000 to £250,000, and that the current estimate of R&D expenditure was £60m compared with £35m in October 1958.

In addition to concern over rising costs, there was criticism of the contractor by the Government and the Air Staff. Reporting on Blue Steel progress early in 1961 the Parliamentary Under-Secretary, Ministry of Aviation (Mr Geoffrey Rippon), referred to the weapon's late in-service date - initial release in May 1962 and final release in 1963 - compared with the in-service date of 1961-2 originally accepted by the Ministry of Supply, and concluded: "Even allowing for the fact that Blue Steel broke entirely fresh ground, A V Roe's past performance has not been satisfactory. They have been left with no delusions about the effect of continued delays. They have thoroughly overhauled their organisation and other resources of the Hawker Siddeley Group have been brought in to assist. There is no room for complacency, and everything now hangs on the success of the Australian trials . . .".<sup>2</sup>

Air Staff criticism was contained in a comment by ACAS(OR) (Air Vice-Marshal R N Bateson) on Mr Rippon's report, saying that it confirmed "the long-expressed opinion of the Air Staff that A V Roe programmes have been unrealistic" and that the management structure at the company's missile division might need "further overhauling". ACAS(OR) went on to say that the Air Staff had "always regarded the firing of the first navigated round as an essential demonstration of a progressive and logical development plan", and that it was "all the more regrettable that this first attempt to prove the missile in free flight should be more than a year behind schedule". In his view, the first navigated round constituted "an essential milestone" - one that had to be passed successfully "before we can have any real confidence in the promise of an Initial Operational Capability within the next twelve months".<sup>3</sup>

But while the Government were worried about the time being taken to develop Blue Steel because this meant costs were rising, and the RAF were worried because the enemy defences the new bomb was designed to penetrate were steadily becoming more sophisticated for it to do so, the company responsible for the hardware were having difficulties - which led to delays - because of the complexity of the technical problems they encountered. In 1955, during the planning of Blue Steel's development - most of which was "done in the laboratory - not in flight"<sup>4</sup> - A V Roe found that there were "a number of problem areas where the information necessary to finalise the missile design could be obtained only by free flight trials". It was also necessary to build up a flight trials organisation which would eventually be able to prove the operational weapons. For these reasons, two series of air-launched free flight test vehicle trials were planned, to precede trials of operational Blue Steels. The first used two-fifths scale

<sup>1</sup> ACAS(I) note. <sup>2</sup> 19 January 1961. M/3706 of 26 January 1961 refers. <sup>3</sup> CMS.2485/54/ACAS(OR)433.

<sup>4</sup> *The Development of Blue Steel* - RAeS Astronautics and Guided Flight Section lecture by R H Francis, formerly Chief Engineer, Avro WRD.

models, made of stainless-steel – to give experience in the design and manufacture of stainless-steel airframes which the operational weapons would have; and the second series were to use full-size vehicles, the main difference between them and the weapons being in the powerplant – de Havilland Double Spectre instead of Armstrong-Siddeley Stentor. The two-fifths scale models were launched from Valiants, the full-size test vehicles from Valiants and Vulcans, and the flight trials went on from 1958 to 1961, at Aberporth and Woomera.

These trials were regarded as an essential preliminary to the development of an operational air-launched guided bomb, for several reasons – because there was little information then available on flight at high supersonic speed; conditions inside the missile during prolonged carriage at high altitude could only be established by trial; the release system had to be proved; and the interface between aircraft and missile equipment had to be examined in a realistic environment.

Avro found difficulty, “largely due to the time spent in learning the techniques of manufacturing in steel” (to quote again from Mr Francis’ lecture), in getting these trials started. They therefore decided to insert into the programme a series of full-scale test vehicles made of aluminium alloy instead of steel, with their auxiliary power supplied by hydraulic reservoirs and batteries instead of the hydrogen peroxide turbine, and with a minimum of aircraft-to-missile connections. The first two of these aluminium alloy test vehicles – inert, dummy ones – were launched in 1958, and a number of powered ones during 1959–1960. While these rudimentary vehicles went a long way towards meeting three of the test criteria, they couldn’t meet the fourth – the interface between aircraft and missile in a realistic environment: this had to await the more sophisticated stainless-steel vehicles, which now had Stentor engines.

They also (Mr Francis explained) towards the end of the programme approximated in other ways too, much more closely to the operational missile than had originally been planned – “thus partly atoning for their late appearance. In fact, the last few, apart from the structural differences, were very nearly the operational type Blue Steel. Their main function had by then become the in-flight proving of the internal systems, including navigation, control and parts of the armament system”.

Mr Francis went on to justify the long Blue Steel period of development in the following terms:-

“Because of the extension of the test vehicle programme, the trials of the operational-type missile started with a much greater back-log of development experience than would otherwise have been available. A number of engineering weaknesses revealed by the test vehicles might otherwise have found their way into the operational missile. The result was that a high standard of performance and functioning reliability was achieved from the start of these trials, and compensated for the previous pains and tribulations”.

During this development period, the Air Staff waited anxiously for the first completely successful flight of an operational-type Blue Steel from a Vulcan, for the delivery of training rounds to Scampton so that Bomber Command might gain handling experience with its new weapon, for the opportunity to declare an Initial Operational Capability, for the formation of Blue Steel squadrons and their training in the new role, and for the flow of suitably modified Mark 2 Vulcans and Victors equipped to carry the guided bomb.

The RAF maintained close liaison with the contractors through No 4 JSTU (Joint Services Trials Unit), formed on 1 September 1956 – in the first year of the Blue Steel contract – at A V Roe’s Woodford, Cheshire, factory “for the evaluation of the Blue Steel missile and to complete the final testing of the missile before its release to the Service” (to quote from the ORB). The unit was controlled functionally by ACAS (OR)<sup>1</sup> and administratively by HQ Home Command, and its records – enumerating every Blue Steel flight-tested<sup>2</sup> – provide a detailed account of the weapon’s development, from scale models to production versions. Its work at Woodford went on for five years; after just over four years it moved its main operation to Australia for the Woomera trials; and at the end of the five-year period it transferred to Scampton, where it was re-named No 18 JSTU, to carry out environmental trials on acceptance missiles (W100As). From the unit’s earliest days there were plans for a move to Australia, and these were first

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<sup>1</sup> At that time AV-M H J Kirkpatrick, who visited the unit on 12 March 1957. <sup>2</sup> There were also many wind-tunnel tests – at RAE Farnborough and Bedford, Avro and the ARA (Aircraft Research Association).

implemented when the unit's first Valiant, WZ370, left for Edinburgh Field, near Salisbury, a market town north of Adelaide, South Australia. This airfield was adjacent to the Weapons Research Establishment, where No 4 JSTU would subsequently be based. The V-bomber reached Edinburgh Field on 20 July 1957 and was followed out by a servicing team and a trials missile. So, from its earliest stage, Blue Steel development work went on both in the UK and Australia. But the unit's main base in the initial years was Woodford, with a Valiant (and later a Vulcan) doing flight trials from there and from Edinburgh Field over the Aberporth and Woomera ranges respectively.

JSTU immediately got down to preparations for air-launching the first two-fifths scale model Blue Steel, which was loaded on to Valiant WZ370 on the very last day of 1956, then test-flown during January (the specific date was not recorded in an otherwise conscientious ORB) at 40,000ft and varying Mach numbers – 0.7, 0.75 and 0.8. The first time a Blue Steel shape was sent through the air on its own was when this model (described as a “cold” – *ie* unpowered – missile) was dropped from JSTU's Valiant on 5 February 1957 with its control surfaces rendered immovable. Although it had been fitted with parachutes and flotation gear for recovery, it was not in fact recovered because the ground radar had locked-on to the aircraft and failed to track the missile.

Valiant WZ370 did another two-fifths scale Blue Steel drop on 5 June, then after its departure for Australia was replaced by Valiant WZ375, which did air-launchings of 19/15 Rounds 004 and 009 on 24 October and 6 December respectively. These were also two-fifths scale test vehicles.

During 1958 the trials activity intensified, both at Woomera and Aberporth, and a full-scale version of Blue Steel – though uncontrolled and unpowered – appeared: this was the W.102, made of light alloy, which was subjected to a loading trial on Vulcan Mk1 XA903 at Woodford on 18 March, ballasted to bring its all-up weight to a realistic 16,000lb. In a rare lapse into lyricism the JSTU's ORB compiler commented that “with the missile attached to the Vulcan, this installation can best be described as impressive, neat and aerodynamically clean”. On the last day of the month taxiing trials began, and on 19 April flight trials. “From handling considerations”, a lengthy report concluded, “the carriage of Blue Steel need impose no special limitations on the Mk 1 Vulcan”.

The number of W.102s built up at Woodford during May (“there are now four in workshops plus one loaded on XA903 for ground retraction and folding-fin tests”, the ORB recorded) and the first to be air tested was released at Aberporth on the afternoon of 9 May from 40,000ft at MO.8 – a trial, summed-up as “satisfactory”, to test the release characteristics (the missile made a clean departure from the aircraft and flew for 14,000yd) and to familiarise the range with the Vulcan/W.100 combination. At the same time scale model (Type 19/15) trials were going on in Australia – Round 011 being launched at Woomera on 30 May and 014 and 015 on 2 and 19 September.

During the latter month the new weapon made its first public appearance: “the commanding officer (Wing Commander S T Underwood) flew in Vulcan XA903 with Blue Steel attached over the SBAC Show at Farnborough”, recorded the No 4 JSTU ORB. The bomb was painted yellow and its under-fin folded sideways; and the aviation magazine *The Aeroplane* pointed out what it referred to as “the sort of security anomaly that one almost always finds at Farnborough” – that “while the Avro stand-off bomb is only permitted to make the briefest of visits, carried under a Vulcan passing over during the flying display, the company's section of the Hawker Siddeley Group stand has as its most dominating exhibit an ‘air-launched aerodynamic test vehicle’ which bears a most striking resemblance to the actual weapon”.

Preparations were made during 1959 for No 4 JSTU's move to Australia, for Blue Steel acceptance trials at Woomera, and by January 1960 the move had been accomplished – with the unit's HQ, Technical HQ and Technical Sections “in the A V Roe compound of the Laboratories Area of the Weapons Research Establishment, Salisbury”, and its Operations Section and Electronics Centre at RAAF Edinburgh Field.

During 1960 the emphasis was entirely on full-scale (W.100) missile testing: a brief prepared for a visit by the Minister of Defence and the Air Minister (Mr Harold Watkinson and Mr George Ward) to RAF Cottesmore on 13 May summed-up Blue Steel development to date. It said that the 1/5th (6/5) and 2/5ths (19/15) scale model programmes had been completed; that three W.102 full-scale unpowered dummies had been released and six W.103 full-scale powered missiles (in light alloy, with Spectre motors) had

been fired. It added that "to achieve full clearance some 80 operational-type missiles are planned to be released, but the first navigated round has yet to be launched (scheduled for August 1960)".

This brief went on to comment that the rate of development of missile projects in the UK was "very much slower than in the USA" – citing as examples "Thor, which had its first successful launch 18 months after it was placed on the drawing-boards, and Hound Dog, the OR for which was issued in late 1956. The first successful firing occurred 20 months later and it reached USAF operational squadron status in the autumn of 1959. Hound Dog" – the brief concluded – "is basically like Blue Steel although with a range of 500 miles, but its construction makes it physically incapable of being fitted to the V-bombers".

At this time, not only was Hound Dog in service with B-52Gs of Strategic Air Command, but Skybolt – with twice its range – was under development for the USAF and RAF; and with the speed at which the Americans got a new weapon into service compared with the time being taken on Blue Steel development, the Air Staff were worried that the latter might be in service for only a matter of two years (1962–1964) before the arrival of Skybolt. This consideration affected the number of Mk 2 V-bombers which should be modified to carry Blue Steel, and also the size of a production order for the weapon. A pessimistic comment made at this time by DCAS (Air Marshal S C Elworthy), in a lengthy minute of 10 May 1960 to the Air Minister,<sup>1</sup> was that the Air Staff had first started thinking about this weapon in 1952; the OR was accepted by the MoS in 1954 for an in-service date of 1960, and "had this date been met the weapon would have had a useful and viable life. An in-service date of 1963 for a weapon with a range of only 100 miles is . . . a different matter".

DCAS added that it had to be accepted that Avros hadn't distinguished themselves with Blue Steel and that in general the UK was a long way behind the Americans in this field. "The USAF have Hound Dog in service. This weapon has roughly the performance of Blue Steel Mk 2 which we have had to cancel<sup>2</sup> but which could not have been in service until 1965. Yet the Americans started on their project after us".

To be fair to the company, it should be stressed that in addition to the technical difficulties of an entirely new kind of weapon and the demands of a complex trials programme, they were still working only under the original development contract placed on 9 March 1956. They had no formal assurance that Blue Steel was to be ordered for the RAF.

This point was picked on by the Prime Minister (Mr Harold Macmillan) in a minute of 16 June 1960 to the Minister of Defence (Mr Watkinson), who had said at their meeting three days earlier that "no definite order had yet been placed for Blue Steel Mk 1". The Prime Minister asked for an early report on this, commenting: "We cannot expect the firm to push ahead on this with the necessary thrust unless they think we are serious in wanting the weapon".

The Treasury subsequently considered the implications of a Blue Steel production order, having been apprised by the Air Ministry of the urgency of this; and the Minister of Aviation (Mr Duncan Sandys), informing the Prime Minister on 21 June that the Air Ministry were awaiting Treasury authority for such an order, said that an early decision was necessary "not only to keep up the morale of the firm, but also to avoid a break in production when the development batch is completed".

By 22 June Treasury approval had been received for a production order for 75 Blue Steels – an approval based on an estimated cost per weapon of £150,000. But later it transpired that this cost was nearer to £250,000, and the cost of development to be £60m compared with an earlier estimate of £35m. As a result the number of Blue Steels to be ordered was reduced, Treasury approval being given on 14 November 1960 for a purchase of 57 operational rounds (W.105s) and 16 training rounds (W.103As – without engines, autopilots or guidance systems). This production order was placed with A V Roe on 15 December 1960.<sup>3</sup>

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<sup>1</sup> Blue Steel file ID9/194/4 Pt 1. <sup>2</sup> ie OR 1159. <sup>3</sup> Blue Steel (OR1132) Financial Aspects (ID/47/296 – Pt 2).

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But concern still remained about the rate of progress of the weapon's development, and the date when it would be released to service, the Parliamentary Under Secretary of the Ministry of Aviation (Mr Geoffrey Rippon) writing to the Minister of Defence on 19 January 1961 to say that – after A V Roe had “strengthened their organisation, particularly on the trials side” – “everything now hangs on the success of the Australian trials”.<sup>1</sup>

The reaction of the Minister of Defence to this report was to tell both the Ministers responsible – of Air (Mr J Amery) and of Aviation (Mr P Thorneycroft) – how important it was to be able to declare an initial operational capability with Blue Steel at the earliest possible moment. It would be helpful, he said, “if we could have even one squadron with an operational capability in, say, January 1962” – the Air Staff were “considering how to achieve this”.

The Air Minister pointed out in his reply (on 23 February 1961) that there should be sufficient suitably modified aircraft, test equipment, air and ground crews to support a squadron of eight Mk 2 Vulcans by January 1962. The position on missiles and warheads was “less straightforward”: there should be enough missiles; the question was, whether they could claim with confidence that they would work. He thought that an essential condition of any claim to operational capability was a firm MoA assurance – based on not less than 20 trial firings – that the missile would work. He added that the proper warhead for Blue Steel<sup>2</sup> wasn't due to be available before March 1962; but it would be possible to equip the missiles before then with an interim use of Yellow Sun warheads.<sup>3</sup>

The Minister of Aviation said it would be unwise to expect the emergency capability the Air Ministry required before June 1962, which would “match the availability of the first Blue Steels from the production contract”. He added that the firing of navigated rounds could now be carried out more effectively in Australia than at Aberporth. But Round 6, which was to have been fired on the UK range, would not now be fired; the firing of a longer-range round, from which more and better information was expected, had been planned for March 1961 at Woomera.

When the Minister of Defence enquired the reasons for abandoning Round 6 – “the first navigational round . . . scheduled for July 1960 . . . to be an important milestone in development” – Mr Thorneycroft explained (on 30 March) that to have fired this round at Aberporth would have delayed the departure of an aircraft to Australia and have held up the more important trials programme there. The present position at Woomera, he added, was that an un-navigated round fired on 24 March had been only partially successful. Records of this trial had to be more fully analysed before further firings – including that of a navigated round, due on 28 March – could take place.

The firing referred to by Mr Thorneycroft was one of 12 which took place over the Woomera range during 1961 from 22 February to 7 December – but only two of them, W.100/018 on 21 June and W.100/027 on 4 September, were successful. The others were all deliberately destroyed after flights varying in duration from 45 seconds to 5 min 19.5 sec.

At a meeting with the Air Minister on 25 April 1961<sup>4</sup> the Minister of Aviation admitted that Blue Steel trials “had not gone particularly well”, but he said that this didn't mean that the system as such wasn't workable – it merely meant that there had been faults in particular components, something which could often happen in the development of a new weapon. At the present time, he added, “everyone was aiming at a release date of mid-1962 for operational service in an emergency”.

In a report which the Minister of Aviation made to the Minister of Defence in September 11 the “faults in particular components” being a fact of life in Blue Steel trials at Woomera was emphasised in the examples he quoted – a navigated round (W.100/022) had achieved a range of 70nm, when trace of it had been lost and it was destroyed for safety reasons – performance up to the point of destruction having been satisfactory. The 4 September round (W.100/027) had flown over 90nm – reports indicating that the round and navigator had functioned satisfactorily but that a failure of the auxiliary power unit had affected the final dive<sup>5</sup> and prevented 100% success. “In general”, he commented, “two faults are

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<sup>1</sup> Development and Production of Power-guided Bombs (Blue Steel) (ID3/946/8(5) – Pt 2). <sup>2</sup> Red Snow. <sup>3</sup> Warhead for the free-falling megaton-range bomb. <sup>4</sup> Minutes in Development and Production of Power-guided Bomb (Blue Steel) (AHB file ID3/946/8(5) – Pt 2). <sup>5</sup> From about 70,000ft.

outstanding from the trials – failures of the auxiliary power unit and malfunctioning of the rocket motor, neither of which is expected to be fundamental. A modification has already been planned which, it is hoped, will rectify the rocket motor fault in W.100A missiles.”<sup>1</sup> He added that nothing in recent firings had thrown doubt on the ultimate capability of the weapon.

A summary of the Woomera trials up to this time<sup>2</sup> said that “out of 38 attempts to launch Blue Steel in Australia when actually airborne, 11 missiles successfully left the aircraft. Of these 11 missiles, however, only three were successful; seven failed as a result of faults within the missile and one because of range equipment failure. The three successful missiles flew about 90 miles under full control of the autopilot and inertial navigation gear . . . and . . . could be regarded as ‘near misses’”.

This summary concluded with two critical comments – that “the general conclusion” was that the pre-production models of Blue Steel had been “particularly badly engineered” and “better things could be expected” from the production (W.100A) missiles; and that the question was “whether this relatively primitive and short-range missile will be ready in sufficient time”. The latter comment seemed to refer to the expectation of receiving Skybolt, with its tenfold increase in range over Blue Steel.

Meanwhile plans were going ahead for acceptance of the new weapon into service at RAF Scampton – where three Vulcan B.2 squadrons (Nos 617, 83 and 27) were designated to be its carriers. In mid-1961 No 4 Joint Services Trials Unit started a detachment there; during July the station’s Missile Storage and Servicing Bay was completed, work continuing on the other specialised facilities required for operations with Blue Steel;<sup>3</sup> and from 1 December No 4 JSTU (UK Element and Australian Rear Party) became established there completely as No 18 Joint Services Trials Unit, with a detachment at Woodford. Its purpose was to carry out Blue Steel environmental trials on 16 acceptance missiles,<sup>4</sup> and this involved four separate tasks – the missile ready for use and storage; on an aircraft at standby; on an operational sortie (up to firing); and its electric and electronic compatibility. Eight Vulcan B.2s of No 617 Squadron<sup>5</sup> were to be available for these trials, on the completion of which the acceptance missiles were to be forwarded to No 4 JSTU in Australia.<sup>6</sup>

Complications in the Blue Steel development trials were reflected in the modifications needed to the aircraft which were to carry the weapon operationally. DCAS (Air Marshal R B Lees) was told in November 1961<sup>7</sup> that the modification programme to bring eight IOC (initial operational capability) Vulcan B.2s up to full operational Blue Steel standard had been made necessary for three reasons: failures of the structural test specimen, involving strengthening modifications which were too late to be embodied on the production line; numerous minor aircraft modifications resulting from late modifications to the missile – again too late to be embodied on the production line; and Air Staff policy, followed since mid-1960, of refraining from asking for any modifications which would delay the delivery to service of these eight aircraft. About 20 modifications were involved, representing some 2,200 man-hours of working time.

The first navigated Blue Steel round to be fired successfully at Woomera, W.100/018, had been launched from Valiant WZ375 on 21 June 1961; the next successes were not until 4 September (W.100/027 from Valiant WZ373) and 21 February 1962 (W.100A/038 – the first of the Service-type rounds to be fired successfully – from Valiant WZ375). Encouragingly for No 4 JSTU and for the Blue Steel programme there was another success on 22 February – round W.100/035 being launched from the same Valiant, following the planned trajectory and impacting 100ft short and 150ft left of the ground target.

During May 1962 a progress report on Blue Steel for the Air Council by the Secretary of State for Air<sup>8</sup> said that since the previous report in March there had been four R&D firings in Australia – two completely successful, one partially successful (falling about five miles short of its target) and the other a

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<sup>1</sup> *Ie* production type. <sup>2</sup> In AHB file Blue Steel (OR1132) Financial Aspects (ID/47/296). <sup>3</sup> For example, HTP (high-test peroxide) fuelling installation and ground-handling equipment. <sup>4</sup> The first to be received was Missile 047. <sup>5</sup> Which had been formed to use the dam-busting bomb in 1943 and now was to inaugurate another entirely new Bomber Command weapon. <sup>6</sup> No 18 JSTU ORB. <sup>7</sup> Minute of 29 November 1961 (Gp Capt D T Witt). <sup>8</sup> In file Blue Steel (OR1132) Financial Aspects (AHB ID/47/296 (Pt 2)).

failure. The report then mentioned that the Scampton environmental trials were "still not fully under way" because of delays in completion of the main test equipments: full testing of acceptance missiles would not be possible with the main test gear until the end of the year. But trials "in a limited form" were about to begin, and would extend in scope as the test equipment was brought nearer its full standard. The MoA had given clearance to carry the training missile; full clearance of acceptance trials missiles for trials purposes was expected by the end of June, and clearance of Blue Steel for operational "emergency" use scheduled for August/September 1962.

Scampton was now fully orientated to the new weapon: its ORB for May included a note by the Missile Squadron (Blue Steel), which said that the squadron was now "firmly established . . . having been here for exactly one year". The first personnel to arrive had been equipment staff of No 4 Joint Services Trials Unit which in December 1961 became No 18 JSTU, the original No 4 still remaining on the weapon, but working in Australia; in September the unit had been joined by the Blue Steel trials team, both the team and No 18 JSTU having offices "annexed to the Blue Steel Servicing Hangar, which now houses four training and three acceptance missiles". The former were "for eventual handover to the Air Force" after acceptance checks had been completed.

In descriptive vein, the note added that "on a site remote from the missile squadron hangar, next to the MT operating section is the HTP storage centre. These buildings were taken over by RAF Scampton in February, and the missile handling and loading flight of the JSTU, whose responsibilities are the fitting, loading, offloading and defuelling of the missile, moved in during March . . . . To date two HTP storage tanks and associated pumping equipment are available on the site and the first batch of the liquid is due on the station some time in June . . .".

Blue Steel training began for No 617 Squadron in July 1962, when training rounds became available for the first time and ten sorties were flown with the missile attached. The squadron had achieved its full complement of eight Vulcan B.2s in June, with the arrival of the last aircraft, XL317, on the 7th. However, this machine then underwent CWP (contractors' working party) modifications, eventually making its first Blue Steel training sortie with the squadron on 28 November.

By that time, No 617 had become 'emergency operational' with the new weapon. On 25 September the Minister of Aviation (Mr Julian Amery) had written to the Air Minister (Mr Hugh Fraser) saying that he was glad to be able to inform him that the Controller of Aircraft, MoA (Sir George Gardner), had that day forwarded to DCAS (Air Marshal R B Lees) "a CA Release for Blue Steel to be carried on Vulcan aircraft, in a national emergency". This clearance did not specifically authorise the launching of Blue Steels, because the requisite trials to prove the safety of the systems hadn't been completed; however, no difficulties had been experienced up to date which affected safety after launch. The clearance had been issued on the understanding that, should a crisis occur which warranted the carriage of Blue Steel with its warhead, limitations on its use could be overridden. This meant in effect, the Air Minister was told, that he could declare an operational capability with Blue Steel as soon as he considered that he was in a position to do so.

The ball was now in the Air Staff's court as to the timing of the declaration of an emergency operational capability for Blue Steel; and it was agreed, on a recommendation by DCAS, that such a declaration should not be made until at least six missiles were operational. A proposed Press facility at Scampton should also be deferred on the same grounds – until there were "sufficient tested missiles" to claim an EOC. The RAF were at this time under pressure to show that Blue Steel was in operational service; on the other hand it was important not to make claims which could not be fully supported. Eventually a time-scale of February 1963 was decided upon – in advance of S of S's Press conference on the Air Estimates Memorandum on 21 February; and the date finally agreed to was 14 February, when the AOC-in-C Bomber Command (Air Marshal Sir Kenneth Cross) would introduce Blue Steel at Scampton and the missile facilities would be open for inspection by Press representatives<sup>1</sup>.

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<sup>1</sup> There were, however, some reservations. CIO (Air Commodore J Barraclough) said in a minute to PS/SofS on 18 January that he had been waiting for an assurance from Bomber Command that Blue Steel, as supplied to No 617 Sqn, and its supporting equipment at Scampton, were sufficiently well developed to be presented to the Press as a viable going concern. HQ Bomber Command had "confirmed that this was so but had entered reservations as to the wisdom of having a facility at all".

On 20 December 1962, in his progress report on new weapon systems and aircraft, DCAS had told the Air Council<sup>1</sup> that the RAF now had four Blue Steel missiles with an operational capability and should have four more in the New Year, and that the contractors "were doing everything they could to speed delivery". At the same time, on the other side of the Atlantic, President Kennedy was telling Prime Minister MacMillan of his plans to cancel the production of Skybolt. A Statement on Nuclear Defence Systems, issued as one of the communiques after their 18-21 December meeting at Nassau in the Bahamas, said that the President had explained to the Prime Minister, when they reviewed the Skybolt development programme, that it was no longer expected that this "very complex weapon system" would be completed within the cost estimate or the time-scale projected when the programme was started. President Kennedy informed Mr MacMillan that for this reason, "and because of the availability to the United States of alternative weapon systems", he had decided to cancel plans for the production of Skybolt for use by the US.

The President offered to continue development of Skybolt as a joint US-UK enterprise, with each country bearing equal shares of the cost, but the Prime Minister decided not to avail himself of this offer - because of doubts about the prospects of success for the weapon system, and because of uncertainty about the date of completion and final costs. An alternative offer of the Hound Dog<sup>2</sup> missile for RAF use was unacceptable to the Prime Minister "in the light of the technical difficulties".

What emanated from the Nassau talks, in the wake of the official demise of Skybolt and the rejection by Britain of the American alternatives, was the provision of Polaris missiles for British submarines and an agreement by both countries to subscribe existing strategic forces - including those in RAF Bomber Command and tactical nuclear forces in Europe - to NATO, in order to assist development of a multilateral nuclear force in the organisation.

The end of 1962, therefore, proved to be a watershed for the strategic nuclear force of Bomber Command. Two years previously, at the beginning of 1960, it could look forward to a future with three weapon systems which would extend its capability into the 1970s - Blue Steel, carried by B.2 Vulcans and Victors; Skybolt, carried by B.2 Vulcans; and Blue Streak, launched from underground silos. Blue Streak had been cancelled because Skybolt offered an acceptable alternative; now Skybolt had been cancelled and Blue Steel - planned eight years previously - did not now have sufficient range to provide the V-bombers with the invulnerability which its concept had envisaged.

When the Press facility to introduce Blue Steel was held at Scampton on 14 February 1963 - in wintry conditions, Vulcan B.2s carrying Blue Steels (captained by Squadron Leader D R Carr and Flight Lieutenant P F Thompson) taking-off in swirling snow and disappearing into dark banks of cloud - the AOC-in-C Bomber Command (Air Marshal Sir Kenneth Cross) said that No 617 Squadron had "already trained" on the new weapon, that No 27's training was "well advanced" and that No 83's would follow. No 617's ORB entry for February reflected this view:-

"As in previous months, Blue Steel Trials and Training flights accounted for the majority of sorties flown, and eight crews from No 617 Squadron are now operational with Blue Steel. The squadron is also responsible for providing missile-equipped aircraft for Blue Steel training purposes to Nos 83 and 27 Squadrons. The training of crews from these squadrons has been so delayed by bad weather and aircraft unserviceability that it is now of paramount importance that serviceable Blue Steel aircraft are flown by these crews whenever available, and to this end centralised planning of Blue Steel sorties has been adopted; by doing this and by staggering the working hours of crews it is possible to provide a crew for a Blue Steel take-off at any time between 0830hr and 2100hr. Priority has been given to initial training of 27 and 83 Squadron crews, and Blue Steel continuation training by No 617 Squadron crews has been necessarily curtailed".

These three Vulcan B.2 squadrons, with two Victor B.2 squadrons - Nos 100 and 139 at Wittering - were to form the Blue Steel force of Bomber Command from 1963 onwards, the Victors (of No 139 Squadron) converting from November of that year.

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<sup>1</sup> Conclusions 17(62). <sup>2</sup> Range, over 600 miles; two carried under the wings of B-52s; entered service in 1961.

Sir Kenneth made no mention of Skybolt, concentrating on the capability and validity of Blue Steel, saying that it had exceeded specifications in range, accuracy and reliability of components.<sup>1</sup> He commented that 140 training sorties had already been flown with Blue Steel, and that the average time taken to train crews was only 15hr – because they already knew their aircraft well, and because of the number of ground training exercises they had done at Lindholme (the Command Bombing School). He stressed that Bomber Command had “learned about the weapon as it was tested”, and said that two units had been responsible for bringing it into service – No 18 Joint Services Trials Unit at Scampton, and No 4 JSTU at Edinburgh Field, Australia.

But despite this introductory fanfare for Blue Steel, the operational scene in which it was to have been an interim weapon had changed, and new plans had had to be made. As the Air Ministry Quarterly Liaison Report for January–March 1963 succinctly put it, under the heading ‘Weapons – The Deterrent’:-

“Since the last report was prepared Skybolt has been cancelled and Polaris substituted, with the result that Bomber Command will have to maintain the independent deterrent without Skybolt for longer than was foreseen. To improve their chances of penetrating enemy defences it has been decided to give the aircraft a low-level capability by:

- (a) Providing a nuclear weapon which can be released from very low altitudes;
- (b) Modifying Blue Steel to enable it to be launched from below 1,000ft;
- (c) Improving the performance at low level of the bombing and navigation fit of the V-bombers.”

These three methods of improving the low-level capability of the V-force were put into effect during the 1960s following a Government decision of 23 January 1963 taken by the Cabinet Defence Committee, when it considered Britain’s deterrent in the pre-Polaris period.<sup>2</sup> The committee had before it a memorandum of 15 January by the Minister of Defence (Mr Peter Thorneycroft)<sup>3</sup> in which he outlined the measures which needed to be taken to improve the credibility of the nuclear deterrent in the period before the Polaris force became operational – that is, up to 1969. These measures were based upon an Air Staff assumption that the V-bombers would have to operate at low level from the mid-1960s if they were to penetrate enemy defences (such operations being practicable, according to experience gained with the training of Valiant squadrons assigned to Saceur).

With low-level operations a *sine qua non* (the TSR.2 – then still a viable project – would “provide useful strategic support”, the Minister said) the need was to modify V-force weapons and equipment accordingly. These modifications were – as already noted in the quotation from the AM Quarterly Liaison Report – to develop the lay-down bomb being designed for RN Buccaneers and the TSR.2 so that it could be used by the V-force; to give Blue Steel a low-level release capability; to provide the force with suitable navigation equipment for operations at low level; and to study the possibility of equipping it with additional electronic or other countermeasures for such operations. The Cabinet Defence Committee agreed to these proposals (having been advised of the total costs involved – nearly £28 million, which included an item for strengthening the Victor B.2 airframe), “subject to the normal processes of inter-departmental consultation” – which meant that the details would have to be worked out between the Air and Aviation Ministries, with the approval of the Ministry of Defence. Thus the Government had willed the end; it was up to the procurement and operating Ministries to provide the means.

The free-fall bomb which the V-bombers were to use when operating at low level was not therefore a new weapon, but an adaptation of one which had been under consideration since the mid-1960s. In its original form, however, it was envisaged by the Naval and Air Staffs – who drew up a joint requirement, OR1177 – as being used by a variety of aircraft for tactical purposes. Types like Canberra, Buccaneer and TSR.2 would carry one or two, the V-bombers several. The difference proposed, under a revised requirement issued in March 1963 as one of the post-Nassau plans for extending the effectiveness of the V-force, was that the version to be carried by Vulcans and Victors would have a higher yield and be principally suitable for delivery in the laydown mode. This weapon was due to be in service by June 1966 – priority being given to its development for the medium bomber force.

<sup>1</sup> *Flight International* report and leading article, 21 February 1963. <sup>2</sup> D63 (1st Mtg). <sup>3</sup> D(63)2.

The implications of modifying Blue Steel to give it a low-level release capability proved much more complex to resolve than the changes needed to a free-fall bomb for the same purpose: in the early months of 1963 not only were the MoD and Air Ministry involved in discussions as to what should be done; so were the War Office, the CoS Committee and the DRPC (Defence Research Policy Committee). It was in fact to the last-named body that the Chiefs of Staff on 14 May referred a note by the Air Ministry which proposed that Blue Steel should be modified to give it a low-level launch and an "up and over" trajectory.

This Air Ministry note, commenting that the Defence Committee decision of 23 January had "committed Bomber Command to low-level operation", pointed out that Blue Steel was "a high-level weapon that must be launched at 35,000ft" and said that the problem was to devise "the quickest and most economical means" of overcoming this difficulty. It went on to suggest four possibilities: developing and producing a new stand-off missile; re-equipping the whole of the V-force with the lay-down bomb authorised for part of it; modifying Blue Steel to give it a low-level trajectory; or modifying the missile to give it a low-level launch and an "up and over" trajectory. This last possibility was the one favoured by the Chiefs of Staff, and which they endorsed for use as an Operational Requirement for the DRPC. Subsequently, in the latter half of May, the DRPC agreed that a project study should be made as basis for the preparation of a detailed technical and financial programme. As a result, DCAS (Air Marshal C H Hartley) was able to report to the Air Minister later that year<sup>1</sup> that the DRPC had "approved the proposals to enable Blue Steel to be modified so that it can be launched at low level".

Modifying Blue Steel to give it a low-level (below 1,000ft) launch capability followed by an "up and over" trajectory would be less costly in terms of money and time than modification to give it a low-level trajectory. The Air Ministry reckoned, in a note of 13 May 1963 prepared for the Chiefs of Staff Committee, that the latter would cost £20 million and take four years, the former about £3 million and take two years.

The other two facets of the programme approved by the Defence Committee for V-bomber operations in the post-Nassau period – providing the V-force with suitable navigation equipment, and studying the possibility of equipping it with additional ECM or other countermeasures – were covered by a Standard of Preparation (No 54) issued by the Air Staff on 3 May 1963, which became the basis for a subsequent Air Staff Requirement (No 380 of 5 May 1964). These documents dealt comprehensively with all aspects of low-level operations, as they affected the three types of V-bomber. On the assumption that weapons releasable at low level or at pop-up height would be available for the Medium Bomber Force by the third quarter of 1963, modifications to aircraft systems to give them low-level capabilities were required "as soon as possible"; and all marks of Vulcan and Victor free-fall aircraft were to have "a capability appropriate to pop-up weapon delivery" by the third quarter of 1963. In the ASR No 380 this latter date was amended to the second quarter of 1964. Both documents said that in nuclear weapon configurations all aircraft would be "required to launch the weapon at the lowest practical height".

For self-protection in their low-level role, all the Mk 2 V-bombers were to carry additional ECM equipment, and in their navigation fit they were to be equipped for terrain-avoidance capability; but all MBF aircraft were to be convertible back to the high-level role, when this was required for limited-war operations. One difference brought about by the new low-level role was that rear-crew members, in both the Valiants (assigned to Saceur) and the Mk 2 V-bombers, were to have swivel or sliding seats and single-point personal equipment connectors, to facilitate escape from the aircraft in an emergency.

The Standard of Preparation, and the Air Staff Requirement which succeeded it, had as their basis that – in the wake of the decision to cancel the Skybolt long-range air-to-ground missile system, which had "much reduced the future credibility of the V-force deterrent in the face of expected Soviet air defences against medium- and high-flying aircraft" – the Mk 2 V-bombers were "required to pose a measure of deterrence until at least 1970, and as such must be modified to enable them to operate in the low-level role against an increasing Soviet defence capability".

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<sup>1</sup> Minute of 16 October 1963 in Blue Steel file ID9/194/4.

This theme, of V-bomber viability in the 1963–1970 period, was developed in comprehensive detail by VCAS (Air Marshal Sir Wallace Kyle) in a paper<sup>1</sup> considered by the Air Council on 14 March 1963.<sup>2</sup> Saying that the cancellation of Skybolt had “made it necessary to review the method of operating our V-force until 1970, by which date British Polaris submarines should be operational”, he referred to Ministerial approval<sup>3</sup> of measures to preserve the effectiveness of the force in this period, then enumerated the changes and equipment required for low-level operations: a lay-down bomb and modified Blue Steel; strengthened airframes for the Mk 2 Victors; low-level training routes, available in Germany and being provided in the United Kingdom; ground-alert facilities (including ORPs – operational readiness platforms) for 100 aircraft at the 36 dispersal airfields; and additional navigation and ECM equipment for the V-bombers. One recommendation which VCAS did not make was that the V-force should mount an airborne alert, which was considered to be “neither economical nor effective”, though the possibility of it would remain open to review.

VCAS also referred to the assignment of the whole of the V-force to NATO under the Nassau agreement, but said that the Government intended to make three conditions – retaining the right to use this force at discretion, if supreme national interests were at stake; it must be available to meet commitments outside NATO in emergency; and its states of readiness, deployment and dispersal, logistics and support must remain a national responsibility – and added that he would report further to the Council on this.

Although the proposals by the Minister of Defence for RAF deterrent force operations in the pre-Polaris period had been endorsed by the Defence Committee, it was necessary for the Air Council to approve the more detailed ones put before it by VCAS, so that the departments concerned could then go ahead with the necessary staff work.<sup>4</sup> At the 14 March meeting the Council took note of the measures approved to preserve the effectiveness of the V-force and invited VCAS to institute the necessary action, noting also that he was preparing a paper on weapons requirements; it also agreed in principle to the proposals for training the force in the low-level role. (During the discussion the AOC-in-C Bomber Command, Air Marshal Sir Kenneth Cross, said that the need for low-level tactics “had been appreciated before the decision to cancel Skybolt”).<sup>5</sup>

Subsequently the process of “inter-departmental consultation” continued which was to bring about the operational profile of the V-force in the mid-1960s – Mk 1A Vulcans and Victors armed with second-generation free-fall megaton weapons, Mk 2 Victors with Blue Steel and Mk 2 Vulcans with second-generation free-fall megaton weapons, with the laydown bomb or with Blue Steel. The whole force was to be trained for low-level operations, with weapon release either at low level (Blue Steel or the laydown bomb) or by pop-up technique (free-fall megaton weapons). Following the original Defence Committee approval on 23 January 1963 of measures to give the V-force a low-level capability, endorsement of subsequent decisions on weapons and aircraft/equipment modifications was given respectively by the Weapons Development Committee and the Defence Research Policy Committee. The WDC, which at the beginning of the year had recommended to the Chief of the Defence Staff that a high-yield laydown bomb should be developed, on 1 October approved the development of Blue Steel as a low-level-launched weapon, and on the same date the DRPC gave a similar endorsement. These decisions, together with the Air Staff Requirement of 5 May (already mentioned) on Medium Bomber Force Aircraft – Low-level Role, meant that plans had been completed for the equipment and operations of the V-force, in its maintenance of the United Kingdom strategic nuclear deterrent role and a quick reaction alert posture, up to the time of the introduction of Polaris missiles by the Royal Navy. The decisions also had the approval of the Chiefs of Staff, and of the Ministers of Defence, Air and Aviation as the latter were involved in formulating them; they represented the Governmental and Service reaction to the fact that Skybolt was not available for the V-bombers and that the “missile gap” had to be filled – by using low-level techniques and modifying aircraft and weapons for that purpose. A paper prepared for the

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<sup>1</sup> Bomber Command in the period 1963–1970 (AC(63)9). <sup>2</sup> Conclusions 4(63). <sup>3</sup> Cabinet Defence Committee meeting, 23 January 1963 (D(63)(1st Mtg)). <sup>4</sup> Minute by VCAS, 24 January 1963, in file Bombers – The Deterrent Future of the Deterrent (AHB ID9/B.1-65, Pt 1). <sup>5</sup> Or as an ex-V-force captain put it picturesquely to the writer: “Skybolt or no Skybolt, we’d have had to get down among the weeds anyway”.

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Weapons Development Committee in mid-1964 by the Air Force Department and the Ministry of Aviation put the current situation succinctly:<sup>1</sup> "Following the cancellation of Skybolt in December 1962 the Defence Committee approved . . . measures necessary to give the V-bombers a low-level capability . . . . "As a result of the [ Committee's ] decision, Standard of Preparation No 54 was issued in May 1963. This was superseded in May 1964 by Air Staff Requirement No 380 . . . . These call for modifications considered essential to give to each type and Mark of V-bomber a low-level capability commensurate with its planned life . . . . The paper does not refer to work on the low-level version of Blue Steel or the laydown bomb . . . which were the subject of separate submissions to the Committee". These plans defined the parameters within which the V-force was to operate until its QRA ended on 30 June 1969.

During this time when Whitehall was busy with drafts, papers, meetings, discussions, minutes and conclusions to decide the future life-style of the V-force, Scampton was busy with the introduction of Blue Steel and finding that this was not without problems. On 30 July 1963 the AOC-in-C Bomber Command (Air Marshal Sir Kenneth Cross) wrote to the CAS (MRAF Sir Thomas Pike) expressing concern about the reliability of the new weapon; he said that it was likely that the chances of a missile being fit for launch at the launching point were no better than 40%, while the probability of one reaching its target after launch was about 75%. This meant that of, say, six weapons on 'Readiness', two or at the most three would be launched; the remainder would have to be carried over the target and dropped free-fall. CAS pointed out in his reply on 9 August that these conclusions were based on a small sample of R&D firings and experience gained from the trials at Scampton; the hope was that, when appropriate modifications has been embodied in production missiles, there would be a noticeable improvement in performance and generation time. (Referring to the latter, the C-inC had said that it was evident that the time to generate a Blue Steel weapon system couldn't be reduced much below seven hours, even when no faults arose, and might take between ten and 15 hours).

A month later (on 28 August) the Secretary of State for Air (Mr Hugh Fraser) was informed by DCAS (Air Marshal Sir Christopher Hartley) that the Ministry of Aviation had given clearance for the use of Blue Steel - unfilled and unfuelled - on QRA with Vulcan B.2s. Thus the Blue Steel/Vulcan B.2 weapon system was cleared for carriage of the weapon in normal peacetime conditions, provided that the weapon was not filled with HTP and kerosine and that the aircraft did not take off.

When S of S and VCAS (Air Marshal Sir Wallace Kyle) visited Scampton on 18 November to see Blue Steel for themselves, they were briefed in advance that the Vulcan B.2/Blue Steel force building up there consisted of three squadrons of aircraft and 24 missiles, and that the principal support facilities consisted of a missile servicing and storage building (MSSB); hydrogen test peroxide (HTP) storage and fuelling building; and warhead storage and loading facilities in the special storage area (SSA).<sup>2</sup>

They were told also of delays in introducing the new weapon: that the start of environmental trials in mid-1962 was approximately 12 months later than originally planned owing to the late delivery of missiles and support equipment; and that further delays had occurred because of the slow rate of delivery of acceptance missiles and of the main test equipment. Operational problems, like those referred to by the AOC-in-C, were also mentioned - Bomber Command's calculation that the chances of a missile being fit for powered launch at the launch point might be no better than 40%; the requirement that at least 75% of the Blue Steel force should be ready for action within 24hr was unlikely to be met; the storage life of missiles appeared to be short: a suitable means of heating missiles on a standby, so as to keep the temperature of HTP above 0°C, hadn't yet been found; and others. By that date, the Minister and VCAS were told, 28 production model Blue Steels had been delivered to Bomber Command: 12 were at Scampton and 16 at Wittering.

The latter station, base for the two Victor B.2 squadrons of the Blue Steel force (Nos 139 and 100), began its build-up for the new weapon late in 1962-early in 1963: the missile support squadron there reported in February 1963 that it had received 10% of its missiles (all trainers) and 25% of its ground equipment. During May crews of No 139 Squadron started Blue Steel courses at the Bomber Command

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<sup>1</sup> WDC Memoranda - WD/P(64)15, 2 June 1964. <sup>2</sup> Blue Steel file ID9/194/4.

Bombing School, Lindholme. In July several crews went on courses in preparation for the squadron's conversion to its new role – which “came one step nearer” on the 25th (the ORB reported) “when the Victor Mk 2 equipped for the Blue Steel role was delivered to the station”.<sup>1</sup> By December, seven crews on the squadron had been converted to the role and its full complement of six retrofitted aircraft had been received – one of them, XL513, with “its upper surfaces painted in dark green and brown colours . . . a proposed camouflage scheme for . . . possible future roles”. (The Standard of Preparation No 54, of 3 May 1963, had said that “in order to give a reasonable camouflage against visual interception throughout the year, the metal upper surfaces of the Valiant and the Mark 2 aircraft are to be coloured by a variegated pattern of greys and greens. . . . The under-surfaces of the aircraft are to remain in the white anti-flash standard”).

No 100 Squadron crews began their Blue Steel training at Lindholme in November 1963; their aircraft went progressively to Radlett for retrofit modifications (and there also some crews were briefed in the correct operation of swivel seats – another modification written into SOP No 54, for the low-level role); in April 1964 the ORB reported “steady progress . . . in converting the squadron aircrew to the Blue Steel role.”

This progress continued steadily during the summer months of 1964, but was slow because of the other demands imposed on the squadron – notably, maintenance of QRA duties and training in the low-level role – and it wasn't until the autumn that this latest (and last) squadron in the Blue Steel force could claim a combat capability, tested in Exercise ‘Micky Finn’ on 26 October. Wittering's ORB recorded that the station “generated 11 aircraft, ten of which carried Blue Steel, in addition to the two Quick Reaction Alert aircraft”. This was the first major no-notice exercise in which the station's missile squadron had participated and “13 missiles were held in the powered state and four in the unpowered . . . the highest level of missiles attained to date”. When these Blue Steels were being generated, three became unserviceable with HTP leaks, the rest being mated to Victors. The missile squadron added the comment in the ORB that “the low-level modification programme was delayed because the exercise greatly reduced the number of serviceable missiles available and consequently reduced the rate of recovery of missiles coming out of the low level programme”.

No 100 Squadron, in its October 1964 entry, made the interesting comment that Wittering “completed Exercise Micky Finn quite successfully and compared very favourably with the only other Blue Steel station, RAF Scampton of No 1 Group”. As to its own capability, the squadron noted that its main problem continued to be the lack of Combat-classified crews and the time needed for new crews joining the squadron to become so qualified. “In summer months”, the ORB commented, “crews have been taking 2½–3 months to become fit to carry out QRA duties. This time will be increased in the winter months because of the bad weather factor. The squadron will therefore have only seven Combat crews until mid-March 1965 and nine until mid-July 1965. Having to average one day's QRA per week naturally has an adverse affect on a crew's flying hours and, more important, its morale . . .”.

It was with one of these crews, captained by Squadron Leader C A Herbert, that *The Times'* defence correspondent, Lt Col Alun Gwynne-Jones (later Lord Chalfont), flew on a 2hr 25min low-level sortie in Victor B.2 XL190 with Blue Steel attached on 17 September 1964. In an article published on 21 September he said that the RAF's intention had been “to demonstrate conclusively that the low-flying V-bomber” was not – as some observers had suggested – “just an Air Staff fantasy”. The AOC-in-C Bomber Command (Air Marshal Sir John Grandy – who had succeeded Air Marshal Sir Kenneth Cross on 1 September 1963), “like his officers and men” was “convinced that their newly perfected flying techniques” would “prolong the effective life of the V-bomber force well into the 1970s”.

XL190, with its six occupants (Flying Officer M W Hands, co-pilot; and rear crew members Squadron Leader A R McQuillan, nav/plotter; and Flight Lieutenants G Unsworth, nav/radar, and C Morris, AEO), did a simultaneous engine start, rolled into its take-off and within four minutes was cruising at 21,000ft where the Blue Steel was tested for accuracy and “found to have an error of half a mile that

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<sup>1</sup> While the squadron ORBs had no compunction about referring to Blue Steel, the RAF Wittering ORB referred discreetly to ‘missiles’, never naming them.

would have to be corrected in flight before it could be launched". Over Edinburgh the Victor turned south and let down for the low-level phase of its sortie, from the Tweed to its target area in Lincolnshire following the contours, flying at 250ft/300kt. The Blue Steel launch was simulated at a radar aiming point, the crew's rough check estimating that it would have fallen 20yd west and 60yd south of its target. Ten minutes later XL190 was back at Wittering.<sup>1</sup> "This high-low technique", its journalist-passenger observed, "would enable the V-bombers to fly at their best operational height until . . . within range of enemy early-warning radar defences, and then . . . come down and take advantage of the screening effect of the Earth's curve". He added that "technical doubts about flying low and fast in aircraft designed to fly in the rare atmosphere at great heights" had been "largely dispelled". RAE Farnborough scientists had assured the RAF that the fatigue life of the V-bombers, some of which had been strengthened for the new role, was "long enough to enable them to carry out all the training . . . necessary for the aircrew".

This was the V-force in its new low-level and Blue Steel roles. The stand-off bomb, now equipping a force of 36 aircraft (Scampton's three Vulcan squadrons had an establishment of eight aircraft each, Wittering's Victor squadrons six each), had come into service later than envisaged (1963-1964 instead of 1961-1962) and with a performance different from that planned for it - as a weapon to be launched at very low level, instead of from the high-flying V-bombers of the original strategic nuclear deterrent force concept. Times had changed, and the V-force operational concepts had perforce had to be modified.

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<sup>1</sup> The squadron ORB simply noted the flight as '1331-1556 Low level route 240'.

## CHAPTER 17

**The Phasing-out of Valiants**

"On 6th August (1964) Flight Lieutenant J.W. Foreman was giving instruction to a student pilot in Valiant WP217 when a loud bang was heard, associated with a pronounced airframe shudder. The exercise was abandoned and on return to base it was found that the starboard flap would not come down. A flapless landing was carried out and subsequent investigation showed the rear spar of the starboard mainplane to be severely cracked, resulting in Category 5<sup>1</sup> damage to aircraft".

This note in the ORB of No 232 OCU at Gaydon was the first record of the metal-fatigue problem which was to lead to the grounding of the whole RAF Valiant force by the end of 1964. An Engineering comment on the incident added that WP217's starboard flap drive shaft had been sheared; and the ORB also said that planned staff and student flying in the Valiant squadron during August had been curtailed "because of severe temporary restrictions" imposed on the aircraft.

At that time there were 56 Valiants in Bomber Command,<sup>2</sup> the biggest concentration being at Marham, where the three TBF (tactical bomber force) squadrons assigned to Saceur were based – as also was one of the two tanker squadrons. There were thus 32 Valiants at Marham; there were nine at Honington (the other tanker squadron), eight at Wyton on the strategic reconnaissance squadron, one at the Command's Development Unit at Finningley and six at Gaydon. The disappearance of this force within five months meant that the RAF had to replace a great deal of bomber/tanker/reconnaissance capability – or to consider doing so. In fact, as will be seen, the TBF squadrons assigned to Saceur were not replaced; the Valiant tankers were replaced by Victors, as were the SR Valiants. There was both an engineering and a political chronology of events following the 6 August 1964 incident at Gaydon, leading from examination of the aircraft, hopes of modification, suspension of the Valiants from flying, to – finally – withdrawal of the whole force from service. These events unfolded gradually, and up to November 1964 it was hoped that about 40 Valiants could be repaired, but in December some much more widespread deterioration was found in one aircraft and all flying was suspended.

On 25 August it was decided, following an examination made by RAE and Vickers-Armstrongs (Aircraft) Ltd, that all Valiants which had used up as much of their fatigue life as WP217 should be grounded and inspected – an inspection later extended to the whole of the Valiant force. When this situation was reported to the Minister of Defence for the RAF (Mr Hugh Fraser – whose title had changed from Secretary of State for Air at the beginning of April) on 28 August, he was told that it was hoped that a simple modification would restore the position – though it was stressed that the examination was not complete. When, during the following month, the Minister reported on the Valiants to the Secretary of State for Defence (Mr Peter Thorneycroft) there were grounds for thinking that 29 of the 36 aircraft so far inspected – up to 23 September – were all right for further flying or could be repaired fairly easily. But on 2 October a further report to the Ministers said that few Valiants would be available, except in an emergency, until repairs had been carried out. This was against the expectation that such repairs would be reasonably possible, subject to confirmation by further technical inspection. In these circumstances, the UK National Military Representative at Supreme HQ, Allied Powers Europe (Air Commodore C.B.E. Burt-Andrews), was instructed to inform Saceur (General Lyman Lemnitzer) of the Valiant situation personally.

However, there was more cheerful news the following month. On 26 November the Minister (RAF) was told – and passed the information on orally to the Secretary of State the following day – that 40 out of a total of 61 aircraft in the Valiant force were judged to be repairable by a simple modification, and that they would then last at least until the end of 1968. At the beginning of December, UKNMR Shape was again instructed to report the latest position personally to Saceur. But shortly afterwards events took a turn for the worse.

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<sup>1</sup> That is, a write-off. WP217 had been one of the original Valiants on No 543 (PR) Squadron, delivered to Gaydon in May 1955. <sup>2</sup> Stats 603 shows 57UE Valiants and 61 on strength at 31 July 1964, but the totals for squadrons and units add up to 58UE and 56 on strength.

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On 9 December, further inspection of a Valiant revealed much more extensive cracks than had hitherto been found, and all flying was suspended pending more examinations. Next day the Minister (RAF) was told of this new development; he informed the Secretary of State, and on 11 December the UKNMR at Shape was again instructed to tell Saceur the latest position.

It was on 19 and 20 January 1965 that the final decisions about the Valiants were taken: on the former date the Chiefs of Staff agreed that the whole force should immediately be withdrawn from service, and the next day the Prime Minister (Mr Harold Wilson) and the Secretary of State for Defence approved this conclusion. On 22 January the Chief of the Defence Staff (Earl Mountbatten) informed Saceur briefly over the telephone, and three days later the AOC-in-C Bomber Command (Air Marshal Sir John Grandy) followed this up with a personal visit.<sup>1</sup>

When Sir John Grandy spoke with Saceur on 25 January the latter said<sup>2</sup> that he found the news graver than he had expected from his brief conversation with the Chief of the Defence Staff three days previously, and asked whether there were any alternative to the strike capability of the Valiant TB force. Sir John said that a number of Vulcan 1s would be going out of service during 1965 and that there was a possibility of them being retained, but that this was subject to decisions by the Chiefs of Staff and the Government. Saceur appeared to be "much encouraged" to hear of this possibility.

On 26 January the Ministry of Defence made a public statement about Valiants, which summed-up the whole situation to date. It said:

"During a routine inspection in August last year,<sup>3</sup> a fault was found in the wing structure of a Valiant. Investigations were immediately set in hand and, as a precautionary measure, some stringent restrictions on flying were imposed. By early December the widespread and serious nature of the problem had become so clear that the aircraft were grounded except in case of operational emergency.<sup>4</sup>

"It is now confirmed that the fault was due to metal fatigue and that this fatigue has appeared throughout the whole Valiant fleet. The only safe way of remedying the damage would involve replacement of the spar in each aircraft, which would be a long and costly process.

"The Valiant, which has been in squadron service for some nine years, was the first of the V-bombers to be developed. The average hours flown by Valiant airframes over that period are some 2,500. Existing plans envisaged that all Valiants in their various roles would have been phased out of service in the next four years. The photo-reconnaissance version is to be replaced by Victors this year, the tanker version by Victors over the next 18 months.

"The Government has therefore decided that it would not be justified in spending the large sums of money involved in the major repair programme, taking into account the very limited useful operational life which could subsequently be got out of the aircraft.

"The loss of the Valiant underlines the need for the earliest possible introduction of the Victor tanker. The Minister of Aviation has had urgent consultations with Handley Page Ltd and hopes that it will be possible to get some tankers earlier this year than was planned. Meanwhile, the deployment of our fighters is being adjusted so as still to permit overseas reinforcement in the intervening months.

"There are three points about this fatigue failure which should be stressed. First, it occurred throughout the Valiant force and was not in any way connected with low level flying. Secondly, the basic design structures of the Valiant's wing and spars are different from those of the Victor and Vulcan.<sup>5</sup> Thirdly, since the Valiant fatigue tests were done, much more has been learnt about this fatigue problem. There is therefore every reason to be confident about the Vulcan and the Victor, on which exhaustive tests have been carried out.

"Some of the Valiants are assigned to Saceur in a tactical role and Saceur and the North Atlantic Council have been informed of our decision. But the British strategic force of Vulcans and Victors is unaffected. This country makes a contribution to the strategic nuclear forces of the Alliance in the shape of the V-bomber force assigned to Saceur. This contribution to NATO remains unchanged by the decision about the Valiant tactical bombers. The British proposals for an Atlantic nuclear force are also unaffected".

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<sup>1</sup> This chronology was drawn up for the CAS (ACM Sir Charles Elworthy). <sup>2</sup> Message from UKNMR to MoD.

<sup>3</sup> Curiously, there is no mention of the occurrence in flight. <sup>4</sup> On 9 December 1964. <sup>5</sup> A backbone, with branches at right angles linking up with the wing spars.

This statement made it clear that the Valiants would be replaced in two of their roles, strategic reconnaissance and flight refuelling, by Victors. The only question was, when this would occur, for the RAF could not afford a gap in either capability. No mention was made of the possibility of replacing the Valiant tactical bombers by Vulcan 1s; this was a matter for detailed discussion.

The Chief of the Defence Staff advised the Secretary of State for Defence (Mr Denis Healey) on 28 January that the Air Force Department considered it a practicable proposition to replace the Saceur-assigned Valiants with an equivalent number of Vulcan 1s, and asked him for his reaction – which was, in a reply of 11 February, that the Valiants should not be replaced. He said that Government discussions on the aircraft programme envisaged a reduction in Britain's European capability,<sup>1</sup> and his inclination was to use the withdrawal of the Valiants as a convenient opportunity of reducing the UK contribution in Europe; but he would await the result of Defence staff studies before taking a final decision.

Subsequently, on 4 March, the Minister expressed his views in a long Minute to the Foreign Secretary (Mr Michael Stewart), putting the arguments for and against replacing the Valiants and concluding that “we should decide now to tell NATO that we find ourselves unable, with the pressures on our defence programme, to replace the Valiants for the few remaining years of their planned service with NATO”. He hoped that the Foreign Secretary would agree.

But the Foreign Secretary did not; he considered that the TBF commitment was one “which we ought to fulfil if we possibly can” and that “everything argued” for fulfilling it. Because of this disagreement, the matter was referred to the Defence and Oversea Policy Committee on 19 March; and as a result NATO was informed on the 25th, through the UK Delegation in Paris, that the Government was unable to replace the Valiants – Mr Healey writing to General Lemnitzer on the following day to inform him personally. He also told the Commons, on 1 April,<sup>2</sup> that the Government had “formed the view that replacement of the Valiants for the few remaining years of their planned service with NATO” could not be justified “by military or other considerations sufficient to override the countervailing need to deal with the pressures upon our defence programme”.

In his correspondence with the Prime Minister (Mr Harold Wilson) following the Defence and Oversea Policy Committee meeting when the decision not to replace the Saceur-assigned Valiants was taken, the Minister of Defence referred<sup>3</sup> to their crews having been “in enforced idleness for three months already”. That was in March 1965, when total flying times at Marham were 82hr 35 min on Ansons and 149hr 5min on Chipmunks – for a strength of 207 RAF officers (including aircrew) and 16 airmen aircrew, plus 1,664 ground airmen.<sup>4</sup> The beginning of this three-month period was marked, in the station's ORB for January, by a long elegiac entry headed “The Valiant Story”, which said that “the decline and fall of the Valiant force began on 6 August 1964 and ended, for the RAF at any rate, on 26 January 1965. Between these dates there had been a period of restricted flying and another in which the grounded aircrews drew on their experience alone for the ability to deliver their weapons in war. Inspection of WP217 after landing at Gaydon on 6 August showed only too plainly that the aircraft had suffered major damage. The fuselage skin below the starboard inner plane had buckled, popping the rivets; the engine door had cracked and on the top surface of the mainplane between the two engines, the rivets had been pulled and the skin buckled. The primary cause of the damage was a broken rear spar on the starboard side. All Valiants of a similar age and life pattern were grounded forthwith.

“By 25 August a manufacturer's working party had been set up to discover the extent to which the Valiant fleet was affected by metal fatigue, and on 17 September XD818 was given an ‘A’ category, and by the 21st 15 other Valiants had been categorised. Eventually all the Valiants were divided into three categories:-

Cat ‘A’	– Flyable to 5% of remaining fatigue life	- 12
‘B’	– Flyable in an emergency	- 19
‘C’	– Grounded	- 5

<sup>1</sup> Cancellation of the TSR.2 was to be announced on 5 April. <sup>2</sup> Written Answers, Col 275-6. <sup>3</sup> Letter in file on State of Readiness of V-bomber Force (MO 3/5/1/ Pt 2). <sup>4</sup> See earlier chapter, on The Valiant Saceur-assigned tactical bomber force, for the USAF presence.

“For a time only the Valiants in Cat ‘A’ flew again, but eventually some Cat ‘B’ aircraft were also cleared for limited flying. Each aircraft was fitted with recorders and a most assiduous watch was kept on the readings in order, if possible, to relate fatigue coefficients to heights flown and weather conditions. The Saceur-QRA commitment was maintained throughout.

“In the meantime, two aircraft in Category ‘B’ were given up to teams from 19 MU who literally hacked out with axes sections of the spars for further examination by metallurgic experts. After further inspection of these parts all the aircraft were grounded on 11 December 1964, from which date until 26 January 1965 the QRA force continued but no flying took place. Aircrews embarked on a period of intense and varied ground training and interest visits.

“On 26 January 1965 the long-awaited and much postponed announcement was received at Marham – by permission of BBC radio and television. Not until 1730hr, when most personnel had gone home for the night, was an official signal received. This authorised the disbandment of No 214 Squadron, cessation of QRA and the ending of all Valiant training.

“The official news and the MoD announcement was numbing in both its effect on Marham and its matter-of-factness. Marham’s contribution to NATO, which was by far the most powerful and reliable of any RAF station, was dismissed and great play was made about the loss of tankers. There was no doubt at Marham or at Shape which was the greater loss”.

The phasing-out of Valiants affected, as has been said, the tanker and strategic reconnaissance elements of Bomber Command in addition to the TB force. The tankers’ replacement by Victors will be fully described in the next chapter. The SR role, performed by Valiants of No 543 Squadron since 1955<sup>1</sup>, was taken-over by Victor SR Mk 2s from July 1965 – after it had been in abeyance for almost a year. But re-equipment with Victors had been planned before the Valiant troubles occurred: a progress meeting on 23 April 1964<sup>2</sup>, discussing proposals to re-equip No 543 with Victor 2s, noted that the first of the new aircraft was expected to be delivered in March or April 1965 and the rest would follow at the rate of one a month. After the second had been delivered it was proposed to phase-out the Valiants on a one-for-one basis. In the event, by the time the first Victor arrived at Wyton on 19 May 1965 the squadron’s Valiants had all been scrapped.

No 543 had been formed as a Main Force photographic reconnaissance squadron at Gaydon on 1 June 1955 with an establishment of eight Mk 1(B)(PR) Valiants, which during 1956 were equipped with H2S Mk 9 Yellow Aster reconnaissance radar. This equipment marked the difference in reconnaissance capability between the V-bombers and the aircraft which had preceded them, in that the Valiant and Victor were equipped with radar in addition to cameras for this role.

An Air Staff Target (OR3561)<sup>3</sup> had been issued in August 1953 for an airborne reconnaissance radar, employing all known methods of deriving the maximum possible information from radar responses, whose output could be used in several different ways – for briefing aircrew before operations on which primary airborne radar might be used for en route navigation and/or for blind bombing; to provide intelligence data; and to prepare material suitable for use in picture matching.

As a result of this investigation into the potentialities of radar reconnaissance the Air Staff issued a requirement (OR3578) in October 1954 for an airborne reconnaissance radar, primarily for use in the V-bombers. What resulted was Yellow Aster Mk 1, a non-scanning radar system which was fitted in the Valiants of No 543 Squadron. It was also put into some Mk 1 Victors<sup>4</sup>.

However, this was an interim equipment, accepted in the interests of speed of introduction into service, despite known limitations in performance and engineering; and in October 1957 the Air Staff issued a requirement (OR3595) for a high-resolution non-scanning reconnaissance radar for the Victor B(PR) Mk 2, with which No 543 Squadron was equipped from mid-1965 onwards.

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<sup>1</sup> The original 543 Sqn had been one of the four Benson PR squadrons, equipped with Spitfire XIs. <sup>2</sup> Referred to in the squadron ORB. <sup>3</sup> Subsequently a Naval/Air Staff Reqt. <sup>4</sup> DRPC paper (DRP/P(58)15) of 26 February in file, Production Orders for RAF Radar Equipment (95/03/027/56).

The reconnaissance radar developed from this requirement was known as Red Neck<sup>1</sup> and was carried in 30ft long pods, 2ft in diameter, under the wings of the Victors. This equipment was able to produce high quality pictures with considerable detail in them, cabin equipment in the aircraft including a rapid processor unit.

The V-bombers in the long-range reconnaissance force therefore possessed a greater capability, through the use of radar, than their predecessors; and because of their large bomb-bays they were able to carry more cameras. The Valiant in its day SR role had 12 – eight main fan, three for wide-angle cover and one for survey work.<sup>2</sup> In its night role the aircraft had five or six cameras in the crate in the bomb-bay. The Victor's camera complement was much the same – up to eight F96s, three F89s and an F49 survey camera in the day crate; and up to five F89s in the night crate.

No 543 Squadron had a dual role; as the ORB put it in October 1960, it was “part of the United Kingdom reconnaissance force” and also had “a secondary role with the medium bomber force”.<sup>3</sup> But from the beginning, emphasis was placed on the former function. In October 1956, when Valiant WZ399 was “received from Vickers-Armstrong Ltd modified with photographic reconnaissance equipment” it was “therefore possible to commence photographic training and four sorties . . . were flown”; and in November the ORB recorded: “now that NBS installation is progressing, productive radar training has commenced, and maximum use of the radar-equipped aircraft is being made”. For the last month of 1956, the first full year of 543's existence in the V-force, its ORB spoke of “a total of seven radar reconnaissance cross-country flights . . . carried out . . . giving NBS operators valuable training in the operation of the equipment now installed in the aircraft”.<sup>4</sup>

From 1957 onwards, more and more use was made by No 543 Squadron of radar reconnaissance – for example, in Exercise Vigilant towards the end of May, the squadron's first operational radar reconnaissance exercise; on several special sidescan sorties flown before a presentation of RR techniques and equipment at Luqa, Malta, in June; and in Operation Antler, the atomic tests held at Maralinga, South Australia, in September-October 1957, radar reconnaissances were made by No 543's Valiants<sup>5</sup> before, during and after each of the three tests – the squadron additionally making a radar reconnaissance of the Woomera range for Blue Steel trials.<sup>6</sup> Then early in 1958 No 543 flew sorties “to obtain material for a radar mosaic of the United Kingdom, excluding Northern Ireland, Sidescan radar . . . being used and this training task . . . due for completion during February” – to quote from the ORB entry for January 1958.

With the operational and training experience thus gained, it was not surprising that the squadron's primary role should have been confirmed – in a Central Reconnaissance Establishment directive (No 2/58) of March 1958 – as radar reconnaissance, with photographic reconnaissance as secondary role. In both these roles, it supported Intelligence and targetting requirements.

No 543, however, in addition to being part of the UK Reconnaissance Force was also part of the Medium Bomber Force and many of its activities reflected the latter commitment – Lone Rangers, designed to exercise V-force crews/aircraft in operating away from main bases; scramble take-offs (when Prince Philip gave the executive order at Wyton on 24 June 1958 five Valiants were airborne in 6min 35sec); Western Rangers – flights by single aircraft to SAC bases; exercises like Sunspot – training

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<sup>1</sup> MoS/Treasury correspondence, 11 November 1958, saying that OR3595 “is to have the code name Red Neck”.<sup>2</sup> The RAF “installed fans of cameras to provide horizon-to-horizon cover, an expedient which reached an extreme in the Valiant B(PR).1 which carried a camera-crate in the bomb-bay capable of holding a fan of eight F96s with 48in lenses and four F49 survey cameras” (*Photo Reconnaissance The Operational History*, by Andrew J. Brookes; Ian Allan Ltd, 1975).<sup>3</sup> “In wartime, would the Valiant B(PR).1s be primarily used to take photographs or to drop bombs? While they were controlled by Bomber Command, PR men felt that there could only be one answer” (*ibid*).<sup>4</sup> In January 1956 the ORB noted preparations to install Yellow Aster in WP223, in May that WZ380 had been fitted with it, and in August that it had been put into WZ391 and trial flying carried out. From 9 October to 29 December the squadron made the first of several detachments to RCAF Namao, for MoS/BC trials to assess the effects of winter conditions on the new airborne radar equipment.<sup>5</sup> The Antler report on air operations referred to “target response research” by the Valiants.<sup>6</sup> In July 1958 the squadron had a detachment at RAAF Edinburgh Field for Blue Steel trials.

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detachments in the clear air of Malta and Libya – and Mick, when all possible aircraft on the station had to be generated for operations; and participation in Bomber Command's Alert and Readiness Procedures. Of course, the squadron's specialised capability was continually being demonstrated, as when in mid-1964 it made an air survey of Northern and Southern Rhodesia and Bechuanaland. Operation Pontifex, as this was called, involved covering 400,000 sq miles of territory – which meant (according to the squadron's ORB) that 66,000 miles of successful flight lines needed to be flown, producing 20,000 prints. This was believed to be the largest task of its kind ever undertaken by the RAF.<sup>1</sup>

During Operation Pontifex, in July 1964, trouble occurred which anticipated that at Gaydon in the following month: WZ394 “developed a crack in the rear spar which necessitated the aircraft being returned to base for repair” – as the squadron ORB put it. No 543's subsequent careful account, in its record book, of what happened after metal fatigue was found to be widespread among the Valiant force, shows how the problem of being reduced to impotence was coped with – although this squadron had the morale-boosting hope of knowing since early 1964 that it was due to be re-equipped with Victor 2s in 1965.

In September 1964, as has been mentioned earlier, all Valiants were inspected: No 543 noted that under a special Technical Instruction (No 122B) “all aircraft were taken out of 1st Line for inspection of the rear spar inner plane, by CWP” (contractors' working party). These inspections showed that only one Valiant was fit to fly a limited number of hours, while six of the seven were available for use in emergency only. As a consequence, “serious policy discussion” followed on future crew requirements and the squadron's future flying programme. By the end of the month these problems had still not been resolved.

Earlier in September No 543 had made the last – as it turned out – Valiant contributions to RAF strategic reconnaissance, tracking Soviet warships in the Norwegian Sea, in a combined RAF/RN/RNoAF operation code-named Darwin (2-16 September). Immediately afterwards it did maritime reconnaissance of naval strike forces in the Atlantic and the Norwegian Sea in a NATO exercise called Teamwork (15-26 September). It was engaged in radar photographic tasks – of the Canadian Pre-Cambrian Shelf, over Kenya/Tanganyika and of TSR.2 development trials routes (the two latter tasks having been going on since early in the year) – and on 30 September its last Lone Ranger returned to Wyton.

As a result of the CWP inspections only two of the Valiants (WZ391 and XD826) were found to be fit for flying; they were to achieve 12hr per month for each of the squadron's five crews. WZ380, 389, 392, 394 and 397 were to be kept fully serviceable for emergency use only; WZ223 was to be semi-stored in fully equipped condition, recovered once a month and fully serviced; and WZ382 was to be stored, and only deterioration servicing done to it. On 1 October No 543's crews were told that following these inspections of the rear mainplane spars their aircraft – with one exception, which was limited to 40hr flying a month – were to be withdrawn from 1st Line; so the policy was to retain five crews to fulfil the squadron's war role in the case of a national emergency, when four of the Valiants taken out of the 1st Line would be recovered.

The intention as far as aircrew were concerned was for the remaining pilots to be kept in current flying practice and for their crews to fulfil a limited classification commitment. The three crews earmarked for training on Victor 2s, plus two other crews, were nominated to remain on the squadron; others would be posted.

This situation, with limited flying and flying limitations (later in October, circuit flying was limited to 40 minutes per sortie, and there were restrictions of 30° angle of bank, 0.5G and 250kt IAS), obtained during the last three months of 1964; then on 10 December the squadron's last two fully serviceable aircraft, WZ391 and XD826, were grounded for checks on their rear spars, and No 543 expressed the hope in its ORB that it could borrow two Canberra T.4s to keep its pilots and navigators in flying

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<sup>1</sup> It was fully described in an *Air Clues* article in March 1966.

practice.<sup>1</sup> On the last day of the year the first of its crews destined to convert to the Victor began their course at No 232 OCU.

Formal notice that the Valiant had been withdrawn from service came to No 543 Squadron in a signal from Bomber Command HQ on 26 January 1965, which said that after exhaustive investigations into the rear spar problems it had been concluded that, in the interests of safety, all the aircraft would need to be re-sparred. This would be too lengthy a task, and the short increase in the life of the aircraft would not justify the enormous cost involved. So, "as from 0001hr on 27 January 1965 all Valiant aircraft were permanently withdrawn from service with the Royal Air Force".

During February-March No 543's Valiants were dismantled; two more of its crews joined the Victor course at Gaydon; and the squadron's role was held in abeyance until it had been re-equipped with Victor B(SR).2s from May 1965 onwards – as will be subsequently described.

In an Order of the Day the AOC-in-C Bomber Command (Air Marshal Sir John Grandy) said that it was "a bitter blow" that the outcome of the Valiant troubles had had to be their withdrawal from service. As the first of the V-bombers they had "played a major role in the nation's defence for nearly ten years". In a concise summary of this contribution he added:

"Valiants were the aircraft from which the first British nuclear weapons were tested, and they were the spearhead of our nuclear strike force until the arrival of the Vulcan and the Victor. They have been flown in the medium bomber, tactical bomber, photo reconnaissance, tanker, electronic countermeasures and associated training roles. Valiants took part in active operations in 1956; a Valiant flew the first non-stop flight in 1960 from the United Kingdom to Singapore and return; and Valiants have been used on innumerable occasions for goodwill visits to many distant countries throughout the world".

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<sup>1</sup> This hope was fulfilled, the January 1965 ORB recording that "two Canberra T.4s were put at the squadron's disposal, to enable the pilots and navigators . . . to keep in current flying practice. These aircraft have been put to full use and during the month . . . completed 23 sorties . . . under the instruction of two qualified flying instructors, Flight Lieutenants J. Cooper, No 58 Sqn, and R. Bradley, No 51 Sqn.

## CHAPTER 18

## Victor tankers and SR

Neither the tanker force re-equipment with Victors nor the taking-over of the strategic reconnaissance role by Victors, from 1965 onwards, resulted from hurried decisions following the demise of the Valiants. Plans to re-equip No 543 Squadron with Victor B(SR).2s had been discussed early in 1963, as mentioned in the previous chapter; and proposals to bring Victors into the tanker role had been formulated as early as 1961. The effect of the loss of the Valiants, particularly so far as flight refuelling was concerned, was to bring to a head decisions which had been in gestation for a long time.

During 1961, when there was one Valiant tanker squadron (No 214 at Marham<sup>1</sup>), the possibility of using Victor B.1s in this role had been considered by the Air Staff<sup>2</sup>; and by early 1962 the idea had become formalised, with the Air Council, at its meeting on 1 March<sup>3</sup>, inviting VCAS (Air Marshal Sir Wallace Kyle) to initiate a design study of the Victor Mk 1 in the tanker role.

The Air Council, at this meeting, also approved in principle the proposal for a third tanker squadron (a second, No 90 at Honington, had become operational in that role by the end of 1961).<sup>4</sup> The question was, whether the third squadron should be equipped with Victor B.1s, and the answer to this depended upon the outcome of the design study.

This study took several months during 1962 and its outcome was a Note by VCAS, The Re-equipment of the Tanker Force with Victor Mk 1/1A Aircraft,<sup>5</sup> which was considered by the Air Council at its meeting on 22 November 1962.<sup>6</sup> In his paper VCAS recommended that the Council should confirm the introduction of the Victor as a replacement for the Valiant in the tanker role – it had “the speed and fuel transfer capacity to provide flight refuelling for all our aircraft that will require the facility” and also “the advantage of being fitted with a tri-point refuelling system” – and also confirm the requirement for a third tanker squadron and authorise its formation “as early as possible”. The Council agreed to these proposals and invited VCAS to initiate the necessary action.

This Air Council decision in favour of FR Victors and a third tanker squadron had powerful endorsement – from the DRPC (Defence Research Policy Committee) and the Chiefs of Staff. At their meeting on 12 December 1962 the DRPC agreed to a proposal that a development contract should be placed for the conversion of 27 Victor B.1/1As to the tanker role, subject to confirmation of this requirement by the Chiefs of Staff.<sup>7</sup> The latter gave their approval on 24 January 1963.<sup>8</sup>

However, two difficulties then arose: the Treasury withheld their agreement to the Victor modification, pending the results of the Defence Review and the deliberations of the Oversea Policy Committee, as the CAS (ACM Sir Thomas Pike) informed the Air Council on 23 May;<sup>9</sup> and the Ministry of Aviation expressed doubts, at a meeting with the Air Ministry on 13 August, about giving the contract to Handley Page because of reservations as to their financial soundness.<sup>10</sup> Later that year, negotiations between Handley Page and Hawker Siddeley Aviation on a possible merger reached deadlock.

While at the end of 1963 the Treasury difficulty seemed likely to be resolved (VCAS being informed on 19 December that they had agreed in principle to the conversion of 24 Mk 1 Victors to the tanker role<sup>11</sup>), the Secretary of State for Air (Mr Hugh Fraser) was told on 16 March 1964 of an “18 months’

<sup>1</sup> Operational in this role since early 1959 and pioneers of RAF jet tanker techniques. <sup>2</sup> A Minute of 25 May 1961 (D of Ops (B&R)/D Air Plans) refers to the latter’s Minute of 18 April and says “there is no technical reason . . . why the Victor 1 should not be used as a tanker” (file ID3/901/11 Pt 1 Use of V-bombers in Tanker Role).

<sup>3</sup> Conclusions 3 (62) (TS Annex). <sup>4</sup> Its bomber commitment ceased on 1 Oct 1961 and its first FR exercise was refuelling Javelins UK-Malta, 11-13 December. <sup>5</sup> AC(62)42. <sup>6</sup> Conclusions 16(62) in file 94/8 Pt 3 Flight Refuelling of Aircraft (AHB ID9/94/8 Pt 3). <sup>7</sup> In a minute of 3 Jan 1963 to CDS (Earl Mountbatten), the Chief Scientific Adviser (Sir Solly Zuckerman) conveyed the DRPC endorsement of the proposal and asked for the CoS’s comments (file ID3/901/11 Pt 1 Use of V-bombers in Tanker Role). <sup>8</sup> 6th Mtg/63. <sup>9</sup> Conclusions 10(63). <sup>10</sup> Doubts were expressed by Mr Neil Marten, MP, Parliamentary Secretary, who also mentioned the possibility of a merger between HSA and HP, in which the Victor contract could be “a significant factor”:

<sup>11</sup> Minute, AUS(A)/PS to VCAS.

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battle with the Treasury":<sup>1</sup> but full financial authority had been given for the necessary R&D expenditure, and also for the first 16 sets of FR equipment. However, the question of the division of the task between Handley Page and HSA had still to be sorted out, and the two firms' quotations examined.

These questions, involving the Air Ministry, the Treasury and the companies, were still being sorted out when the new factor of Valiant fatigue entered into the negotiations; and on 17 September VCAS asked, in a minute to DCAS (Air Marshal Sir Christopher Hartley), that the administrative work should be speeded-up and pressure brought to bear to carry out the technical work as soon as possible. He said that although the outcome of the investigation into the Valiants' fatigue life wasn't certain, "at least we know that the life of our . . . tanker force will be considerably less than . . . expected".

DCAS replied on 14 October that the proposed contracts with Handley Page and Hawker Siddeley had still not been let, but told VCAS of "repeated assurances" that work had not so far been held up for the want of full contracts. However, towards the end of 1964 there was a swing of policy in favour of Handley Page as sole contractor, in an exchange of correspondence between the civil service heads of the Departments concerned. On 27 November the Permanent Secretary, MoA (Sir Richard Way), wrote to the Second Permanent U-SofS (RAF) (Mr M.T. Flett), asking whether he would agree that all 24 Victors should be converted by Handley Page - referring to "labour difficulties" at the HSA Avro-Whitworth Division and saying that Handley Page had been "very resilient in the face of their problems". In his reply (on 9 December) Mr Flett agreed, subject to "firm proposals for the whole conversion programme . . . acceptable to our two Departments . . ."

However, with the withdrawal of Valiants from service in January 1965 and with the first Victor tankers not due to enter service until the last quarter of that year, the RAF was likely to be left without a flight refuelling capability for nine months; so VCAS (now Air Marshal Sir Brian Burnett) and DCAS proposed to the Air Force Board on 5 February 1965<sup>2</sup> that there should be a "crash programme" to produce six two-point Victor tankers,<sup>3</sup> to be delivered from June 1965 onwards, which would restore the FR capability by August, when six would have been delivered. Their proposals were approved by the AFB Standing Committee on 8 February 1965.<sup>4</sup> Nine days later, in a Parliamentary debate on the aircraft industry,<sup>5</sup> the Minister of Defence for the RAF (Lord Shackleton) told the Lords that it rather looked as if the Victor tankers would be available a good deal earlier than planned - that there was a good prospect that the first two would be in service, "in a partly modified condition, in early April and four more at the end of August".

The Minister's forecast was a little optimistic; in fact No 55 Squadron - the first Victor tanker squadron (Nos 214 and 90 Squadrons of the Valiant tanker force were disbanded on 1 March 1965) - flew the first two converted Victor B.1As into Marham on 25 May and made the first sortie from there on the following day. By August, after 2½ months' training and completing a No 3 Group trial, the new flight refuelling squadron was "in business" and escorted four Lightning F.3s of No 74 Squadron to Cyprus.<sup>6</sup>

This exercise "marked the first occasion that the Victor tanker has been used for an operational overseas deployment" - as No 74 put it in their ORB for August. Their Lightnings had made their first flight-refuelling contacts with No 55 Squadron during July<sup>7</sup>, and earlier in the year had kept in practice with KC-135 tankers of the US Air Force, under a special RAF/USAF arrangement known as Operation Billyboy. A Fighter Command/Near East Air Force Operation Order announcing this<sup>8</sup> said that owing to "a temporary lack of in-flight refuelling tankers in the Royal Air Force" an alternative tanker source was needed to maintain the FR proficiency of the fighter squadrons, until the situation was restored by the introduction of Victor tankers. It added that the United States had agreed to provide

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<sup>1</sup> Minute, PUS/S of S. <sup>2</sup> AFB Standing Cttee (AFB SC(65)5 Victor Mk 1/1A Tanker - Crash Programme Note by VCAS and DCAS). <sup>3</sup> The full conversion was to three-point tanker. <sup>4</sup> AFB SC Conclusions 3(65). <sup>5</sup> Lords Hansard, 17 Feb 65, Col 568. <sup>6</sup> Exercise Forthright 22 and 23 (No 55 Sqn ORB). <sup>7</sup> No 74 Squadron's ORB recorded that on 20 July "conversion on to the Victor tankers of No 55 Squadron began", and No 55's ORB referred to the squadron "getting down to the day-to-day business of training the pilots of No 74 Squadron in the techniques of in-flight refuelling" <sup>8</sup> Joint Operation Order No 5/65 of 2 April 1965 (FC ORB Appendices).

sufficient KC-135 tanker support<sup>1</sup> to meet the training requirements of Nos 23, 56, 74 and 111 (Lightning) squadrons of Fighter Command and No 29 (Javelin) Squadron of NEAF for a period of six to nine months. Training for FC squadrons would begin on 5 April and for No 29 Squadron on 26 April, subject to the successful conclusion of negotiations with the Turkish Government.

No 74 Squadron, based at Leuchars, did their first training with KC-135s – based at Upper Heyford for Billyboy – during April, doing 1½ hr sorties on which the Lightnings took aboard 3,000lb of fuel. By the end of that month, nine pilots had completed at least three such sorties. Then in May the exercise was repeated, one-hour refuelling sorties being followed by 40min PIs.

In its ORB for August 1965 No 55 Squadron noted that operations for the month “saw the culmination of 2½ months’ training and effort on the part of both air and ground crews in the shape of Exercise Forthright 22 and 23” – the deployment of No 74 Squadron Lightnings to Akrotiri. During that month, too, No 55 was “on show” to the Press, and the aviation journal *Flight International* concisely summed-up the current RAF flight-refuelling situation by reporting (in its 19 August issue) that

“with the premature retirement of the RAF’s Valiant tankers last February, due to fatigue problems, the Service was temporarily deprived of operational air-to-air refuellers. Following a prototype conversion last year, the RAF accepted an offer from Handley Page to convert Victor B.1As to tankers much more rapidly than would otherwise have been done. Now, after only six months, including a two-month work-up, 55 Squadron based at RAF Marham has five Victor tankers operational, with more to come. On August 14 they took part in an exercise in which four Lightning F.3s flew to Cyprus non-stop in 4½ hr.

“The first Victor tankers have two refuelling points; the hoses and drogues are unwound from the underwing pods, which can be used simultaneously. When the ‘customer’ has made contact, he edges forward until the yellow part of the hose has wound back to the pod and he is then in the optimum position for accepting fuel, which starts to flow automatically. The Victor captain flies the tanker while the co-pilot manages the 31-cell fuel system and keeps a check on tanker c.g. movements.

“Most fuel transfers are performed in stable air above 30,000ft; it takes about four minutes to refuel a fighter and about ten minutes for a bomber. The Victor B.1A tanker conversion carries 52,860lb of transferable fuel.

“The present two-point tankers will not be converted to the three-point standard to which later Victor conversions will be made. The three-point refueller will have an additional hose/drogue unit on the fuselage underside. This will be a tremendous advance on the old single-point Valiant tanker on which failure of the hose/drogue equipment meant the complete waste of a sortie. The RAF will subsequently form two more Victor tanker squadrons at Marham”.

The deployment of USAF KC-135s to Europe to provide in-flight refuelling training for the RAF during the interim period between the Valiants and Victors ended at the end of July 1965, and in a letter of thanks for this assistance VCAS (Air Marshal Sir Brian Burnett) told the Vice Chief of Staff of the Department of the Air Force (Lieutenant-General William H. Blanchard) that during the four months’ deployment “all our operational Lightning and Javelin pilots” had “either renewed or obtained their full qualifications for in-flight refuelling operations”. He added that the RAF had “been able to prove the compatibility” of its Victors and Vulcans with the KC-135.<sup>2</sup>

In a reply (on 11 August 1965) General Blanchard commented that an annual RAF-USAF exercise “would ensure compatibility of procedures” and went on to suggest that it “might be worthwhile to explore the possibility” of RAF Victors refuelling USAF fighters – an idea subsequently put into effect, in what amounted to a return fixture for Billyboy; for on 9-16 March 1966 No 55 Squadron did Exercise Jake, described as “a joint RAF/USAF operation to prove the Victor 1A/F-100D<sup>3</sup> combination in the refuelling role.” The squadron’s ORB recorded that “compatibility checks of refuelling . . . equipment were carried out at Marham while a special course at the Inflight Refuelling School was

<sup>1</sup> Two based at Upper Heyford and one of these deploying to Adana/Incirlik, plus an additional tanker for a limited period at Adana/Incirlik. <sup>2</sup> Correspondence in file Use of V-bombers in Tanker Role (AHB, ID3/901/11 (pt 1)). <sup>3</sup> North American Super Sabre.

arranged for the F-100 pilots, led by Captain Evans of the 48th Fighter Wing based at Lakenheath. The flying phase was carried out entirely by squadron aircraft and crews on four sorties . . . . The exercise was a complete success in all aspects . . . ."

No 55 Squadron's operational status, from August 1965 onwards, embodied the successful outcome of the Victor tanker "crash programme" approved by the Air Force Board in February of that year;<sup>1</sup> and the subsequent addition of two more squadrons to the Victor tanker force – No 57 in December 1965 and No 214 in July/August 1966<sup>2</sup> – endorsed the original Air Council decision of November 1962 to have three flight-refuelling squadrons.<sup>3</sup> Nos 55, 57 and 214 were all based at Marham, which also had the conversion unit – the Tanker Training Flight.

An impression of some of the fascinations and hazards of jet tanker operations can be gained from some of No 55 Squadron's ORB entries<sup>4</sup> during its early months' experiences. Thus in November 1965, when escorting a Lightning F.2 of No 19 Squadron – left behind at Akrotiri after a detachment there, because of unserviceability – across the Mediterranean, "the return journey was accomplished . . . without incident – the primary tanker landing at Luqa in order to discuss diversion facilities, and the Lightning leaving the remaining tanker abeam Lyons for Gutersloh". In that simple description the world of flight refuelling seems to be encapsulated – the Victor majestically heading towards the UK, the fighter peeling off for its base in Germany. Things didn't always, however, go so smoothly. In the following month two of 55's aircraft were escorting two Lightnings (an F.3 and a T.5 two-seat trainer) to Akrotiri for a Near East sales demonstration when "high cirrus forced the formation to climb over France where conditions were difficult for refuelling. At FL380, still in cirrus and refuelling into sun, the F.3 had great difficulty in making contact and finally broke his probe. He diverted immediately to Laon/Couvron while the formation continued to Akrotiri without further incident . . ." During the same month (on 9 December) the squadron flew a one-off sortie which enabled a Buccaneer S.2 on an endurance trial to remain airborne for over eight hours – "achieved with two fuel transfers well within the capability of the two-point tanker". Captain of the Victor, which flew for 3½hr, was Flight Lieutenant B.E. James.

For almost a year, until No 57 Squadron did its first operational exercise (with No 55 – escorting four Lightnings to and from Akrotiri) in June 1966, No 55 Squadron maintained Bomber Command's flight refuelling capability with two-point tankers, which were gradually converted to three-point standard during 1967.

Both these first two Victor tanker squadrons had been in the Medium Bomber Force until their change of role occurred. No 55 had an interim of about two months, becoming non-operational in the MBF on 1 March 1965 at Honington and receiving its first Mk 1A two-point tanker at Marham on 25 May, with four of them on its strength by the end of that month.<sup>5</sup> No 57 flew into Marham as a bomber squadron on 1 December 1965 and gradually changed its role and its aircraft,<sup>6</sup> receiving its first (three-point) tanker on 14 February 1966. No 214, unlike the other two already a tanker squadron – with Valiants, had a six months' hiatus in operational activity, from the end of 1965 until re-formed in mid-1966 – although it didn't receive the first of its own aircraft until 27 September, building-up to seven Victor K.1/1As<sup>7</sup> by the end of the year. It could thus be said that the Marham-based three-squadron Victor tanker force was fully in being by the end of 1966.

Its activities had some features in common with those of the Medium Bomber Force – for example, continuation training, standardisation, Lone and Western Rangers, Group and Command exercises including Micky Finns<sup>8</sup> – but there was no QRA and no dispersal, and crew classification was different; they became "operational tanker" (or "tanking" – both terms are found in the ORB). The squadrons'

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<sup>1</sup> Air Force Board Standing Committee, Conclusions 3(65), 8 February 1965. <sup>2</sup> Officially re-formed on 1 July 1966, No 214 effectively re-formed on 8 August after three crews (including that of the CO, Wing Commander D. Mullarkey) had finished their courses at the Tanker Training Flight. <sup>3</sup> Air Council Conclusions 16 (62), 22 November 1962. <sup>4</sup> For November 1965 the compiler was Flying Officer P.G. Beer, for December Flight Lieutenant C.J.L. Horne. <sup>5</sup> Two (XH602 and XH648) arrived on 25 May; the establishment was for six Victors. <sup>6</sup> Another aspect of the change of role was that the squadron once again had "its own ground crew to carry out 1st Line servicing" – as opposed to the Centralised Servicing introduced in MBF squadrons from 1 March 1964. <sup>7</sup> The designation K.1 for Mk 1 three-point tankers was introduced in June 1967. <sup>8</sup> In which (as also in Kingpin) a Victor tanker crew flew an ACP (airborne command post) role.

main work was with Fighter Command, on cross-country exercises or on overseas deployments – the latter under the code-name Forthright, the squadrons practising their own part in them on Levant Rangers.<sup>1</sup> No 55 Squadron had the interesting experience in 1966 of an operational event on a cross-country which led to a new type of exercise being evolved. On 25 May,

“Flying Officer J.M. Kennell and crew, while flying an accompanied cross-country,<sup>2</sup> were ordered by Air Defence Operations Centre (Fighter Command) to depart from the briefed route and proceed into ‘area twelve’. Refuelled to full and under Buchan radar control the pair of fighters went off to make a successful interception with an unidentified target. The ‘bogey’ is thought to have been a Badger or a Bear, but this is not confirmed. A further refuel allowed the fighters to reach their base, Leuchars; while the tanker returned to Honington<sup>3</sup> arriving at the descent point with a low fuel reserve. This no-notice exercise demonstrated the co-operation and flexibility which exists between the squadron and Fighter Command, even when carrying-out refuelling continuation training”.

This experience led to Operation Perigree Mobile, described in No 55’s ORB for August 1966 as a “joint (bomber/fighter) operation . . . evolved

“to enable Lightning aircraft, participating in an accompanied cross-country training exercise, to be used to intercept enemy violations of UK airspace. All squadron crews of the necessary classification, ‘operational tanker’. are being authorised to fly this operation when required by the Air Defence Operations Centre. In effect, tanker/fighter combinations when airborne have been given the flexibility to become a limited standing patrol when necessary”.

When No 214 Squadron had become operational, the roles of the Marham squadrons were described in a *Royal Air Force News Letter* early in 1967<sup>4</sup>, which noted that “all three were equipped and declared operational within 23 months of the withdrawal from service of the Valiant tanker in the early part of 1965” and went on: “The Victors were intended to supersede the Valiants during 1966/67 but because of the sudden withdrawal of the Valiant, plans were made to introduce the Victor much sooner. As an interim measure the first Victor tanker squadron was equipped with aircraft designed for two-point refuelling only. The first tanker was delivered to No 55 Squadron in May 1965, months ahead of schedule, after the manufacturers had modified the existing bomber aircraft by fitting extra fuel tanks in the bomb bays and two refuelling pods, each containing a refuelling hose, drogue and trailing mechanism, under the wings.<sup>5</sup> These aircraft are capable of refuelling two fighters at once while flying at a wide range of heights and speeds.

“Three-point tankers entered service with No 57 Squadron in January 1966, and the build-up continued with the re-formation and re-equipping of No 214,<sup>6</sup> whose aircraft have been given an increased fuel capacity, improved navigational aids and communications equipment, and under-wing floodlighting for night refuelling operations. Fitted with the probe-and-drogue system of flight refuelling, the Victor tankers of No 214 can not only refuel two fighters simultaneously but also have a capability for refuelling bomber or transport aircraft at the rate of 4,000lb of fuel a minute, from a third refuelling point in the lower rear fuselage. This point can also be used as a reserve position for fighter aircraft.

“While the primary task of No 214, and its two sister squadrons at Marham, is to provide flight-refuelling facilities in support of Fighter Command’s overseas reinforcement commitments, they can also give added mobility and flexibility to the Vulcans and Victors of Bomber Command. The new long-range transport aircraft<sup>7</sup> now entering RAF service have been designed with a flight-refuelling capability and it is possible that the Tanker Force could have many varied tasks in the future”.

While this description of the Tanker Force in the late 1960s spoke of its having “varied tasks in the future” and indicated that these included support for bomber and transport aircraft, in fact the training

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<sup>1</sup> According to No 55’s ORB, “an unofficial title given by squadron members for the route experience ranger currently flown . . . before becoming operational in the tanker role. This . . . involves general air traffic flights to Akrotiri, Akrotiri-Luqa and Luqa-UK”. <sup>2</sup> With Lightning F.3s of 23 or 74 Sqn, whose ORBs are much more laconic than those of the tanker sqns. <sup>3</sup> Marham had been closed in April for runway resurfacing. <sup>4</sup> No 159 (13 April 1967) – “RAF’s Third Victor Tanker Squadron”. <sup>5</sup> Handley Page were officially complimented, by the Air Force Board, for their “speedy conversion of . . . Victor tankers . . . meeting a most important operational need” (Minute, Minister of Defence for the RAF (Lord Shackleton)/Minister of Aviation (Mr R. Jenkins), 3 June 1965).

<sup>6</sup> The *News Letter* referred to No 214’s “becoming operational” at Marham. <sup>7</sup> VC10s and Belfasts.

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with Vulcans was discontinued in early 1969<sup>1</sup> and although there were mutual sorties between the Marham Victors and VC10s of No 10 Squadron<sup>2</sup> these formed only a minuscule part of flight refuelling activity, which was largely concerned with training and deployments. Figures compiled for 1969<sup>3</sup> – a spectacular year for the FR squadrons because they supported Royal Navy Phantoms and RAF Harriers in the *Daily Mail's* Transatlantic Air Race (4-11 May) – showed that the major part of Tanker Force flying activity for the year was taken up with basic training on the squadrons. More than 3,500hr were flown in converting new crews, on continuation training and on Tanker Rangers. The other main periods of airborne time – over 2,000hr in each case – were devoted to receiver aircraft training, with Lightnings, Phantoms (including the RN ones) and Harriers; and to deployments – chiefly with Lightnings, but also in support of the RN and RAF Transatlantic Air Race entries. More than 300hr of the Victors' flying was at air displays, over 40hr replenishing fighters on patrol in the northern area of the UK Air Defence Region, and 85hr on trials.<sup>4</sup>

On some deployments, aircraft of all three Marham squadrons were likely to be involved, the Victors refuelling the fighters and each other. Thus No 55 Squadron recorded in its ORB for 16-19 February 1968 that Exercise Forthright 74 was "flown by Wing Commander H.A. Harvey and Flight Lieutenant G.T. West with their respective crews, in conjunction with aircraft of Nos 57 and 214 Squadrons". It "involved flying to overhead Luqa and making a rendezvous 120nm east of [there] with incoming Lightning F.6s of No 23 Squadron, from El Adem. Having refuelled them to the Malta/Italy boundary they were passed to the second tanker, flown by No 214 Squadron. This aircraft, which had been refuelled south of Nice by Flight Lieutenant West, then refuelled the Lightnings back to Leuchars".

Valiant and Victor flight refuelling developed from 1958 onwards against operational scenarios of V-bomber flexibility and of British overseas bases, requiring rapid reinforcement. In 1957 the Secretary of State for Air (Mr G.R. Ward) had told the Defence Committee<sup>5</sup> that flight refuelling would increase the number of targets within range of the V-bombers and would also give them greater freedom of tactical routing.

Perhaps the most dramatic expression of the range that could be conferred on a V-bomber by in-flight refuelling occurred when on 20-21 June 1961 a Vulcan B.1A of No 617 Squadron captained by Squadron Leader M.G. Beavis<sup>6</sup> flew non-stop from Scampton to Sydney – a distance of 11,500 miles – in 20hr 3min. On its journey the Vulcan took on fuel four times – over Cyprus, Karachi, Singapore and 500 miles south of Singapore – and nine Valiant B(K).1 tankers of No 214 Squadron were deployed: four to Tengah, two to Karachi and three to Akrotiri. They had previously escorted eight Javelins (four each from Nos 23 and 64 Squadrons) to Karachi, to prove the feasibility of reinforcing the Far Eastern theatre with these all-weather fighters.

What might be described as the apotheosis of long-range tanker-supported fighter deployment was achieved on 19-20 May 1970 when No 54 Squadron flew two of its Phantom FGR.2s non-stop to Singapore – setting-up a world record time of 14hr 8min for the 8,680sm distance – when the squadron's ten Phantoms went to RAF Tengah to participate in the five-nation exercise Bersatu Padu<sup>7</sup> in Western Malaysia. They were refuelled en route by Victors from all three of the Marham squadrons.

No 54 Squadron recorded in its ORB that "basically the form of deployment was to despatch a pair of aircraft per day between 16 and 20 May, staging through RAF Masirah. However, a pair of aircraft led by Squadron Leader G.H. Arkell-Hardwick and Squadron Leader D.C. Read, with Flight Lieutenant J. Armstrong and Flight Lieutenant B.G. Mayner set off on 18 May to fly non-stop to RAF Tengah. Unfortunately one of the Victor tankers scheduled to RV with the pair over RAF Gan was unserviceable and Flight Lieutenant Armstrong had to land at RAF Gan. Meanwhile Squadron Leaders Arkell-Hardwick and Read set a new time of 14hr 14min for the non-stop UK-Singapore flight, only to see on the following day a pair led by Squadron Leader J.E. Nevill and Flight Lieutenant B.J.J. Straughan with Flight Lieutenants J. Walmsley and A.W. Spencer clip six minutes off their time, creating a world record of 14hr 8min". All ten of the squadron's Phantoms had arrived at Tengah by 23 May.

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<sup>1</sup> Use of V-bombers in Tanker Role (AF/901/11, Pt 2). <sup>2</sup> No 57 Sqn ORB, 27-28 September 1966. <sup>3</sup> Brief for CAS, January 1970 (file referred to above). <sup>4</sup> These figures no doubt include the Tanker Training Flight at Marham. <sup>5</sup> 2 August 1957 meeting (Appendix to AC(58) 28). <sup>6</sup> Later Air Marshal Sir Michael. <sup>7</sup> Malaysian for "complete unity".

This long overseas flight by a complete squadron tested the parameters of FR operations to the full – planning, pre-positioning of tanker aircraft and crews including reserves (No 55 Squadron detached 54 groundcrew to Akrotiri and No 57 sent 38 to Masirah Island), control en route, and fighter/tanker rendezvous made by night and in adverse weather, testing the training and techniques of the crews.

At night the Victors were “lit up like Christmas trees”. which aided visual recognition, after Tacan and radar had brought the Phantoms within range; but the problem of darkness was compounded by bad weather for the record-breaking aircraft as they neared their fourth refuelling rendezvous, over Gan Island. An article in *Flight International* for 11 June 1970, based on an interview with the crews,<sup>1</sup> described what happened and how the operation was triumphantly concluded:-

“Coming up to RV4, the Phantoms at 33,000ft were flying in and out of cloud. They had to descend to 25,000ft to meet the Victor at 27,000ft. They then flew into the clear again and joined up visually. The RV had been flight-planned for 2237hr and at 2243hr they plugged in. This refuelling (over Gan) was a big one, with a first off-load of 15,800lb.

“Shortly after contact was made the tanker flew into cloud: this looked like cirrus but turned out to be a thunderstorm and provided the Phantom crews with the most hair-raising part of their trip. The cloud thickened, rain streamed from it, there was turbulence and lightning, and every part of the Victor and the refuelling pods were bathed in the dancing blue lights of St Elmo’s fire.<sup>2</sup>

“Not unexpectedly, the Phantom broke off contact when they had taken on some fuel; but they stayed in visual contact, and when all three aircraft had got clear of the thunderstorm area, rejoined for refuelling. Then the Victor returned to Gan, a second one accompanied them for about 400 miles and on a refuelling from it they took on 6,700lb, before it too returned to Gan. This meant a total of 22,500lb on RV4.

“From 200nm east of Gan the weather improved: the Phantoms avoided isolated thunderstorms and at 2340Z, when they were at 90°E at 30,000ft, the dawn came and they encountered a friend.

“This was a VC10 of 10 Squadron, callsign Ascot 2409, whom they first heard” then saw, when he was en route from Gan to Changi. Flown by the squadron commander, Wing Commander D.E.B. Dowling, he was above the Phantoms, at 33,000ft, doing MO.85, so at MO.90 the latter were gradually overhauling him. The VC10, said Nevil and Straughan, ‘helped us a lot’: he was getting better performance from his HF radio than the Phantoms were, so was able to get landing forecasts from Changi and Tengah which he passed to them. He also got clearance to proceed and permission for them to do a low pass fly-by at Tengah.

“With drops to 290kt then 300/320kt for flight refuelling, the Phantoms had maintained an average airspeed of 524kt (603mph) over the 8,680sm from the UK.

“They passed the helpful VC10 seven miles to the south of it and got clearance to start a high-speed descent overhead Sumatra, under radar surveillance. Then they were intercepted by a Lightning of 74 Squadron, which led them in to Tengah at 540kt for a low pass over the control tower, where Flight Lieutenant J.W. Lawes, senior air traffic control officer, as official RAeC observer, timed the Phantoms as they passed overhead – 14hr 8min 40sec after they passed over Hornchurch”.<sup>3</sup>

This success could not have been achieved without the compatibility of speed with the Phantoms provided by the Victor tankers, and also their fuel transfer capacity.

These were capabilities which had been stressed by VCAS (Air Marshal Sir Wallace Kyle) in his Note for the Air Council in November 1962<sup>4</sup> recommending the replacement of Valiant tankers by Victors – which, he said, had the “speed and fuel transfer capacity to provide flight refuelling for all our aircraft that will require the facility, such as Lightnings, TSR.2s, Argosies and Belfasts”. He added that a design study had confirmed that two squadrons of Victor three-point tankers “would be able to meet the planned fighter reinforcement task to the Far East over the direct route in our required time-scale of ten days”.

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<sup>1</sup> Fourteen hours to Singapore. How the RAF claimed a new record. <sup>2</sup> “A more or less continuous luminous electrical discharge of weak or moderate intensity in the atmosphere emanating from elevated objects . . . or from aircraft in flight” (*Observer’s Handbook*, HMSO). <sup>3</sup> Record attempts from London had to begin within 50km of Hyde Park corner. <sup>4</sup> Re-equipment of Tanker Force with Victor 1/1A Aircraft, 19 November 1962.

Since the Victor tanker force came into being in 1965/66 there have been changes in the aircraft the Victors were planned to support, in their operational scenario, and in the tankers themselves. Perhaps the biggest of these changes was in the operational scenario, with Britain's withdrawal from bases east of Suez during 1971. Meanwhile the aircraft being refuelled, in addition to Lightnings and Phantoms, included Harriers and Buccaneers; and eventually the Victors themselves changed from the Mk 1 to the Mk 2 version and the force was reduced to two squadrons. The aviation journal *Flight International* carried a valedictory note when on 12 February 1977 it commented that

"the last of the Royal Air Force's Victor K.1 tankers have now been withdrawn from service with the disbandment in late January of 214 Squadron at Marham, Norfolk. The squadron pioneered development of air-to-air refuelling rendezvous procedures and techniques with the RAF strategic bombers in the late 1950s and early 1960s. At that time it was equipped with Valiant bombers, and then tankers.

"The fleet of RAF tankers now consists solely of Victor K.2s of Nos 55 and 57 Squadrons, also based at Marham. The K.2 has two additional underwing fuel pods, each of which carries 1,700gal. The 7ft-wider-span wing houses 18,500lb thrust Rolls-Royce Conways in place of the K.1's 11,000lb thrust Sapphires, both of which improvements give considerably better airfield performance. The Victor K.2 carries about 30 per cent more fuel than did the K.1, 110,000lb compared with 80,000lb".

Nos 55 and 57 Squadrons had re-equipped with Victor K.2s in 1975 and 1976 respectively. A description of their activities in the *RAF Briefing Book* says that "the Victor K Mk 2 tankers, with their three refuelling drogues, provide air refuelling in support of long-range intercept and maritime strike attack sorties. Phantom, Buccaneer, Lightning, Jaguar and Harrier crews of Strike Command all practise regular air-to-air refuelling and are capable of rapid overseas deployment . . ."

A total of 24 Victor K.2s, all of them converted to the tanker role by Hawker Siddeley Aviation, were delivered to the RAF between 1974 and 1979. The original contract had been "technically agreed in October 1969, but limited at Radlett to initial design and feasibility studies" – to quote the official historian of Handley Page<sup>1</sup>, whose future was at that time in doubt. The contract was subsequently "awarded to HSA Ltd" – initially in July 1970, followed by an R&D contract for three aircraft<sup>2</sup> – "whither 21 Victor B.2Rs and the veteran trials B.1 (XA922) were transferred in July and August, when the whole of the Colney Street and Park Street complex was sold for re-development by the Receiver, Kenneth Cork of W.H. Cork, Gully and Co . . ." <sup>3</sup>

The production contract to HSA, who took over the work from 27 February 1970, was for 26 aircraft<sup>4</sup> and 24 were actually delivered – six in 1974/75, six in 1975/76, seven in 1976/77 and the remaining five between 1977 and 1979. One of these K.2s (XL513) suffered a bird strike on take-off on 28 September 1976; the take-off had to be aborted and the aircraft suffered Cat 5 damage, *ie* was a write-off<sup>5</sup>.

Strategic reconnaissance was the other role in which Victors took over from Valiants, and in this case there was no controversy – no battle between the Air Ministry and the Treasury, with industrial complications, as there had been in the case of the tankers; no Governmental decision like that on the non-replacement of Valiant TBs with Vulcans – but simply a planned substitution of Victors for Valiants in the SR role in one squadron, No 543, though with a hiatus of five months in operations between withdrawal of one type and re-equipment with the other.

At the end of the last chapter reference was made to the dismantling of the Valiants at Wyton, to the training of selected crews on Victors at Gaydon and to the re-equipment of No 543 Squadron with Victor B(SR).2s from May 1965 onwards. Although the first of the new aircraft (XL230) arrived on 19 May there was much to be done before the squadron could become operational again in its SR role. During the period of re-equipment (the ORB noted in June) aircrew who had had experience in this role

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<sup>1</sup> C.H. Barnes, *Handley Page Aircraft since 1907* (Putnam & Co, 1976). <sup>2</sup> K6A/42 of 13 August 1970. <sup>3</sup> This was the end of Handley Page Ltd as an aircraft design and manufacturing organisation. <sup>4</sup> K24A/123 of 11 May 1971. <sup>5</sup> The other loss suffered by the RAF Victor tanker fleet was of a K.1A (XH618), involved in a collision with a Buccaneer on 24 March 1975. It came down in the North Sea and four members of the crew were lost, only the captain surviving. The Buccaneer was able to return to its base.

were expected to concentrate on classification while new crews were trained in it; at the same time "the suitability of the Victor 2 in the role" was to be evaluated. HQ Bomber Command had directed that a "priority A trial" was to be carried out to confirm that the Victor B(SR).2 in the radar reconnaissance role was able to fulfil the operational tasks previously undertaken by the Valiant B(PR).1 "in the maritime search role" A second Victor (XM715) had arrived on 23 June and on 5 July, when at 0300hrZ Bomber Command called an Exercise Micky Finn, No 543 – "for the first time in a long while", as the ORB put it – were "actively involved. Two maritime reconnaissance sorties were flown . . . by Squadron Leader Holland, Flight Lieutenant Hunter and their respective crews."<sup>1</sup> When on 12 August the current Joint Services Staff College course visited Wyton they were shown round one of 543's new aircraft and also "photographs taken on the previous day's sorties, the first by a No 543 Squadron Victor" (as the ORB recorded): so the squadron could be said by then to be getting back into business, although by August 1965 it still had only three aircraft, out of an establishment of eight, half of which was achieved in the following month when a fourth Victor arrived.

Between September 1965 and April 1966, when it attained a full complement of eight aircraft, No 543 – its role described at the beginning of 1966 as being "part of the UK Strategic Reconnaissance Force" and having "a secondary role with the Medium Bomber Force" – trained and exercised its crews in radar, photographic and maritime reconnaissance. Lone Ranger flights, with a PR task inserted; trials – of the Victor B/SR.2 itself and of new camera equipment; co-operative exercises with Shackletons – combining "the high, fast search capability of the Victor with the low-level capability of the long-range maritime patrol aircraft" (to quote from the ORB for September 1965); participation in Exercise Mick – during which aircraft were generated and maritime reconnaissances flown – under the Bomber Command Alert and Readiness Plan; classification of crews under the Command's new scheme for the Reconnaissance Force, which became effective at the beginning of 1966; visits to Wyton by the No 3 Group Standardisation Unit; and occasional special tasks:<sup>2</sup> these were the duties of No 543 Squadron in the later 1960s.

When the squadron had reached its established strength the Ministry of Defence (Air) decided that a Press day should be held at Wyton "to celebrate the re-equipment with Victor Mk 2 (SR) aircraft", as the ORB put it, and this was held on 29 June – unfortunately marred by the loss of one of the Victors and its crew on a demonstration flight.<sup>3</sup> In subsequent coverage the AOC of the Central Reconnaissance Establishment, Air Commodore B.P. Young, was quoted as saying that 543's main wartime role was "high-level maritime reconnaissance, providing overall ocean surveillance for RAF Coastal Command and other maritime air and naval forces to exploit"<sup>4</sup>; and in a caption to the photograph which it reproduced of Grand Harbour, Malta, taken by one of the Victors specially for this occasion, the journal said: "Day and night, over land or water, taking a surreptitious peep or making a long and infinitely precise survey, the squadron has, as its primary wartime task, high-level maritime reconnaissance". A full intelligence assessment of all the shipping in the harbour had been made in under 30 minutes, it was noted, by photographic intelligence interpreters of JARIC (the Joint Air Reconnaissance Intelligence Centre) at nearby RAF Brampton. The report also pointed out that RAF Wyton was unique in having a fourth wing added to "the usual . . . station trilogy of ops, tech and admin wings" – a photo wing, responsible not only for supporting the reconnaissance squadrons<sup>5</sup> but also for "first phase" interpretation – commenting that, when it was considered that a Victor could bring back up to 10,000ft of film, it was easy to believe the assertion that the Wyton photo wing was the largest photo-processing unit in the UK after JARIC.

An official account of 543's activities also appeared at this time, approved by the station and the squadron and published in the restricted journal *Air Clues* (July 1966 issue). This said that the RAF now

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<sup>1</sup> A later description of the squadron's role in *Dateline – Royal Air Force* (No 153, dated 9 October 1972) said that "its duties include maritime reconnaissance, and photographic radar reconnaissance. The radar is used to provide information unobtainable by visual or photographic methods. With this radar, the Victor SR.2 can cover an area equal to the whole of the Mediterranean on a single sortie, while four aircraft operating together can produce a radar map of the whole of the Atlantic in a matter of hours".<sup>2</sup> *Eg*, in October 1965, providing photographs "from which any recent ground disturbances could be identified on the West Yorkshire Moors, to assist the police in murder enquiries".<sup>3</sup> XM716, captained by Flight Lieutenant J.A. Holland.<sup>4</sup> *Flight International*, 7 July 1966.  
<sup>5</sup> Nos 58 (TacR) in addition to No 543, the other Wyton squadron being No 51 (SD – Com/Can).

had "an improved air reconnaissance capability" with the Victor B/SR Mk 2s, which had a performance in excess of that of the Valiant B(PR) Mk 1s. "in terms of range, speed, height and operational effectiveness". The article commented that the Victor's range was "at least 40 per cent greater" than the Valiant's, while with improved radar equipment the SR Victor could map an area of 750,000 square miles in six hours. Five Victors, it said, "could cover the whole of the Atlantic in less than seven hours, and on a single sortie could produce radar photographs for a mosaic of the whole of the Mediterranean which would enable a count of every ship to be made".<sup>1</sup>

Other Victor capabilities noted were that three times the number of photoflashes for night photography could be carried than by the Valiant; improved navigational equipment, enabling a higher standard of accuracy to be attained; and the F96 48in camera compared with F49 6in cameras.<sup>2</sup> Further, there was a trial evaluation of colour photography for intelligence and survey purposes; and an innovation in the use of infra-red false colour, giving a more effective penetration of camouflage than infra-red black-and-white film - terrain being depicted in bright contrasts of yellow, magenta and blue.<sup>3</sup>

The unrefuelled range of the Victor B/SR.2 had been impressively demonstrated by No 543 Squadron in May 1966 when one of the two aircraft they had detached to Piarco, Trinidad, to take part in British Guiana Independence Celebrations flew back non-stop to Wyton - 3,896nm - in 8hr 21min 20sec, proudly recorded in the ORB as "an unofficial world record". This flight, in XL165 captained by Flight Lieutenant M.J.B. Haley with Group Captain A.H. Chamberlain (the station commander) as co-pilot and Wing Commander R.H.McV. Redfern (squadron commander) as nav/plotter, was made on 31 May.

In addition to its more public tasks like surveys of territory and the photographic recording of damage in disaster areas, after earthquakes or hurricanes,<sup>4</sup> the SR Victors contributed to the effectiveness of the V-bomber deterrent force by reconnoitring peripheral areas of the Soviet and Eastern Bloc territories.

This aspect of their role was made clear in exchanges of correspondence between the Treasury and the Ministry of Supply and the Air Ministry in the late 1950s/early 1960s, when approval was sought for expenditure on a "new high-resolution radar for RAF reconnaissance".<sup>5</sup> The primary purpose of this new equipment, to be used in Victor (PR) Mk 2s, was to "provide high quality information upon which to brief navigators to enable them to navigate accurately to their targets and to recognise the correct 'echoes' on arrival in the target area . . . ." It was proposed that Red Neck<sup>6</sup> (as the radar was called) should be accommodated in pods 30ft long and 2ft in diameter under the wings of the Victor.

Later correspondence about Red Neck,<sup>7</sup> saying that it was required "to enable a long-range reconnaissance force to fulfil its operational tasks", defined the latter as being six in number. First, contributing to the effectiveness of the deterrent by demonstrating RAF reconnaissance ability and (as has already been mentioned) in reconnoitring peripheral areas of the Soviet and satellite countries. Secondly, contributing to the assessment of the situation in circumstances which might lead to global war. Thirdly, acquiring intelligence prior to or in the course of limited war beyond the capability of short- or medium-range forces. Fourthly, undertaking all aspects of reconnaissance in peacetime, as required under the joint direction of the various agencies involved. Fifthly, progressing reconnaissance developments and techniques, particularly of advanced radar techniques. Sixthly, being prepared for participation in an "open skies" programme.<sup>8</sup>

Although the development of Red Neck was discontinued early in 1962 as a result of an economy review of the R&D programme, the extensive correspondence which it generated put on record the less-

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<sup>1</sup> One of the trials, in October 1965, was designed "to ascertain the ability of the Victor to count ships down to trawler size".<sup>2</sup> The *Air Clues* article included photographs of Merseyside taken with the F-49 and F-96 cameras, showing the extraordinary increase in detail achieved by the latter.<sup>3</sup> Infra-red colour was used in the West Yorkshire moors photographs.<sup>4</sup> E.g., the Agadir earthquake and Hurricane Hattie.<sup>5</sup> Letters in file on Production Orders for RAF Radar Equipment (95/03/027/56).<sup>6</sup> This high-resolution non-scanning radar "for the Victor B(PR) Mk 2 aircraft", subject of ASR No OR/3595, "is to have the code name Red Neck" (MoS/Treasury letter, 11 November 1958.)<sup>7</sup> In AHB ID9/B.14-10 Bombers - Photographic Reconnaissance Victor Mk 2 - Radar Reconnaissance Equipment OR 3595 - Red Neck: Minute, DCAS/AUS(S), 29 September 1960.<sup>8</sup> Suggested by President Eisenhower at the Geneva "summit" in 1955.

publicised tasks of the strategic reconnaissance force in contributing to the RAF bomber role as part of the V-force. The importance of this contribution had been underlined since the inception of that force, when No 543 Squadron was the second squadron in the force to be formed – only a few months after the first Valiant bomber squadron, No 138. It was further emphasised when No 543 proceeded smoothly to gradual re-equipment with Victor B(SR).2s from May 1965 onwards. As has been stated, these second-generation V-bombers, with their greater range and improved radar and photographic reconnaissance capability, provided the V-force with much more powerful and accomplished SR support from the mid-1960s onwards.

## CHAPTER 19

## V-force Low-level Operations (1963-1969)

“At Edinburgh the aircraft turned south to begin the low level section of the flight. From the Tweed to the imaginary target area in Lincolnshire the bomber followed the contours, flying at 300kt at about 250ft . . .

“Passing between, and apparently slightly below, Harrogate and Leeds the flight had settled into a smooth and efficient routine. On the inter-communication set the only sounds were the breathing of the crew, the regular height checks being read from the radar altimeter, and periodic readings of time and distance.

“At 4.25 the simulated launch of the Blue Steel missile took place – its accuracy computed by a radar aiming point on the ground. A rough check by the crew estimated that it would have fallen 20yd west and 60yd south of the target . . . Ten minutes later the crew were back at base being debriefed and interrogated on the mission”.

The bomber was Victor B.2 XL190 of No 100 Squadron, being flown from Wittering on 17 September 1964 on an afternoon (1331-1556hrZ) training sortie described in the ORB as “low-level route 240” by Squadron Leader C.A. Herbert and his crew (Flying Officer M.W. Hands, co-pilot; Squadron Leader A.R. McQuillan, nav/plotter; and Flight Lieutenants G.W. Unsworth, nav/radar, and C. Morris, AEO). In the sixth seat was the writer of the report<sup>1</sup> quoted from above – the defence correspondent of *The Times*, Mr Alun Gwynne-Jones.<sup>2</sup>

At Wittering, on 4 February that year, the Air Ministry had laid on a major presentation of RAF Bomber Command to the Press, the keynote of which had been the low-level capability of the V-force with Blue Steel – the Secretary of State for Air (Mr Hugh Fraser) saying that the force was now equipped and trained to attack targets from low level; and the demonstration Blue Steel sortie described in *The Times* typified the kind of training being done on the V-bomber squadrons from 1963 onwards. At the Wittering Press conference the AOC-in-C Bomber Command (Air Marshal Sir John Grandy) was reported<sup>3</sup> as saying that the ability to operate at low level with Blue Steel was a “major innovation”, and that constant training in low-flying techniques was now general throughout the Command. By low level (the report continued) “he meant low-level to Buccaneer and TSR.2 standards – ‘contour hugging’, to use a Press phrase he did not like. Obviously one could not drop Blue Steel at only 5ft or 10ft, although it fired very quickly after release, but one could fire it very low indeed”.

The AOC-in-C, publicly describing his Command in the aftermath of Skybolt,<sup>4</sup> said that penetration of enemy territory depended upon six factors – aircraft performance, evasive routeing (with and without flight refuelling), high- and low-level capability, electronic countermeasures, the success of earlier strikes in eliminating enemy defences, and stand-off weapons.

The development of Blue Steel as the Command’s stand-off weapon, its introduction into service and the plans for Skybolt to succeed it, have been described in a previous chapter. At Wittering, after the AOC-in-C’s presentation, the Air Minister (Mr Hugh Fraser) said in answer to a question that no consideration was given to a Blue Steel successor; he thought that the V-force would remain a viable deterrent until 1970-71. Developments in its capabilities had turned the “gap” which had been forecast between the end of its viability and the coming into service of Polaris “into a considerable overlap”. What had these developments been?

After Skybolt had been cancelled at the end of 1962 and a subsequent decision had been taken by the Defence Committee in January 1963<sup>5</sup> that the V-bombers should be given a low-level capability, the implications of this decision were studied by the bodies concerned in implementing it. The Defence

<sup>1</sup> Published in *The Times* for 21 September 1964 under the heading “Only 250ft Up with Nuclear Missile V-bomber Tactics Demonstrated”. <sup>2</sup> Later Lord Chalfont. <sup>3</sup> *In Flight International* for 13 February 1964.

<sup>4</sup> Although the Press conference had been called ostensibly to show off the first Victor Blue Steel squadron – No 139 (Jamaica) Sqn. <sup>5</sup> D(63) 1st meeting, 23 January 1963.

Research Policy Committee had previously advocated that a high-yield lay-down bomb should be developed as a matter of the highest priority<sup>1</sup> and subsequently endorsed a proposal to give Blue Steel a low-level launch capability<sup>2</sup>; and the Air Staff drew up a Standard of Preparation,<sup>3</sup> for action by the Ministry of Aviation, spelling out comprehensively all that was required to enable the V-bombers "to evade organised defences as much as possible . . . by flying as low as possible en route, avoiding ring defences by the use of stand-off weapons where available". The SoP said that the Mk 2 V-bombers were "required to pose a measure of deterrence until at least 1970, and . . . must be modified to enable them to operate in the low-level role against an increasing Soviet defence capability". Such modification was required "as soon as possible": it involved the aircraft themselves, their operational environment, their weapons, their crews, their systems, their defensive and their nav/attack systems. In fact, the V-force was substantially re-engineered during 1963-64 to operate in an entirely different role from that for which it had originally been designed.

At the time these plans were made for the low-level role the Valiants were still an effective part of the force, trained to operate in that role as the TBF assigned to Saceur: their weapons were American, the Mk 43 lay-down bomb; or alternatively they would use the British tactical nuclear bomb called Red Beard, employing a "pop-up" delivery technique – that is, a climb up from low level to a release altitude of about 12,000ft. It was considered that no airframe modifications to the Valiants were required for operations in a low level environment, nor to the Mk 1/1A Vulcans and Victors.

The Mk 1/1A and Mk 2 Vulcans and Victors were chiefly to carry the Yellow Sun Mk 2 (megaton) bomb, using a pop-up delivery; but in addition the Mk 2s modified for Blue Steel (a total of five squadrons) were to release it at low level, and some of the Mk 2 Vulcans were to be armed with ASR 1177-type<sup>4</sup> high-yield lay-down bombs. Pop-up manoeuvres were only required in the cases of Yellow Sun, and possibly Red Beard, delivery. In the high-low-high profile envisaged for the V-bombers' operational mission, the low level phase was considered as being flown in nominal terms at 240kt/500ft, with a required fatigue life of at least 5,000hr for the Mk 2s – which it was thought the Vulcans could achieve without modification, the Victors possibly after cropping of wing tips.

In a low level environment certain flying hazards were likely to be encountered: turbulence; damage from hailstones or bird strikes; restricted visibility – reduced by misting, heavy rain and the impact of insects on the windscreen – when visual reference was required; high temperatures – their effect on crew comfort and the effect of moisture on instruments; icing conditions; crew escape in emergency – for the rear-crew members without ejection seats, their chances of getting out of the aircraft facilitated by swivel or sliding seats, and quick-release personal equipment connections; increased fuel consumption at high speeds; and handling problems at high speed/low level, and in the pop-up delivery technique.

The V-bombers' ECM equipment was also to be increased for their low-level role, with a large number of jammers, plus Window and flares; and the aircraft were to be suitably camouflaged for close-to-the-ground operations – their upper surfaces a variegated pattern of greys and greens, their under surfaces still in white anti-flash finish.<sup>5</sup> Nav/attack systems were also to be modified or added to, for example with side-scan radar installations and roller maps in the Mk 2s, and terrain avoidance/clearance radar.

The Standard of Preparation in which these modifications were described, and which the following year (May 1964) was superseded by an Air Staff Requirement – No 380, formed a blueprint for the metamorphosis of the V-force from a high-level force – though still capable of operating in high-level and limited-war roles – and showed how many agencies were involved in the changes of equipment and techniques: the Air Staff as prime mover,<sup>6</sup> the Ministry of Aviation as procurer of the hardware, the aerospace industry, and the RAF itself – particularly in the V-bomber squadrons, where the new practices were to become a way of life.

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<sup>1</sup> DRPC(AES) meeting of 2 January 1963. <sup>2</sup> DRP/M(63)16, 1 October 1963. <sup>3</sup> Standard of Preparation No 54 Medium Bomber Force Aircraft – low-level Role. Issued 3 May 1963. <sup>4</sup> A higher yield version of the low-yield lay-down bomb being developed for the TSR.2 and Buccaneer as a Naval/Air Staff requirement. <sup>5</sup> *Flight International* described the Victor's "opulent white undersides" and "greens-and-gravy topsides" at Wittering on the Press day there (13 February 1964 issue). <sup>6</sup> Though having to convince the Treasury that the associated expenditure was fully justified.

The decision to give the V-force a low-level capability, taken in 1963, meant that Bomber Command in that year added two new operational commitments – the other new one being the assignment of the V-force to NATO, under the Nassau Agreements<sup>1</sup> – to its task of introducing Blue Steel, which was to be released from low level under the new policy. But so complex were the changes involved that it was 1964 before the decision could be fully implemented, despite willingness and enthusiasm on the squadrons. The modifications originally thought necessary were amended in discussion (for example, requirements for navigation systems improvement were reduced, and it was found not to be possible – in the time available – to obtain the special low-level ECM equipment originally envisaged), Treasury approval was given to the expenditure involved,<sup>2</sup> and on 24 July 1964 the Secretary of State for Defence (Mr Peter Thorneycroft) approved the V-bombers' low-level role proposals – having been informed that, “so far as current equipment and aircraft clearance limits” allowed, Bomber Command were now doing “the necessary low-level training for this role”.<sup>3</sup>

This training had started on the squadrons in the spring of 1963 – the free-fall squadrons with Mk 1/1As being the first to practise the new role, the pioneer V-bombers being the Vulcans of No 101 Squadron, which began low level flying from Waddington on 21 March, with a second sortie on the 26th. Next month No 50 Squadron there “commenced to train in earnest for the low level MBF role” (as their ORB put it), and in July the third Waddington squadron, No 44, recorded that “a change of policy” had been introduced: the squadron had “converted to the low-level role” and would in future “carry out operational nuclear sorties using a high-low-high profile”. Its limited-war commitment, however, remained unchanged.

The Victor Mk 1/1A squadrons also started low-level flying in the spring of 1963, No 55 at Honington and No XV at Cottesmore in April, the latter commenting in its ORB for May that “low-level training for the new role of the squadron has injected a welcome stimulus into the training programme”. Its conversion to the role had begun on 1 April; no major navigation problems had been encountered, and it was hoped that six crews would be qualified by the end of June. Likewise on No 55, whose first low-level sortie had been successfully flown by Flight Lieutenant D. Mobberley and his crew on 29 April: the squadron was to be fully trained in the role by the end of June “to be able to meet the Command’s new policy”. The other Honington squadron, No 57, started later – its low level training began in June 1963; on the 6th its CO, Wing Commander J.R. Mason, and his crew flew the first “LL XC RBS GT” sortie. The other Cottesmore squadron, No 10, initiated low-level flying with a sortie by its CO, Wing Commander T.C. Gledhill, and his crew on 29 April; and when during the following month 23 low-level exercises were done, the ORB noted: “It can be seen that the squadron has now undertaken a low-level attack role. Due to aircraft fatigue limitations the majority of sorties are flown at 1,000ft above ground level, with every third sortie at 500ft a.g.l. The low level training took priority over all other flying during the month”. In June No 10 did 11 low-level exercises, in July 15, in August and September 25<sup>4</sup>, in October 27, but in November only 13 and in December only nine: in this last month of 1963 the CO informed his squadron that it was to be disbanded on 1 March 1964.<sup>5</sup> So after January 1964, when it effectively ceased to be a bomber squadron, No 10 was no longer involved in the Command’s low-level policy.

The Blue Steel squadrons – Vulcan B.2s at Scampton and Victor B.2s at Wittering – didn’t begin low-level training until the spring 1964, no doubt because they had only recently become familiar with their weapons in the high-level delivery role for which they had been designed, and because the Blue Steels themselves had to be modified – a programme which began at Scampton and at Wittering in May 1964, the ORB for the latter station noting that “it should be complete by the end of the year”. Flying training in the Blue Steel low-level role officially began at the beginning of March 1964 – No 27 Squadron at Scampton recorded in its ORB that on 1 March “the station commenced a limited low-level training commitment in preparation for the low-level Blue Steel operational role” – and the first low-level Blue Steel training sortie recorded was that by Squadron Leader J.J. Mudford and his crew of No 139 (Jamaica) Squadron from Wittering on 2 March 1964.

No 27 Squadron initially nominated four crews for low-level flying, but in April 1964 this limited commitment was widened to include all crews. No 83, another of the Vulcan B Mk 2/Blue Steel

<sup>1</sup> The *Statement on Nuclear Defence Systems* – see earlier chapter. <sup>2</sup> A total of £2.2m for R&D and £11m for production. <sup>3</sup> Minute of 24 July 1964 to S of S for Defence in V-bombers Low Level Role (AHB ID9/B.6-80).

<sup>4</sup> The ORB for September noting that Victor XA941 was collected from No 232 OCU to replace XA931 “which did not have incorporated Mod 935 for low-level operations”. <sup>5</sup> Disbandment took place on 29 February 1964 and the squadron re-formed with VC10s on 1 July 1964.

squadrons at Scampton, had noted in its ORB for February being officially informed that it would be "changing to a low-level role in the near future", adding the comment: "This change follows news of successful low-level firings of the Blue Steel missile in Australia.<sup>1</sup> Training in the new role will commence as soon as possible, but will of necessity be slow due to the limitation of hours which the aircraft may fly at low level. All crews received a comprehensive briefing on low-level techniques from a team from Waddington<sup>2</sup> on 28 February". In March the ORB recorded: "In the latter part of the month the squadron was required to start low-level training but none was achieved, due mainly to unsuitable weather conditions. Priority is now given to training in the low-level/Blue Steel role and crews are having an opportunity to fly with an operational missile . . ." In fact it was on 10 April that No 83's first low-level sortie was made, by Flight Lieutenant L.H.A. Nel and his crew in XL426, and that month the squadron's ORB commented: "The start of low-level training in Blue Steel squadrons this month was a significant event. Difficulties resulting from weather, trials bookings, etc, hampered progress in the early stages, but with two routes now available these problems are already less pressing. At the moment training is being concentrated on pure low-level navigation at 500ft to 1,000ft; no information is yet available on Blue Steel launching techniques at low level".

Curiously, the senior Blue Steel squadron at Scampton, No 617, made no mention in its ORB for early 1964 of any change to a low-level role. The first reference to such training occurred in August, and then almost as an after thought. Under "Training" the entry recorded that "44 sorties were flown and of these, 23 were flown with Blue Steel training rounds, five were training profile flights and the remainder . . . night checks, air tests and practice display flights. Low-level stages were incorporated in 13 of the Blue Steel sorties and in three of the training profile flights".

The Vulcan B Mk 2 free-fall squadrons, at Coningsby, also began their low-level conversion early in 1964. No 9 recorded in its ORB for January that

"the squadron is to have an operational capability in the low-level role. Training for this . . . was to have begun on 1 January . . . However, clearance to fly the squadron aircraft at low level was not given until 22 January. The conversion training as laid down in BC/S.7168/63/Trg (Provisional Training Instruction for the Low-level Conversion of Vulcan B Mk 2 Free Fall Squadrons) is to be completed by 1 April 1964".

The ORB went on to say that owing to the late clearance, and to inclement weather during January, no low-level sorties had been flown in that month; and there was a further reference to the effect of the new role on classification:-

"Because of the introduction of low-level training, the high-level classification requirements have been considerably reduced in quantity. To balance this reduction of bombing and navigation requirement at high level, crews will now have to carry out low-level navigation stages, high-low-high profiles and - when clearance is given - pop-up attacks. These changes are shown in Training Instruction BC/S.7188/63 Trg App 'C'".

Simulator training was employed - "all squadron captains received indoctrination on . . . low-level handling in the Flight Simulator on . . . 7/8 January" - and No 9's first low-level sortie was flown by Flight Lieutenant R. Humphrey and his crew in Vulcan B Mk 2 XM601 on 5 February 1964.

On the same day the CO of 12 Squadron at Coningsby, Wing Commander P.J. Lagesen, and his crew flew its first LL sortie; and in January its ORB had observed that

"the Mk 2 Vulcan was cleared for low level flying and sanction given for crews to fly the three Bomber Command routes.<sup>3</sup> This marks the first major departure from the original role and the training

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<sup>1</sup> The first low-level trials Blue Steel was successfully launched from a Vulcan at 2,000ft/300kt at Woomera on 19 November 1963 (AOC-in-C Bomber Command/S of S correspondence (Development of Blue Steel, AHB ID3/946/8 Pt 1)). <sup>2</sup> Where low-level training had begun in March 1963, and where they themselves had been briefed by a team from RAF Marham - the Valiant Saceur-assigned TBF base - on 5 March 1963. <sup>3</sup> These were 21/R, 23/R and 24/R, used by the Medium and Tactical Bomber Forces. (HQ BC Low Flying Routes (September 1963 BC/S.7311/Trg)).

requirements of the bomber since it first started operating from Coningsby. A fairly popular innovation amongst the pilots: the rear crew members are, perhaps understandably, a little less enthusiastic. Modifications are afoot to assist them to leave their seats in conditions of high 'G' loading. In addition the outer seats will be swivelled".

In February the ORB noted that the majority of crews had "completed the initial qualification requirement of four low-level sorties at 1,000ft and a squadron commander's check at 500ft a.g.l."

No 35, the third B Mk 2 free-fall squadron at Coningsby, having noted in its ORB for January 1964 that its Vulcans had been cleared to begin training in the low-level role, recorded in February: "This month the squadron started low-level training. Wing Commander D.B. Craig<sup>1</sup> flew the squadron's first low-level sortie on 4 February" – a 3hr 49min "Low Level BC 23R; NBA/RBS Attacks" flight.

The 1963-69 period, when low-level penetration techniques were introduced and practised by the Vulcan and Victor squadrons, was as pioneering a time for the V-force as 1955-63 had been – both in the air and on the ground. For the implications of the new role were not limited to lower flying: they involved the introduction of a new weapon (WE177, the high-yield lay-down bomb, a weapon specially tailored for low-level strategic operations); the application of a new technique (pop-up delivery) to an existing bomb, the Yellow Sun Mk 2 megaton weapon; and the delivery of suitably modified Blue Steel stand-off bombs from low altitude. At the same time, the Medium Bomber Force retained its conventional-weapon capability, and its ability to reinforce RAF Commands in the Near and Far East at short notice.

At the beginning of this period, the British strategic megaton-weapon deterrent consisted of nine Vulcan and six Victor squadrons (the Valiants were all by then in the tanker, Tactical Bomber Force or strategic reconnaissance roles, and by September 1963 the Thors had all been air-lifted back to the United States). Then, in 1964, two Victor B.1/1A squadrons (Nos 10 and XV) were disbanded; and in 1965 two more Victor B.1A squadrons (Nos 55 and 57) converted to the tanker role in succession to the Valiants. Thus, for most of the low-level period, V-force deterrent capability rested on 11 squadrons with three different kinds of megaton-range weapon: the Yellow Sun Mk 2 free-fall bomb carried by the Waddington-based Vulcan B.1As of Nos 44, 50 and 101 Squadrons; the WE177 high-yield lay-down bomb carried by Cottesmore-based Vulcan B.2s of Nos 9, 12 and 35 Squadrons (based at Coningsby until November 1964); and the Blue Steel stand-off weapon carried by Scampton-based Vulcan B.2s of Nos 27, 83 and 617 Squadrons and Wittering-based Victor B.2s of Nos 100 and 139 (Jamaica) Squadrons. Yellow Sun Mk 2, introduced into Bomber Command during 1961,<sup>2</sup> was the basic free-fall megaton-range bomb of the V-force, as Blue Danube had been the kiloton-range bomb; and during 1963 YS Mk 2s were modified for the free-fall role by teams from the BC Armament School at Wittering, which visited Honington, Waddington, Cottesmore, Wittering, Scampton and Coningsby between July and the end of August.<sup>3</sup> The WE177 came into service at Cottesmore during September 1966, trials having begun there in December 1964<sup>4</sup>: this was the first British nuclear weapon (originally designed for the TSR.2) to have been tailored specifically for low-level operations. Blue Steel, modified from mid-1964 onwards for the low-level role,<sup>5</sup> was initially used on QRA in its unpowered – *ie* free fall – version.

The Scampton ORB made specific reference to this in its monthly summaries: in September 1963 it noted that "the main task of the Armament Support Squadron" had been "to take over the armament aspects of a Blue Steel Weapon System QRA, in the free-fall role . . ."; and in the following month that the squadron was "supporting the armament work associated with keeping two aircraft at standby readiness in the Blue Steel unpowered role . . . ."

Wittering followed suit, mounting its first Blue Steel QRA on 1 February 1964. In January the station ORB had recorded that that month "saw a shift of emphasis from the effort of the previous three months, which were devoted largely to accepting training missiles for Wittering's use and operational missiles for Scampton's use". Priority had been given to "accepting operational missiles in the unpowered role

<sup>1</sup> Later Air Chief Marshal Sir David: see Foreword. <sup>2</sup> See the BCAS, Wittering, ORB for June and July 1961.

<sup>3</sup> BCAS ORB for July and August 1963. <sup>4</sup> Cottesmore ORB for December 1964. <sup>5</sup> Scampton ORB, May and June 1964.

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in preparation for the first Blue Steel QRA at Wittering". When this took place the ORB noted that "in accordance with a Bomber Command directive,<sup>1</sup> a QRA was mounted with a Blue Steel missile for the first time. The missile was held in the unpowered role, maintaining serviceability for the full month".

At both stations, low-level Blue Steel modification programmes began in May 1964; these followed the development and firing trials of the missile in this role.<sup>2</sup> Scampton's ORB noted for that month: "the low-level missile modifications programme commenced . . . and seven missiles are presently allocated to CWP (contractors' working party)"; while Wittering was even more specific, recording that "the low-level missile modification programme was started on 19 May . . . It should be complete by the end of the year". The time needed to modify Blue Steels seems to have varied between the two stations, for in June the Scampton ORB noted that "three missiles were modified by the contractors' working party, during the month, to the low-level role", commenting that this number was "fewer than planned"; while at Wittering other commitments held up the programme<sup>3</sup> and it wasn't until August (the ORB recorded) that the "first missiles in the full role" were produced – but by September there were six of these.

1964 also saw the inauguration of a major change in aircraft engineering support for the V-force – the introduction, on 1 March 1964, of centralised servicing for the MBF squadrons. This meant that, overnight, squadrons lost their groundcrews and with them the old loyalties that had traditionally bound a squadron together. To take one or two random examples, No 35 Squadron at Coningsby noted in its ORB for March 1964 that its strength was 41 officers, commenting succinctly that "all RAF groundcrew and aircraft, hitherto shown under 'strength figures' and 'aircraft state' respectively, are now allocated to Technical Wing". One of the Scampton squadrons, No 83, had some critical things to say about the new system while allowing that it needed to be given time to prove itself:-

"The bed of roses promised us under centralised servicing did not unfortunately materialise. With an aircraft availability of 21, the station managed 5.3 sorties per day, giving roughly 1.7 per squadron. Under squadron servicing in the past, comparable aircraft availability rarely gave us an average of as low as two sorties per day and it was more often nearer three.

"Nevertheless it is early days to judge the system; things will undoubtedly improve, or at least one must hope so since present monthly hours per crew is barely enough to maintain crews in flying practice".

No 100 Squadron at Wittering, noting that from 1 March 1964 it had "lost its aircraft and airmen when centralisation of all technical services became effective", commented that it was not intended to compare the relative merits of the two systems "except to say that for such peacetime detachments" – the squadron had just returned from a successful visit to New Zealand, on which "major factors" were the "high serviceability of the aircraft and the enthusiastic and competent work" of the groundcrew – "or wartime dispersals, only the conventional squadron organisation, with men and machines under its own command" could achieve better results than those obtained on the NZ visit.

At Waddington No 50 Squadron commented, in its ORB for June 1964, that "as a result of the latest Bomber Command Establishment Review the two squadron engineering officers and the squadron airmen, who had been detached to Technical Wing since February 1963, were finally posted to Technical Wing, Royal Air Force Waddington, for centralised servicing. A sad occasion for No 50 Squadron. The one remaining SNCO on strength is Sergeant Gledhill, H., for secretarial duties".

The situation at Honington was somewhat different: a Victor Wing had been formed there in March 1963, Nos 55 and 57 Squadrons becoming 'A' and 'B' Flights. But on 10 April the formal trial of the

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<sup>1</sup> Bomber Command had given authority, on 1 October 1963, for the use of Blue Steel missiles in the unpowered condition on QRA (HQ BC ORB, October 1963). <sup>2</sup> On 10 April 1964 DCAS (AM C.H. Hartley) was informed that only one more round remained to be fired before initial low level clearance could be given (file Bombers – Powered Bombs Blue Steel – ASR1132 (AHB ID9/B.18-100); on 10 and 14 April respectively missiles 054 and 058 were launched successfully at 1,000ft a.g.l. (No 4 JSTU ORB). <sup>3</sup> In June "HQ Bomber Command dictated that the unit tasks required to support the July generation exercises of missiles/aircraft systems were to take priority over the CWP low-level modification programme"; and in July the programme was "somewhat retarded" owing to Exercise Impervious (7-8 Jul), "a maximum effort exercise involving operational missiles".

“centralised flying and technical organisation” ended, the station reverting to “the normal two QRA weapons systems”. However, “approval was sought to maintain the existing organisation at least until the end of 1963”.

Honington and Waddington had been the trials stations for Bomber Command’s new scheme of centralised services, for a year before the system was introduced throughout the V-force. On 8 January 1963 Honington’s ORB noted that No 3 Group HQ had given formal authority “for a trial of centralised operation and technical control” of the two resident Victor squadrons. Objects of the trial were “to meet the operational, flying and servicing tasks as laid down; to evaluate the advantages and disadvantages of centralised control; and to make recommendations”. Main features of the centralised organisation were “the co-ordination of flying and ground training of both Nos 55 and 57 Squadrons by a Wing Commander Training”. The trial began on 14 January.

The Waddington trial started a month later, Bomber Command HQ’s ORB recording that “the centralised flying/servicing trials organisation” there “became effective on 4 February”. Its aim was “increased servicing efficiency” and “to provide experience” in operating this type of organisation “so that any further increase of aircraft allotted to QRA could more readily be absorbed”.

Waddington’s own ORB commented that on 4 February the station had “converted to centralised planning and servicing control”, all aircraft and servicing personnel coming under central – as distinct from squadron – control”. The three squadrons – Nos 44, 50 and 101 – would “remain as separate entities for operational and training purposes and comprise aircrew officers with administrative staff only”. The ORB further noted appointments which had been made on the introduction of centralised planning and servicing control – *eg*, OC Hangar Squadron, OC Flight Line Squadron, OC Technical Control Cell.

These trials led to the introduction, the following year, of a centralised system on V-force stations, Bomber Command HQ’s ORB noting that with effect from 1 January 1964 Waddington and Honington “changed from trial centralised organisations to the new Command standard ‘Integrated’ flying station organisation”. In an Administrative Standing Order issued on 23 January<sup>1</sup> the Command set down the philosophy behind the change, noting that while the present organisation of operational stations had “met the requirements of the past six years” the “additional operational and technical tasks” imposed on them demanded an organisation that would “exercise . . . unified control and direction” of a station’s resources; obtain “optimum utilisation of the complex weapon systems now in service, without imposing additional burdens on the technical manpower”; achieve increased efficiency by exploiting the flexibility inherent in the application of greater numbers of aircrew to a large aircraft establishment; and “enable air and ground crews to meet the higher demands of the future and, at the same time, to lead an orderly and well regulated life”. The ASO added that “various trials of centralised flying and servicing organisations” had been carried out and that a “final organisation” had been agreed.

The implications of the new system were that, on each station, “a Flying and Servicing Planning and Control Section, jointly responsible to Wing Commander Operations and Wing Commander Technical”, was to be set up: its purpose was to “co-ordinate the various operational and training tasks, stated by Wing Commander Ops, with the planned aircraft availability”. Referring to station organisation, the ASO said that “apart from members of flying squadrons on operational stations which are directly under the station commander, all personnel . . . are to be allotted, where practicable, to appropriate functional squadrons within three wings commanded by wing commanders”. It added that “operational flying squadrons are to be commanded by wing commanders, responsible directly to the station commander. These squadrons are to be made up solely of flying crews”.

Changes in accordance with this new policy were made on V-force bases during the spring of 1964: thus Coningsby noted in its ORB for March that “to achieve a more efficient utilisation of manpower and resources” a new station organisation had been introduced; it consisted “mainly” in centralisation of technical resources but also included “centralisation of the direction and control of the daily flying programme”. Scampton recorded that centralised servicing had been introduced from 1 March and

<sup>1</sup> ASO No 11 – Organisation of Selected Operational Stations, Bomber Command.

further commented: "To meet diverse requirements in the preparation of aircraft, missiles and aircrews, a Planning and Control section was established within Operations Wing HQ. Under the new organisation, training sorties are allocated to squadrons by the Air Plans Officer, who is responsible for the preparation and administration of daily flying programme". The Technical Wing also noted that March had been the first month when it had operated on a centralised basis; and the station commander (Group Captain K.G. Hubbard) referred in his comments to the change-over to "centralised servicing" as being one of the month's "major aspects". Honington, however, had made the most precise reference to the new system when on 1 January 1964 its ORB commented that "under the terms of Bomber Command Administrative Standing Order No 11, the following changes" were to take place: a Flying and Servicing Planning Central Section was "to co-ordinate the flying task with aircraft availability" (it was to be jointly controlled by Squadron Leader Air Plans and Squadron Leader Technical, and to be jointly responsible to Wing Commander Operations and Wing Commander Technical); and Wing Commander Ops was to consult squadron commanders and then issue a flying programme on behalf of the Station Commander.

This centralisation on the MBF bases reflected the unity of role of the squadrons using them – those armed with Blue Steel, the Vulcan B.2s at Scampton and the Victor B.2s at Wittering; those carrying the WE177 lay-down bomb (in service from 1966 onwards), the Vulcan B.2s at Coningsby – three squadrons which moved to Cottesmore in November 1964; and the Yellow Sun Mk 2-armed Vulcan B.1As at Waddington. These squadrons formed the core of the low-level QRA force (two Victor B.1/1A squadrons, Nos 10 and 15, were disbanded in 1964 and two others, Nos 55 and 57, became tanker squadrons in 1965).

Although the squadrons had become flying units only, with aircraft and aircrew but no groundcrew, the sense of identity and pride in tradition were maintained – largely through competitions designed to demonstrate operational efficiency, the results showing where training had been effective and which crews had managed to get the best out of their aircraft and equipment, although a squadron-based incentive to get the latter serviceable no longer existed.

The type of low-level training engaged in by the V-force during the 1963-69 period may best be judged from typical squadron records. Thus, in the Blue Steel role, No 27 at Scampton enumerated in January 1965 the "principal types of bombing run used on RBS (radar bomb site) targets during exercises and day-to-day training profiles". These were, Type 2, high-level ballistic release; Type 2E, a 'pop-up' ballistic attack simulating an unpowered Blue Steel release after a low-level stage; Type 3A, high-level Blue Steel run simulating a powered release; Type 3C, simulated Blue Steel powered release from low level; and Type 3E, a combination of Types 2E and 3C attack. These five different types of attack show how much flexibility there was in the operational scenario of a squadron charged with delivering a single type of weapon.

One of the Victor Blue Steel squadrons, No 139 (Jamaica) at Wittering, described in April 1965 a "new method of unpowered attack . . . the '2H' . . ." This was "similar to the present 'pop-up' attack" in that the aircraft climbed from low level to a safe release height, the significant difference being that aiming was "completed prior to the climb", which was made "at full power and constant attitude". The ORB commented that this procedure would replace "the present unpowered attack" when the procedure had been computed and instrument modification completed.

The Cottesmore Vulcan B.2 squadrons (Nos 9, 12 and 35), which were armed with WE177 from the autumn of 1966,<sup>1</sup> had an intensive flying programme; the station ORB for October 1967 lists Lone, Goose, Western and Pacific Rangers, Kinsman dispersals, Co-op and Billion exercises, a trial and scramble take-offs.<sup>2</sup>

The Pacific Rangers were round-the-world flights via the United States: No 12 Squadron at Cottesmore recorded its first in that month when between 9 and 23 October the CO (Wing Commander D.H. Tew) and his crew flew Vulcan B.2 XM598, with two ASCs (aircraft servicing chiefs) in addition to the five-man aircrew, via the USAF Offut, McClellan, Honolulu, Wake and Guam bases to Singapore (RAF

<sup>1</sup> Cottesmore's ORB records in September 1966 that "the first operational 950lb bomb was received . . . during the month". <sup>2</sup> Co-op was a NATO exercise and Billion a No 1 Gp competition.

Tengah), from where they returned to Cottesmore via Gan, Muharraq and Akrotiri. This was Pacific Ranger No 4904, and it continued to emphasise the operational flexibility and away-from-base capability of the V-bombers.

The conventional role of the Vulcans was also maintained: in June-July 1966 another of the Cottesmore squadrons, No 35, had four of its B.2s at Tengah on a Matterhorn detachment and during this one of its aircraft dropped 21 1,000lb bombs in a firepower demonstration at the China Rock bombing range.

During 1966 the Waddington free-fall (Yellow Sun Mk 2) squadrons were gradually re-equipped with Vulcan B.2s, No 50 being the first to receive one of the new aircraft (XJ783), starting flying with it on 18 January.<sup>1</sup> This change involved postings of aircrew to the other squadrons on the station, so that those with most experience would have the first chance of flying B.2s. As No 50's ORB explained, having detailed the personnel moves to Nos 101 and 44, the reason for these was "re-allocation of crews in order of time served in the V-force, to prepare for their systematic replacement by Vulcan B Mk 2 crews as the re-equipment programme progresses; hence the longest-serving Mk 1A crews have come to 50 Squadron, those with least time in the V-force to 101 Squadron and the rest to 44 squadron". By November 1966 No 50 squadron had received its full complement of B.2s.

No 101 Squadron also referred, in its ORB for January 1966, to the change of aircraft and to a new system of classification. It said that the month was "noteworthy for a number of reasons. First, because of the pending re-equipment of the station with Vulcan Mk 2s . . . a complete re-organisation of . . . crews was carried out. . . . The most experienced . . . went to No 50 Squadron - . . . the first to be re-equipped - and the least experienced to No 101 which will be the last . . . to be re-equipped . . . . Secondly, the new classification scheme came into operation on 1 January . . . . It appears to have significant advantages over the previous scheme inasmuch as much of the responsibility for awarding categories is the prerogative of the squadron commander. . . ."

No 44 got its first B.2 in January 1967 and was fully re-equipped by October; No 101, last operators of Vulcan B.1As, finished squadron service on 31 December.

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<sup>1</sup> This aircraft, Waddington's first Mk 2, had arrived on the station of 23 December 1965.

## CHAPTER 20

**Bomber Command in the mid-1960s, the end of QRA and the phasing-out of Blue Steel**

When Air Chief Marshal Sir Wallace Kyle took over as AOC-in-C Bomber Command on 19 February 1965 he was given a Directive from the Chief of the Air Staff (Air Chief Marshal Sir Charles Elworthy)<sup>1</sup> setting-out the roles and responsibilities of the medium bomber and the reconnaissance forces. At that time the Command had nine Vulcan squadrons (six of B.2s, three of B.1As) in No 1 Group; four Victor squadrons (two of B.2s, two of B.1s/1As) and a Radar/Strategic Reconnaissance Flight of Victors and five Valiant squadrons (three of tactical medium bombers assigned to Saceur and two of tankers) in No 3 Group; and in the HQ squadrons based at Wyton a mixed force performing special duties (Canberra/Comet/Hastings), tactical reconnaissance (Canberra) and strategic reconnaissance (Valiant) roles.

The Directive gave the AOC-in-C three overall guidelines: he was to be responsible for the efficiency, training and readiness for war of all formations in his Command; he was to maintain his forces at the highest standard of efficiency that could be achieved with the resources available; and he was to establish and maintain operational links with National and Allied authorities as necessary to fulfil the terms of the Directive, in particular with Saceur.

Defining the roles of the component forces of the Command, the Directive said that the MBF was assigned to Saceur for targetting and for the planning, co-ordination and execution of strikes in accordance with his Nuclear Strike Plan; in other respects the force was under national control. Its main tasks were to serve as the principal national deterrent to war by maintaining a capability to meet aggression by immediate nuclear retaliation; in the event of unilateral retaliatory action, to destroy targets allocated to it under the National Plan; in the event of general war, to destroy targets allocated by Saceur under his NSP; and to provide reinforcements for limited war or other operations in RAF overseas Commands, or in support of Allied forces – as directed by the Air Force Department. The MBF was to be trained to disperse at short notice, and to operate from dispersal airfields; its aircraft were to fly to overseas bases to exercise reinforcement plans, and flights were to be made “to carry out operational training and . . . support British interests abroad”.

These instructions made clear the reasons for types of work done on the squadrons: continuation training, crew classification, ranger flights, Group and Command competitions, dispersal and readiness exercises.

By the time the new AOC-in-C had taken up his post the Valiants had been removed from Bomber Command service: a Ministry of Defence announcement<sup>2</sup> of 26 January 1965 said that the photographic reconnaissance version of the Valiant would be replaced by Victors during that year, and the tanker version “over the next 18 months”. As for the tactical bomber force at Marham, the Ministry commented that

“some of the Valiants are assigned to Saceur in a tactical role and Saceur and the North Atlantic Council have been informed of our decision. But the British strategic force of Vulcans and Victors is unaffected. This country makes a contribution to the strategic nuclear forces of the Alliance in the shape of the V-bomber force assigned to Saceur. This contribution to NATO remains unchanged by the decision about the Valiant tactical bombers . . .”.

Thus, while there was no change of roles during 1965, there was a change of cast with the disappearance of the Valiants. The latter change affected No 3 Group, and by the time it had occurred the Group had two Victor B.2 Blue Steel squadrons (Nos 100 and 139) and two B.1/1A/(K)1A tanker squadrons (Nos 55 and 57) plus a Victor B.2 Training Flight at Wittering and B.1A Tanker Training Flight at Marham.

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<sup>1</sup> Directive for the AOC-in-C, Bomber Command, RAF (18 February 1965 – AF/W.292/64). <sup>2</sup> A unified Ministry of Defence had been formed on 1 April 1964, the Air Ministry becoming the Air Force Department.

The Directive for the Reconnaissance Force given to the AOC-in-C in February 1965 said that the photographic/radar reconnaissance squadrons, normally under National control, were "earmarked for assignment to Saceur" on the declaration of a reinforced alert. The electronic reconnaissance squadron was under National control. The P/RR element of the reconnaissance force was to provide photographic, survey and radar reconnaissance at home and overseas, as directed by the Air Force Department of the MoD, and to provide reinforcement overseas in conditions other than general war; but in conditions of general war to provide P/RR as directed by Saceur.

After the withdrawal of Valiants from the strategic reconnaissance role, Victor B.2s took it over, No 543 Squadron at Wyton re-equipping from May 1965 onwards<sup>1</sup> (as recounted in Chapter 18).

During 1963 a paper prepared in the Air Ministry and sent to the Foreign Office, as material for use by UK representatives in NATO countries to put across the capabilities of the V-bomber force, provided a useful summary of the Bomber Command front line to that date. It said that, over the last decade, Britain had spent some £1,000 million on creating, maintaining and perfecting the V-force – which, originally equipped to carry free-falling nuclear weapons, was being re-equipped with supersonic guided missiles. The V-bombers carried "highly efficient and powerful electronic devices", causing confusion to enemy radar and control systems and complicating and reducing the chances of making effective interceptions. A proportion of the V-force, the QRA (quick reaction alert) element, was at immediate readiness by day and night throughout the year and four aircraft could be airborne in under two minutes – a standard maintained by regular practice, with "no warning" alerts being a feature of normal training. Operational warning would be provided by the Anglo-American BMEWS (ballistic missile early-warning system) or the Western European early-warning radar chain, linked through various operations centres to Bomber Command HQ. In a deteriorating international situation the V-force would be dispersed to airfields throughout the United Kingdom and could be scrambled simultaneously by the Bomber Command Operations Centre. In their conventional role the V-bombers could carry 10–20 tons of high-explosive bombs<sup>2</sup> and V-force squadrons might be required to reinforce overseas Commands in a variety of emergencies – in which it might be necessary to contemplate the use of either nuclear or conventional weapons.

This paper, sent to the Foreign Office on 5 March 1963, summed-up the V-force to the beginning of that year, when the QRA commitment had been in force for 12 months and the Fylingdales BMEWS station was to be declared operational,<sup>3</sup> and Blue Steel was coming into service with the Vulcan squadrons; and before the whole of the force had been committed to NATO under the Nassau Agreement.<sup>4</sup>

By now, not only was there a major change in operational concept – from high level to low level in the primary role of delivering thermonuclear weapons; but what had been the V-force, an elite corps in Bomber Command, had now become the whole of that Command, operating two types of V-bomber, the Vulcan and Victor, delivering three kinds of megaton weapon – missile, lay-down and free-fall – and supported by the reconnaissance (photographic, radar and electronic) force. The Canberra light bomber element which had once formed part of the Command was now overseas, in RAF Germany (2nd Tactical Air Force) and the Near East Air Force: Canberras in the UK were now used on the special duties and tactical reconnaissance squadrons at Wyton or for bomber training by No 231 OCU at Bassingbourn.

Although the V-bombers had been in service for ten years (the Valiant since 1955, Vulcan since 1956 and Victor since 1957) there was no question of replacing them with a second generation of strategic

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<sup>1</sup> The first of the squadron's Victors, XL230, arrived at Wyton from Radlett on 19 May. <sup>2</sup> The Vulcan B.2s 21,000lb (nearly ten tons), the Victor B.2s 35,000lb (16 tons). <sup>3</sup> On 17 September 1963. <sup>4</sup> The *Statement on Nuclear Defence Systems* said that the Polaris decision "created an opportunity for the development of new and closer arrangements for the organisation and control of strategic Western defence", and the Prime Minister "suggested . . . that . . . a start could be made by subscribing to NATO some part of the force already in existence. This could include allocations from United States strategic forces, from United Kingdom Bomber Command, and from tactical nuclear forces now held in Europe". This statement was issued after the Kennedy–Macmillan talks at Nassau, 18–21 December 1962.

bomber aircraft:<sup>1</sup> Valiant development had been confined to the B.1 and its variants (only a prototype version of the B.2 had been built); the Vulcan and Victor had both achieved much greater power and range in their B.2 versions, and the arming of Vulcans with Skybolt would have given them a continued high level strategic capability well into the 1970s – a prospect dramatically terminated in December 1962.

In the meantime the new tactical strike/reconnaissance aircraft, TSR.2, had been under development since 1958 and was expected to enter RAF service in 1966/67, replacing Valiants and Canberras in the strike and reconnaissance roles. It would also be available to supplement the strategic nuclear deterrent capability, carrying the same type of lay-down bomb as the one used by Vulcan B.2s in the low-level role. This view was promulgated by the prime contractor, British Aircraft Corporation, who in a brochure of January 1963<sup>2</sup> said that “with the appropriate weapons TSR.2 can . . . make a considerable contribution to the strategic deterrent”. However, the Chiefs of Staff expressed a more qualified opinion: while saying<sup>3</sup> that TSR.2 “would be available to supplement our strategic deterrent” they added that “it could not . . . , without an airborne alert capability, which was understood to be impracticable, fulfil the requirements necessary to make it in all circumstances a credible deterrent vehicle”. The role of the aircraft “would therefore remain essentially tactical”.

However, what TSR.2 would do or would not do, could do or could not do, became academic questions when the aircraft was cancelled by the Government on 6 April 1965. The announcement was made in the Budget speech by the Chancellor of the Exchequer (Mr James Callaghan), who said that the decision to cancel had been taken after a thorough review of all the information that could be made available. It had been decided that TSR.2 was too expensive and had “got to be stopped”; the planned programme “would have cost around £750m for research, development and production. An order for 150 aircraft would have meant that each one would have cost £5m . . . . A programme of this order was not one which . . . could be held to represent value for money. It was not only too costly in terms of defence expenditure, but making far too great a demand on the country’s scarce resources of highly skilled manpower”. The decision which had been taken “was inevitable if we are to contain defence expenditure”.

It was a decision which caused great controversy and bitterness, in the political arena, in the Services and in the aircraft industry, and echoes of the feelings it aroused rumbled around for many years afterwards. In 1980, one commentator<sup>4</sup> put the view that “the RAF had been reduced almost to impotence by the cancellation of every long-range weapon system that came along after the V-bombers – Blue Streak, Blue Steel Mk 2, Skybolt and TSR.2”. He added that Bomber Command “was slowly eroded and eventually abolished”.

This process, however, was one which affected all the RAF Commands: in the case of the UK-based ones, a “radical review” was undertaken in 1966–1967. The 1967 *Statement on the Defence Estimates*<sup>5</sup> said that the aim was that each Service “should have a major front-line command, covering the whole, or the bulk, of its ‘teeth’ units based in this country”. The change came about on 1 April 1968 when Strike Command was formed, amalgamating the former Bomber and Fighter Commands, which became respectively Nos 1 and 11 Groups. In the case of No 1 Group, the amalgamation into Strike Command had been preceded during 1967 by the merger of Nos 1 and 3 Groups – the peacetime organisation which had succeeded Bomber Command’s eight wartime operational groups<sup>6</sup> – into No 1 Group, achieved by 1 November 1967. But the transmutation of Bomber Command into No 1 Group, Strike Command, did not affect the maintenance of QRA by the V-bomber squadrons – a role which continued until 30 June 1969 – nor the physical assets of the former Command in terms of aircraft and weapons.

The integration of all the UK-based bomber, tanker and reconnaissance forces into No 1 Group prior to the formation of Strike Command meant that stations had to be transferred from No 3 Group, and this

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<sup>1</sup> A supersonic reconnaissance/bomber aircraft had been proposed in OR 330, issued in 1954, on which Specifications R.156T and B.156D were based. A V Roe were awarded a development contract and designed the Avro 730, but the project was cancelled in 1957. <sup>2</sup> *TSR.2 Strategic Weapon Systems*. <sup>3</sup> COS Meeting (3rd Mtg/63), 15 January 1963. <sup>4</sup> Air Vice-Marshal Stewart Menaul, in his book *Countdown Britain's Strategic Nuclear Forces* (Robert Hale Ltd, 1980) <sup>5</sup> February 1967 (Cmd 3203). <sup>6</sup> Nos 1, 2, 3, 4, 5, 6(RCAF), 8(PFF) and 100.

process went on during 1967. At the beginning of that year No 3 Group had six stations – Mildenhall, where its Headquarters were; Bassingbourn, where No 231 OCU (Canberras) and the Joint School of Photographic Interpretation were based; Honington (which had been on a “care and maintenance” basis since 1 May 1966<sup>1</sup>); Manston; Marham (base of the Victor tanker force – Nos 55, 57 and 214 Squadrons); and Wittering (where the two Victor B.2 Blue Steel squadrons, Nos 100 and 139, and also the Victor B.2 training flight were based).

At the beginning of May 1967 No 1 Group took over RAF Bassingbourn, No 231 OCU and the administration of JSPI;<sup>2</sup> then in August Manston was transferred to Coastal Command.<sup>3</sup> This meant that in the last full month of its existence (October 1967) No 3 Group had four stations – Honington, Marham, Mildenhall and Wittering; and when it was disbanded on 1 November 1967 these stations and units – including, for example, the Bomber Command Armament School at Wittering – were transferred *en bloc* to No 1 Group.<sup>4</sup>

No 3 Group had been the Bomber Command formation which pioneered the V-force, all of whose original units and squadrons it had controlled, from 1954 onwards – No 1321 Flight at Wittering, the Valiant trials unit; No 232 OCU at Gaydon, where Valiant training was done; No 138 Squadron at Wittering, the first V-bomber squadron; No 543 Squadron, the Valiant strategic reconnaissance squadron, at Wyton; and the rest of the seven-squadron Valiant bomber force – at Marham (Nos 214, 207 and 148 Squadrons), Wittering (No 49) and Honington (Nos 7 and 90). It also, in the BCAS at Wittering,<sup>5</sup> controlled the fountainhead of RAF knowledge on atomic weapons – from 1953, when the School was set up and the first nuclear bombs were delivered there; and the ECM squadron, No 199, first based at Hemswell and then at Honington, was under No 3 Group’s control. The last entry in this distinguished Group’s ORB, as it disappeared into No 1 Group at the beginning of November 1967, was a neat Latin tag, “*Tertius primus erit*” – “the third shall be the first”.

During the last four months (December 1967 – March 1968 inclusive) of its 31-year-old existence Bomber Command consisted only of No 1 Group; then on 29 April it was disbanded and the following day became No 1 (Bomber) Group of the newly formed Strike Command.<sup>6</sup> At a ceremony at Scampton the last AOC-in-C Bomber Command and first AOC-in-C Strike Command, Air Chief Marshal Sir Wallace Kyle, said that Bomber Command’s achievements under the stress of battle had been due to “a combination of conviction, leadership, invention and courage. Conviction, by men who had made the study of air power their business and insisted that the offensive was necessary to achieve victory. Leadership, exemplified by Marshal of the Royal Air Force Sir Arthur Harris who infused the force with a sense of purpose against all the efforts of the gloomy propounders of cold reason. Invention, by the scientists and engineers working directly with the professional airmen. Courage, by the aircrew without whose response to this conviction, leadership and invention, all would have been futile”.

Sir Wallace went on to draw a parallel from the past for the present and the future. “Let me assure you”, he said, “that the determination which earned for the wartime Command its reputation as one of the finest fighting organisations ever evolved still pervades the stations and squadrons. Whether people agree with it or not, we have had the task over the last ten years or so of providing this country’s main deterrent against major aggression. We have also of course had the continuing responsibility to provide reinforcement for our overseas garrisons at short notice. I hope you will accept that our professional skills, our sense of purpose and our morale are as high as ever and remain second to none in any air force in the world”.

The “main deterrent against major aggression” had been embodied in the V-force since 1955–1956 and sharply articulated in the quick reaction alert posture since early 1962 – a QRA which was to continue

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<sup>1</sup> On 1 December 1967 it reverted to an “active airfield” status: it was going to become an F-111K station, but this procurement was cancelled on 16 January 1968; then No 12 Sqn with Buccaneer S.2s was re-activated there on 1 October 1969. <sup>2</sup> HQ BC Org Memorandum No 4/67, 28 April 1967. <sup>3</sup> Ditto, No 9/67, 1 August 1967. <sup>4</sup> Ditto, No 17/67, 9 October 1967. <sup>5</sup> Subsequently the Strike Command Armament School. <sup>6</sup> “Royal Air Force Bomber and Fighter Commands will stand-down at 2359hr on 29 April 1968 immediately prior to the formation of Royal Air Force Strike Command at 0001hr on 30 April 1968” (Joint Admin Instruction No 1/68 Formation of Strike Command).

until taken over by the Royal Navy's Polaris force in mid-1969: the change in management of the V-force, from Bomber to Strike Command, was administrative rather than operational. The short-notice reinforcement of overseas garrisons also continued temporarily<sup>1</sup> but was to be terminated during 1971 by British withdrawals from the Far East and the Gulf.

The cessation of the Quick Reaction Alert Force was recorded in the ORB of HQ Strike Command, which said that "at midnight on 30 June 1969 the Medium Bomber Force of Strike Command handed-over to the Royal Navy the responsibility for providing the UK permanent peacetime QRA force". It continued:-

"Over the past seven years a proportion of the V-force has been held at a high state of readiness to counter surprise attacks, whilst at all times the remainder of the force has maintained the capability to generate all weapon systems to meet their commitments to NATO. The peacekeeping value of this contribution to NATO and the Western cause has been inestimable; the burden has been a very heavy one and has demanded dedicated service from air and ground crews alike.

"The handover of the QRA responsibility will entail only minor changes in the state of readiness of the V-force, and in all other respects it will continue to function and have the same operational commitments as before.

"The V-force will maintain its unique contribution to the long-range Western deterrent and will continue assigned as part of the NATO deterrent force".

The continued responsibilities of the V-force in the period covered by this history (1945-1970) will be referred to subsequently; but mention should be made here of other statements on the cessation of QRA.

In a Parliamentary written answer on 3 July 1969 the Minister of Defence (Mr Denis Healey) said:-

"Responsibility for the United Kingdom's contribution to NATO's strategic nuclear deterrent was transferred from the Royal Air Force to the Royal Navy on 30 June 1969. Our Polaris force is now able to undertake this task and it is no longer necessary to keep aircraft of the V-bomber force at immediate readiness. Apart from those aircraft which have replaced Canberras in the strike role in support of Cento, the Vulcan aircraft remain assigned to NATO but will now be available for operations in the tactical role. I should like to pay tribute to the way in which officers and men concerned at all levels in the Royal Air Force have discharged their arduous responsibilities for the last twelve years,<sup>2</sup> and to express full confidence in their successors in the Royal Navy".<sup>3</sup>

A tribute to the V-force was paid by the aviation magazine *Flight International*, which in its Parliamentary column for 31 July 1969 said:

"For seven years RAF Bomber Command has provided the British nuclear deterrent force.<sup>4</sup> From the entry of its Vulcans and Victors into service, in 1955 and 1956 respectively,<sup>5</sup> it has consistently improved its techniques both in airborne times and in flight refuelling. From the early 1960s onwards the scrambling times of detachments of four V-bombers had been well under the four minutes' warning of missile attack provided by BMEWS (ballistic missile early warning system).

"Flight refuelling was first perfected with Valiants as tankers, subsequently succeeded by Victors. Following the cancellation of the American Skybolt, the Vulcans and Victors have used the British guided stand-off nuclear weapon Blue Steel.

"On 30 June . . . this nuclear deterrent role was transferred from the Royal Air Force to the Royal Navy; and in the House of Lords last week the Earl of Cork and Orrery asked whether the Government had sent any message of gratitude to the officers and men of the V-force on relinquishing their responsibility. He was told by the Lord Privy Seal, Lord Shackleton, that the Chief of the Air Staff had sent a

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<sup>1</sup> Eg in November 1968 eight Vulcans did a westabout reinforcement exercise to the Far East, and on 19-20 May 1970 Victor-supported Phantoms flew non-stop to Singapore in Exercise 'Bersatu Padu'. <sup>2</sup> *Ie* since the V-force came to full strength, in 1957. <sup>3</sup> Hansard Col 136. <sup>4</sup> This should be 12 years; the QRA had lasted for seven years. <sup>5</sup> The years were 1956 and 1957.

congratulatory signal to Strike Command . . . and that the Secretary of State for Defence had paid a similar tribute 'in another place' on 3 July. The Earl said he was grateful for this answer, which he was certain would meet with approval, and asked if Lord Shackleton would consider giving the message a higher degree of publicity. The latter agreed that there was merit in this suggestion and said he would circulate it in the Official Report, adding: 'I have seen something of the V-bomber crews. They were the most extraordinarily dedicated and efficient body of men, and no praise can be too high for their devotion to duty'.

"The message from the CAS, Air Chief Marshal Sir John Grandy, to HQ Strike Command, put on Parliamentary record, was as follows:-

" 'For AOC-in-C from CAS. As you know, the last White Paper announced that this year the Royal Air Force will transfer to the Royal Navy the responsibility of providing Britain's contribution to the strategic nuclear deterrent. I think it appropriate to remember that this task has meant maintaining, at all times throughout seven years, the highest state of readiness which the Royal Air Force has known in peacetime. The way in which QRA . . . has been performed and the reaction of the force to the operational demands of Saceur . . . has been an unsurpassed demonstration of professional skill, dedication and tenacity.

" 'The long hours of arduous duty in cockpits, crew rooms, dispersal, hangars and operations rooms have brought the reward of knowing that a vital task has been successfully completed. I send my congratulations to you and all under your command who have been connected with this very heavy responsibility over the years.

" 'But when QRA by the medium bomber force ends, it does not presage a general relaxation in our readiness for operations. The future roles of the force will call for the same determination as you have shown in the past and the maintenance of high generation rates. When you set about your new and continuing tasks you can look with justifiable pride upon your past achievements and from them find inspiration for the future' "

The CAS mentioned "continuing tasks"; Strike Command HQ in its ORB reference to the ending of QRA had mentioned "only minor changes in the state of readiness of the V-force", which would "have the same operational commitments as before", would "maintain its unique contribution to the long-range Western deterrent" and "continue assigned as part of the NATO deterrent force".

In his announcement on 3 July the Minister of Defence had mentioned the future role of the Vulcans: apart from those which had replaced Canberras in the strike role in support of Cento, they would "remain assigned to NATO but . . . now be available for operations in the tactical role". As at 30 June 1969 there were six squadrons of B.2s for these tasks, three at Scampton with Blue Steel (Nos 27, 83 and 617) and three free-fall squadrons at Waddington (Nos 44, 50 and 101).

Blue Steel, however, was gradually phased out of service during 1969 and 1970. It had gone from Wittering by the end of 1968 with the disbandment of the two Victor B.2 squadrons there - No 100 on 1 October and No 139 (Jamaica) on 31 December; and the Strike Command Armament School there noted in its ORB that on 17 January 1969 "two Blue Steel missiles were taken over by STCAS, one for training purposes, the other held on behalf of MoD . . .". In that month HQ Strike Command had ordained that the final phase of the run-down of the missile engineering squadron at Wittering should be completed by 31 March.<sup>1</sup>

At Scampton there was a change during 1969-1970 from three squadrons in the Blue Steel role - Nos 27, 83 and 617 - to two in the free-fall/conventional role, Nos 27 and 617, with a new role added - long-range maritime reconnaissance. No 83 Squadron was disbanded on 31 August 1969 and the other two gradually changed to the free-fall role as their crews were given conversion courses at the Strike Command Bombing School at Lindholme and their aircraft were converted from the Blue Steel configuration by Hawker Siddeley Aviation at Bitteswell.

<sup>1</sup> 25 August 1970, in AF/CT3415/65 Pt 1 Blue Steel - Operational Use and Phase Out.

No 27 started its transition sooner: June 1969 was the last month in which it was concerned solely with Blue Steel operations; in July crew detachments to Lindholme for free-fall conversion courses began. At the end of that year the squadron ceased operations as a Blue Steel unit and January 1970 was its first month in a 'solely free-fall role', which the ORB described as "medium bomber equipped with WE177 or 21 x 1,000lb conventional bombs".

No 617 went on being a Blue Steel squadron – the last in the RAF – until the end of 1970; its last training flight carrying one of the missiles was on 21 December, and for that month the ORB recorded: "All squadron crews have now been converted to the free-fall role and as from 31 December 1970 there will be no further Blue Steel training commitment".

HQ Strike Command had informed Scampton during August 1970<sup>1</sup> that the Blue Steel weapon system would cease to be operational by the end of the year and that the missile servicing and storage building (MSSB) was to be cleared of all associated equipment by 31 March 1971, as the building was required by another unit – a deadline which was fulfilled, as recorded in the Scampton ORB: "Missile Engineering Squadron closed down on 31 March and the building was handed-over to DOE for conversion".

So ended a unique and significant era in RAF weaponry – that of the air-launched powered guided nuclear bomb, originally conceived (as described earlier in this study) in the late 1940s/early 1950s.

Modifying Scampton's aircraft from Blue Steel to free-fall roles took longer than training the crews: the station's ORB noted in September 1969 that "Phase 1 of aircraft conversion to the Free Fall Role commenced with the feed-in of aircraft to Hawker Siddeley Aviation Ltd, Bitteswell", and this programme took two years, for the last recorded return was of XL387 in September 1971. During that period 18 aircraft were converted<sup>2</sup> for Nos 27 and 617 Squadrons – which, in their post-QRA roles, operated in much the same way as they had done before except for the new maritime reconnaissance role (already mentioned) and the fact that some of the exercises now had different names. Thus Exercise 'Micky Finn' (no-notice readiness) was called 'High Noon', and detachment to dispersal airfields was 'Candela' instead of 'Kinsman'. On 4 February 1970 conventional bombing training began at Scampton<sup>3</sup> and that month the first conventional-bombing 'Lone Ranger' was flown. In other respects, however, the routine of activity continued in much the same way for the medium-bomber squadrons as it had in the QRA period: readiness was continually being tested, through High Noons and Micks; so was mobility, through 'Goose', 'Western' and 'Lone' Rangers; so was the NATO commitment in exercises like 'Blue Noon', 'Sky Blue' and 'Co-op'.

In a sense, the wheel had come full circle for the RAF medium-bomber V-force during the 25 years covered by this study, for it had originated in 1955 with one type of aircraft (Valiant) capable of delivering a free-fall nuclear weapon (Blue Danube) or conventional bombs: in 1970 it had one type of aircraft (Vulcan B.2) capable of delivering a free-fall lay-down nuclear weapon (WE177) or conventional bombs, the major difference being that low level had replaced high level as the method of attack, and countermeasures capability had improved – though this was relative, of course, to the increasing sophistication of enemy defences.

During those years, Bomber Command had introduced three types of V-bomber into service, including three Marks of the Vulcan and Victor, but there was to be no supersonic successor – the Vulcan would eventually be succeeded in the 1980s by the two-crew Tornado; it had had one entirely new weapon in the Blue Steel air-launched guided bomb, but there was to be no successor to that either – neither Blue Steel Mk 2 nor Skybolt; and it had used warheads developed and tested by the Atomic Weapons Research Establishment and RAE Farnborough in successive and increasingly powerful weapons –

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<sup>1</sup> 25 August 1970, in AF/CT3415/65 Pt 1 Blue Steel – Operational Use and Phase Out. <sup>2</sup> Scampton's ORB for June 1969 noted that "provisional plans have been drawn up for the re-conversion of Blue Steel aircraft to the free-fall role; aircraft with low total airframe hours have been chosen". <sup>3</sup> In October 1969 the ORB recorded: "Aircrew ceased training on the Blue Steel trainer and survey work has commenced to convert the Trainer to the Free Fall role".

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Blue Danube, Red Beard, interim Yellow Sun (the first megaton-range weapon), Yellow Sun Mk 2, Blue Steel and WS177. Although from mid-1969 the Vulcan force was no longer responsible for strategic nuclear deterrence, it provided a powerful part of Saceur's strike armoury and a long-range maritime reconnaissance capability, while the Victors continued their invaluable flight-refuelling and strategic reconnaissance roles.

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Ministry of Defence

**AIR HISTORICAL BRANCH (RAF)**  
**1984**

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