THE PROCEEDINGS
OF THE ROYAL AIR FORCE HISTORICAL SOCIETY

Issue No 7 - February 1990

Committee

The opinions expressed in this publication are those of the authors concerned and are not necessarily those held by the Royal Air Force Historical Society or any member of the committee

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FUTURE PROGRAMME

Monday 5 March 1990 - Annual General Meeting. 1745 hours, Royal Aeronautical Society, 4 Hamilton Place, London. Immediately following the AGM will be a lecture by Dr Philip Towle of the University of Cambridge on 'The RAF and Air Control between the Wars'.

Monday 25 June 1990 - Battle of Britain 50th Anniversary Seminar. This all-day seminar will be held at the RAF Staff College, Bracknell, Berks, by courtesy of the Commandant. It will also be attended by College staff and students, and by a visiting party from the West German Staff College in Hamburg.

The programme is as follows:

0930-1015	Arrival and Coffee
1015	Welcome by the Commandant, Air Vice-Marshal A F C Hunter
1020	Opening remarks by the Chairman, Air Chief Marshal Sir Christopher Foxley-Norris, Chairman of the Battle of Britain Fighter Association
1025-1050	The British Air Defence System: Mr Derek Wood, co-author of *The Narrow Margin*
1055-1110	The Influence of the Battle of France: Mr John Terraine, author of *The Right of the Line*
1115-1145	The German Objectives, Strategy and Commanders: Dr Horst Boog, Senior Historian of the Military History Research Centre, Freiburg
1155-1210	The British Commanders: Dr Vincent Orange, biographer of Sir Keith Park
1215-1230	The Influence of Intelligence: Mr Edward Thomas, author of sections of *British Intelligence in the Second World War*
1235-1300	The Battle Itself: Group Captain Tom Gleave, of the Battle of Britain Fighter Association

1300-1415	Lunch
1415-1545	Discussion Groups. To allow for further consideration of matters raised by the morning speakers, those attending will be divided into some ten groups, each chaired by a serving officer and comprising - as far as numbers will allow - a cross-section of participants
1600-1620	The Legacy of the Battle for the RAF: Air Chief Marshal Sir Michael Knight
1620-1630	Closing remarks: The Chairman
1630	Envoi: Chairman of the RAF Historical Society
	Tea and departure

Since the numbers attending will probably exceed the capacity of the Brooke-Popham Lecture Theatre, the morning's proceedings and the closing addresses will be relayed to an overflow meeting via CCTV; seats in the main hall will be allocated to those members whose applications to attend are received first. Applications should be submitted to the Secretary on the form enclosed with the Proceedings, accompanied by a cheque for £10 to cover the cost of coffee, lunch and tea.

Wednesday 27 June 1990. The Society is hoping to arrange a seminar in conjunction with King's College, London, on Air Marshal 'Maori' Coningham, with Dr Vincent Orange as guest speaker. The seminar will probably be held at King's College in the early evening, and numbers will of necessity be restricted. Members who think they may wish to attend are invited to submit their names to the General Secretary, either by letter, accompanied by an SAE, or personally at the AGM. It is hoped to announce further details at the AGM.

Monday 29 October 1990. Negotiations are continuing with the USAF Historical Foundation with a view to running a seminar on the theme of 'The RAF and the USAF in Europe, 1941-1945'.

EDITOR'S NOTES

Members will be interested to know of the recent publication of *The Berlin Blockade**, written by Ann and John Tusa, both of whom participated so successfully in last June's Berlin Airlift seminar.

The Editorial Sub-Committee has recently become concerned at the number of unsolicited book reviews submitted by members. Whilst we are keen to review suitable works, the Sub-Committee is anxious to ensure that members are not embarking on reviews without prior consultation. Any member who feels that a particular work deserves a review should consult with the Review Editor well in advance, in order to ensure that duplication and nugatory effort are avoided. Please contact:

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Members will be saddened to learn of the death of Mr Paul Wood, who lectured to the Society at the Berlin Airlift seminar. Paul Wood was for many years a leading member of staff at the Air Historical Branch, and maintained his links with the Branch right up until his death.

The Editor apologises for the delay in the production of this issue of *Proceedings;* the influenza strain and the storms which swept Britain over Christmas 1989 and early 1990 has left neither the Editorial Committee nor the printers unaffected.

* Tusa, A & J - The Berlin Blockade - Hodder & Stoughton, £16.95 (hard back); Coronet Books, £4.99 (paperback)

SEMINAR HELD ON MONDAY 23 OCTOBER 1989 AT THE RAF MUSEUM HENODN

THE ORIGINS AND DEVELOPMENT OF THE BRITISH STRATEGIC NUCLEAR DETERRENT FORCES 1945-1960

MRAF Sir Michael Beetham

I welcome you all to this seminar on the origins and development of the British strategic nuclear deterrent forces 1945-1960. Let me give a special welcome to our guests and to those of you from Kings College; for this Royal Air Force Historical Society gathering is unique in that it is a joint venture with Kings College, and this reflects the importance and interest in the subject of nuclear weapons.

Now our aim today is to consider how the British Strategic Force came about and how it is played its part, as a deterrent both politically and militarily. We are talking here about Bomber Command and primarily the V-Bomber Force. Conceived shortly after the war, the V-Bomber Force became operational in the mid-1950s and held a main responsibility for maintaining Britain's nuclear deterrent until, with the cancellation of Skybolt, this role passed to the Royal Navy and the Polaris submarines in the 1960s. We cover the period of the strategy of massive retaliation; often derided in subsequent years, I suggest it was a quite credible and sensible strategy in those days where both the British and American nuclear forces were vulnerable the first strike. But once a second strike capability became feasible, then the strategy of flexible response became a practical proposition. We shall talk about the development of the V-bombers, the development of the British nuclear weapons throughout the kiloton trials in Australia and the megaton trials on Christmas Island, strategic thinking in Whitehall and then, this afternoon, the build-up of the V-bombers to a high pitch of efficiency and readiness.

As you can see from the programme, we have assembled a range of most experienced and knowledgeable speakers, but we also have a great deal of experience and knowledge in the audience. We are thus, during the day, looking forward to some valuable contributions from the floor.

The first speaker is Mr Humphrey Wynn. Humphrey Wynn was a wartime transport pilot, he made his career in journalism and was for a

time assistant editor of *Flight International*. In more recent years, he has worked as a historian in the Air Historical Branch, where he has written in-house histories covering the post-war bomber role and the Royal Air Force's strategic nuclear deterrent forces, and I think no one could be more appropriate to give us the historical background.

Humphrey Wynn

The course of events which led to the creation of the British Strategic Nuclear Deterrent Forces, by which we mean in the context of today's symposium, the RAF Bomber Command V-bombers, the Valiant, Vulcan and Victor – and the nuclear weapons they were designed to deliver, the original kiloton-range Blue Danube and the later megaton-range Yellow Suns and Blue Steel guided bomb end – that course of events began in November 1944.it was then, with war still raging in Europe and the far east that the British Chiefs of Staff asked their Technical Warfare Committee to look ahead and advise them on future weapons and methods of warfare. This committee set up a sub-committee of distinguished scientists, headed by Sir Henry Tizard and asked them to make a report.

Although the Tizard Committee, as it came to be known, was allowed no official access to atomic energy developments, its report in July 1945 foresaw the devastating effects of nuclear weapons, envisaged the development of jet bombers able to cruise at 500 mph at 40,000 feet carrying a bomb load equivalent to that of a Lancaster, and postulated the idea of nuclear deterrence: 'the only answer we can see to the atomic bomb is to be prepared to use it ourselves in retaliation. The knowledge that we were prepared, in the last resort, to do this might well deter an aggressive nation.'

Barely two weeks after the Tizard Committee Report became available to the Chiefs of Staff, the possibility that they have foreseen – the release of atomic energy explosively – became a reality. On 16 July 1945, the Americans exploded the world's first atomic bomb, and on 6 and 9 August single B-29 Superfortresses, each dropped one atomic bomb on a Japanese city, devastating Hiroshima and Nagasaki. What was Britain to do in response to this awesome development which had completely changed the face of warfare? It was to be almost a year and a half before a British decision was made.

The Government, a Labour administration which had been returned

to power in the General election of July 1945, set up a committee of senior ministers on the day after the second American bomb had been dropped, to oversee and decide upon atomic energy policy. Known as GEN 75, this eventually took the crucial decision, in January 1947, to develop atomic bombs: but not before much discussion and deliberation had occurred, creating what I might call an 'atomic climate' among leaders of the Government and of the Civil and Military Services. Prime Minister Clement Attlee told the GEN 75 Committee at the end of August 1945 that a decision on 'policy with regard to the atomic bomb' was imperative. He also became the first British leader to propound the policy of nuclear retaliation, telling his fellow senior ministers: 'the answer to an atomic bomb on London is an atomic bomb on another great city.'

The Chiefs of Staff also reacted. They instructed their Technical Warfare Committee to revise the Tizard Report in the light of the new development, and in October 1945 they expressed their views to the Prime Minister on the international control of atomic energy and, if that should be impossible to achieve, the possession of the means of retaliation. Their views were that, in the event of failure to secure international agreement through the United Nations Organisation, which formerly came into being on 24 October, the possession of atomic weapons would be vital to Britain's security: they considered that their production should start as soon as possible. The Chiefs also accepted the conclusions of the revised Tizard Report, one of which was that, for the next ten years, the only practicable means of delivery of atomic weapons would be by unmanned aircraft. They also propounded the policy of nuclear deterrence, saying: 'The best method of defence against the new weapon is likely to be the deterrent effect that the possession of the means of retaliation would have on the potential aggressor.'

The GEN 75 Committee sought other high-level views from the senior civil servants; and the resultant Report by Officials which was produced at the end of October. Recommended that the government should undertake the production of atomic bombs 'as soon as possible.'

Another powerful body in this decision-making process –.the Advisory Committee on atomic Energy –.recommended in December 1945, that one or two atomic piles should be constructed in the UK for

the production of plutonium. The Chiefs of Staff also urged the Prime Minister, at the beginning of 1946, that at least two piles should be constructed. They said: 'Until the United Nations Organisation is proved, we require … the greatest capacity to make atomic bombs that economic factors and the supply of raw materials will allow.' The GEN 75 Ministers reacted by advising that work should proceed on building the first pile and setting up a research establishment at Harwell.

So by early 1946, the stage had been set for Britain's atomic energy programme, and two of the leading acrors were about to appear upon it. At the end of January 1946, the Prime Minister announced the appointment of Professor J D Cockcroft as Director of the Research Establishment at Harwell, and of Marshal of the RAF Lord Portal, recently ennobled after his arduous wartime years as Chief of the Air Staff and entitled – one would have thought – to an honourable retirement, as Controller of Production of Atomic Energy (CPAE), a cumbersome title which belied the decisive role, he was to play. In May 1946 Portal visited the United States, and although he was given no access to official atomic energy information – the McMahon Act, shortly to become law, effectively denied any such disclosures – he was clearly impressed by what he saw and on his return urged that Britain should 'think big, take chances and translate into reality the priority which the Government have afforded to the atomic energy project.'

Meanwhile, another catalyst towards an atomic bomb decision, the revised Tizard Report, had been completed: it emphasised the small number of atomic bombs needed to achieve decisive results, and the need to proceed with the development of high-performance, long-range aircraft on the highest priority.

In early July 1946, the Chiefs of Staff recommended that the Cabinet Defence Committee should accept that these conclusions as a basis for planning – and on the 22nd. It did so. The way was now clear for the Air Staff to issue the relevant Operational Requirements, and on nine August it put out the first of these – OR1001, for a bomb 'employing the principles of nuclear fission.'

During the latter half of 1946 to more principal actors appeared upon the stage – Dr William Penney, who knew more than anyone else in Britain about the making of the atomic bombs from his

association with the American programme, and as Chief Superintendent of Armament Research worked directly under Portal in the Ministry of Supply; and, then Wing Commander, J S Rowlands, who led the RAF team which worked under Penney to assemble the first British atomic bomb, and who subsequently saw it into service as Blue Danube.

Two final, crucial events occurred towards the end of 1946. First, in mid-November Portal sent a Note to the Prime Minister saying that he considered a decision was required about the development of atomic bombs in the UK – and it is no exaggeration to say that in his new role, with his prestige and his standing with the Chiefs of Staff, he played a crucial part in bringing about the atomic bomb decision. Secondly, in mid-December the Air Staff finalised its Operational Requirement (OR229) for four-jet bomber, able to deliver a 10,000 lb 'special' (i.e. atomic) bomb to a target 1,500 nm distant at a cruising height of up to 50,000 feet and at a speed of 500 kt.

The momentous decision to develop atomic bombs in the UK was taken by the GEN 75 Ministers on the afternoon of 8 January 1947, when they considered Lord Portal's Memorandum; and on the same day – by coincidence – the Ministry of Supply started to send out letters to selected companies in the aircraft industry, inviting them to submit tenders to the Specification B.35/46 for the new bomber – an invitation which resulted in brilliant responses with revolutionary designs, particularly from Avro and Handley Page.

It must be remembered that the years 1947-55, when the atomic bomb and the V-bombers were under development, were times of austerity and economic difficulties at home, and darkening horizons abroad – with the real threat of a Third World War. Winston Churchill said in 1946 that an 'iron curtain' had descended across Europe; and 1947 as Lord Ismay remarked, saw the end of post-war co-operation between Russia and her former allies. In 1948, the Communists took over Czechoslovakia and the Russians closed Berlin to traffic from the West. The countries of Western Europe banded together in the Western Union Treaty – which formed the basis of NATO and the UN United States sent F-80 fighters and B-29 Superfortresses to Europe. In 1949 NATO effectively came into being.

Because of the deepening world crisis in the late 1940s and early 1950s, the massive rearmament programme from 1950 onwards, and

the need to support NATO with an effective bomber force, and because of the very advanced design of the new medium bombers and the problems posed by their development, the Air Staff – through the Ministry of Supply – ordered in 1949, a second type with slightly lower performance requirements, the Vickers Valiant. This could be brought into service more quickly, as an insurance against the possibly delayed appearance of the advanced types, the delta-winged Vulcan and the crescent-winged Victor – spectacularly beautiful aeroplanes, which took almost ten years to come into service, in 1956 and 1957 respectively. The Valiant, which entered Bomber Command early in 1955, spearheaded the V-Force and gave sterling service in many roles – bombing, strategic reconnaissance, air-to-air select refuelling (which it pioneered for RAF jet fighters and bombers) and atomic weapon trials.

During the early 1950s the Air Council drew up comprehensive plans for the deployment and manning of its new medium jet bomber force. There was to be new leadership, at Command, Group and station levels, able to ensure and inspire a Quick Reaction Alert and rapid take offs, as fast as fighters in the Battle of Britain; there would be new aircrew categories with high qualifications of skill and dedication, and new technical trades to cope with the offensive and defensive equipment of the new bombers, some 200 of which were to be based on ten Class 1 airfields with 9,000 ft runways and fully supplied for supporting and recovery facilities; and they were to beat 36 dispersal airfields all over the British Isles, so that the V-Force should never be caught on the ground by a surprise missile attack. This programme represented a massive investment in personnel and material resources.

Britain exploded her first atomic bomb under water in the Monday Bellow Islands in November 1952; and a year later, the first production bombs with this warhead – Blue Danube –.were delivered to RAF Wittering, to the Bomber Command Armament School commanded by Wing Commander Rowlands. The eventual climax of the development effort – the bomb and the V-bomber – occurred on 11 October 1956.when, in the Operation Buffalo trials at Maralinga, South Australia, a live Blue Danube was successfully dropped from a Valiant of No 49 Sqn captained by Sqn Ldr Edward Flavell.

That is the historical background – of necessity in condensed form

– to the creation and deployment of the RAF Strategic Nuclear Deterrent Force, about which you will subsequently hear in more detail from the very distinguished senior officers who themselves played a leading part in it.

Air Marshal Sir John Rowlands

Humphrey Wynn has given the historical background, and many of you have read the excellent books of Margaret Gowing, which deal with the relevant historical economic and political matters up to 1952. It would therefore be pointless of me to dwell again on those aspects. Instead, I propose to talk only about my own first-hand knowledge, experience and responsibilities relating to the development of Britain's first atomic bomb. I have had no access to papers, so am relying on my memory of events that happened 35-40 years ago.

Having read mathematical physics at university I was aware, at the beginning of the war, of the theoretical possibility of an atomic bomb. Even so, Hiroshima came as a considerable surprise, and I avidly read the very four American Smyth Report on the atomic project. The decision to develop a British atomic bomb was taken in 1947, but I didn't know it at the time. Shortly afterwards, however, I was suddenly summoned to be interviewed in London and I had no idea of its purpose. After a long quizzing by senior RAF officers and civilian scientists, I was told by AVM Davies that I had been selected to head a Royal Air Force team to participate in the development of a British atomic bomb. AVM Davies was responsible for weapon development policy, under Lord Portal, the Controller of Atomic Energy.

My brief, given orally, was fairly comprehensive and, to the best of my recollection, was to:

- Understand the science and engineering relating to all aspects of the atomic bomb.
- Provide Service advice and assistance as appropriate.
- Ensure that the weapon could be properly stored, serviced and operated by Service personnel.
- Train RAF personnel, in due course, to staff the RAF Weapons School.
- Advise the Works Department on relevant aspects of the design

of Service storage buildings and the training school.

- Prepare procedures and regulations for storing, servicing and operating the weapon.

The RAF team assembled in HER[1] was small, but hand-picked. Most of us were graduates in mathematics, science or engineering, and all had had practical Service experience. There was also a GD officer to look after operational aspects. Most of the team were placed in various departments of HER. They participated, as appropriate, in several facets of design, development and testing of components, and also in various committees. The total sum of their experience became invaluable when pulling all the threads together and preparing the Service manuals on storage, servicing and operational procedures.

The plan was to develop an implosion bomb on the lines of the American bomb dropped on Nagasaki. We were aware that the bomb would usher in a new era for the RAF because it would increase its striking power by several orders of magnitude. The development of the bomb was exacting technically and, as Margaret Gowing has so well described, HER was working on the proverbial frontiers of knowledge in many areas. Although this was fascinating, it took time and everywhere there was a sense of pressure and urgency to meet set dates.

There were of course problems in many areas, but it is perhaps worth mentioning the radioactive components, not only because they form the heart of a weapon, but also because they were totally new an Royal Air Force. Two extremely poisonous radioactive substances were involved: polonium and plutonium. Plutonium metal – the fissile material – was not available until fairly late in the programme, and it proved to be temperamental in behaviour. For instance, it could contract when heated. Since the metal was so poisonous, it had to be

[1] Originally set up in 1947 as an enclave within the Armament Research Department (later Establishment) at Fort Halstead, the function of the High Explosives Research (HER) division – the relatively benign title being assumed in the interests of security – was tasked with designing the 'physics package' which would eventually lead to a practical warhead. A site at Aldermaston was acquired in 1950 and HER moved there in the following year, becoming the Atomic Weapons Research Establishment in 1952. **Ed**

handled in hot boxes, and the components had to be sealed in wafer-thin cladding. This cladding had to be perfect, because even a pinhole could be disastrous. All in all, it was a headache, and a challenge to engineers and metallurgists. These problems were, in due course, overcome and it remained to test the theory by bringing the fissile components together gradually – hoping they would not go supercritical and that the mathematicians had got their sums right. This was done under the aegis of Mr Moyce of HER. The test was done late at night with only a few people about – an interesting experience.

As the bomb was developed, a full-scale model was gradually built up in a large building, which was in the charge of the RAF element. So far as I can recall, this was the only place where the complete model was assembled and certainly the only place where all the HER components were assembled together with the ballistic case which had been developed by RAE Farnborough. The bomb was fairly big – over a 5 feet in diameter and 12 feet long – hence the name 'Fat Man' used by the Americans. The tail had flip-out fins, which needed to operate over an extreme temperature range. I recall one of the trials in a large, very-low-temperature chamber. It was a wintry day with snow on the ground, but, on emerging from the chamber, it felt like a summer's day. Apart from being big, there had to be provision to load the fissile material during flight. This involved more than a minor modification to the Valiant aircraft, and I remember spending an interesting morning at Vickers with DOR when we broke the news.

In parallel with these developments. The RAF team was deeply involved with Works in specifying and designating sites for weapons storage and handling. Many of the requirements were totally new to the RAF. For example, some of the factors affecting storage of the fissile components included:

- They must be in a thief-proof containers.
- There must be no chance of them being surrounded closely by water.
- They must be proof against an aircraft crash, and any consequent fire.
- Fissile components must be kept at a minimum distance from

each other at all times – to avoid supercriticality.

The missile components were therefore stored in large, strong, cylindrical steel safes sunk into concrete. The safes were waterproof and cadmium-plated. They were housed in separate small buildings which some of you may have seen operational stations.

I must now turn to the bomb trial – codenamed Hurricane – which was to take place in the Monte Bello Islands, off the NW coast of Australia. The task force, commanded by Admiral Torlesse sailed some time before the radioactive components had been finally produced in HER. The weapon was to be exploded just below the water line on HMS *Plym*, a naval frigate, riding at anchor in the Monte Bello lagoon. Other RAF personnel including doctors and technical NCOs, also attended the trials. In order to give confidence to the Service, Dr Penney had asked that the assembly and loading of the fissile material should be done by the RAF. The actual job fell to me, but the late Sqn Ldr Mitchell was also trained in the procedure. We both worked closely with Mr Moyce of HER.

First the radioactive components had to be transported to Monte Bello, and I was left largely to co-ordinate the arrangements. After many and varied discussions, I wrote an operation order to the movement. Only three copies were made: one for the Controller Atomic Energy, one for Dr Penney and the third for me. Security was paramount.

The time factor made air transport is sensual and this was by Hastings and Sunderland aircraft. Each piece of radioactive material was transported it specially-designed containers, which had to be crashproof, waterproof, fireproof and, very importantly would float. Part of the brief in the Operation Order was that, if the aircraft had to ditch, Squadron leader Mitchell, Mr Moyes and I would cling onto these containers – which looked like a very large dustbins – and ignore the sharks! Fortunately that contingency didn't arise. We took out two sets of components – one to act as reserve. I must have signed for these items because, a week or two after returning to the UK with the reserves set, Admiral Brooking of HER said I'd better make a formal written statement that once it had been destroyed in a trial, otherwise the Treasury might pursue me for a million pounds or so.

We moved the material to Lyneham by road and staged through

Malta, Sharjah, Negombo and Singapore. Security was tight everywhere. Apart from the crew there were only three of us aboard the Hastings. In Singapore, we landed at Seletar and, within minutes, we and the components had been transferred to a Sunderland riding at anchor in the Straits. We were airborne, very quickly and flew uneventfully to land on the sea at Monte Bello.

There we had some hectic work at rehearsals but were ready on D-Day some time beforehand, the main task force retired a considerable distance away from Monte Bello, leaving just a few of us aboard HMS *Plym* to await the go-ahead. In the still watches it was a somewhat eerie experience to be in the deserted lagoon, in an almost deserted ship. Shortly, we hope to be vaporised. The assembly went smoothly and we then abandoned HMS *Plym*. The only dangerous part of the operation was the long journey from Monte Bello to the task force in mountainous seas in a small harbour launch. Back on the depot ship – HMS *Campania* – we turned our backs on Monte Bello during the countdown and were all somewhat relieved when the weapon exploded as planned. Shortly afterwards, I flew back with Dr Penney and the spare radioactive components – this time in a Hastings, all the way from the Australian mainland.

Our thoughts then turned to the introduction of the bombs into the RAF and the training of air and ground crews several sites had been explored as a location for the school. In the event it was decided to collocate, the school and the first storage site at RAF Wittering, so that people with first-hand knowledge of the bomb would be responsible for the receipt and storage of the first bombs into service, as well as training. I was appointed the first Commanding Officer of this unit and moved there in 1953. There we had a hectic period, working against the clock, to be ready for the arrival of the first bombs and the first students. We were ready for both, and I well remember travelling to Aldermarston to take delivery of the first bomb. Transport was by No 43 Group. As you would expect, we were deluged with visitors of this unit: the Royal Family, the Prime Minister, members of Service Boards and so on. In fact, everybody who was anybody paid us a visit.

Lots more could be told that but this seems to be an appropriate place to stop – with the first bombs in the RAF and the first Service personnel under training. Perhaps I could add a tailpiece. After two

tours on units, I went back to Aldermarston, this time on the hydrogen bomb. Then I did a tour as the 'atomic' attaché at the British Embassy in Washington, where, amongst other things, I was responsible for matters concerned with the McMahon Act. But these are subjects, no doubt, for a future symposium.

Air Vice-Marshal W E Oulton

You have heard that once it was decided to go for the atomic deterrent, we went by a series of steps, which led up eventually to and other trial – Mosaic – at Monte Bello, planned for the spring of 1956, and then a further trial to be at Maralinga in the central Australian desert in the autumn of 1956. But at the end of 1955 there came a different kind of bombshell – ie a real threat that there would soon be an international agreement not to have any more atmospheric testing, which would leave us out in the cold and no longer in the front rank of world affairs, which was quite intolerable. So the Government decided to press on with the testing of a fusion bomb, many times more powerful than kiloton bombs we have been talking about, before the ban could be applied – and that meant pretty quickly. There were, however, a few snags. Penney hadn't yet invented the weapon, didn't know if it would work in the time, and didn't know what the yield would be if it did. The test would have to be an air burst at some remote place, where a mishap such as an accidental surface burst would not cause loss of life or widespread radioactive damage leading to a world outcry, remembering the row after Bikini. The only aircraft capable of doing the job was the Valiant, which was really not yet in service, and at first sight, it looked as though the aircraft carrying the weapon might be destroyed; and all this meant building a Class 1 airfield and a major supporting base, with extensive scientific facilities is, at some very remote place, in just 12 months. And as yet there was no organisation in being, so, quite simply, I was ordered to set up a task force and operated to meet Penney's requirements, which in brief were to deliver the experimental nuclear device at a given time to position plus or minus 300 yards and no more in any direction, where the explosion was to be minutely recorded by a vast array of instrumentation, both on the ground and in the air, and to collect samples from the cloud deliver these to Aldermarston inside 24 hours.

Christmas Island in the central Pacific, 1,200 miles south of

Hawaii, was chosen as the base and operational site, and Malden, a small rocky pimple about four miles by three, 400 miles to the south east, was the target area and instrumentation site. The whole lot was about 9,000 miles west from the UK, five days by transport aircraft, a month by a fast supply ship. The Navy would surprise sea transport and deliver a sure 100,000 tons of material, equipment and supplies plus an aircraft carrier, the *Warrior*, a control ship, the *Narvik*, and other operational ships. The army would provide a Sapper regiment, plus ancillary units to do all the construction and the RASC to feed us. AWRE would field a large scientific team of civilian, RAF and Army personnel to do the assembly, testing, monitoring, fall-out prediction and other chores of that kind. The RAF would transport the devices and, with Navy support, carry out the tests and get the results home to AWRE.

So, in June 1956, we got to Christmas, a pretty barren kind of place with nothing there other than a derelict WW II airstrip, largely overgrown, and periodically, a very good District Officer and a gang of some migrant Gilbertese workers to gather the copra. The so-called Port London was nothing more than 30 feet of broken down jetty with shallow water alongside, but with very deep water in the anchorage outside the lagoon, where all supply ships had to anchor, and 1,000 tons a day would have to be unloaded and delivered ashore. The Army built from a scratch, a tented and hutted town, with all its infrastructure for 4,000 people, plus a Class 1 airbase to operate seven different types of aircraft and a major scientific facility.

Meanwhile, the RAF formed No 160 Wing at Hornchurch, with the first batch of key personnel and drew on Commands for the Valiant squadron, No 49, to drop the bomb, two Canberra squadrons, No 76 on B.6s for cloud sampling, and No 100 on PR7s for high-level wind finding, photography and a courier service back to the UK; also, later on, No 58 Sqn to back them up. Plus two Shackleton squadrons – Nos 206 and 240 – for weather, sea search and photography, the Hastings transport service with four aircraft constantly available for shuttles to Honolulu and Australia, a Dakota flight, No 1325, for communication with Malden and other islands, helicopters of No 22 Sqn, and an Auster flight for insecticide spraying, plus staging post along the route of course. Naval aviation provided a vital flight of helicopters and four Of ventures in the aircraft carrier stop. It was already and it plays in

just 51 weeks – which I think is a fantastic achievement by all concerned. Meanwhile, there was the problem of how to deliver the bomb. With an unknown yield – maybe 10 megatons, guessed Bill Penney – it was feared that the dropping aircraft's skin temperature might rise enough to unstick the Redux-bonded construction.

So, step one was to paint the Valiant a special brilliant white to reflect the heat is much as possible. Step two was to put the maximum possible distance between aircraft and explosion, firstly by dropping from a maximum height at which the Valiant was a stable bombing platform – which turned out to be 45,000 feet – and secondly, Farnborough devised a so-called escape manoeuvre – a maximum rate turned at Mach .76, 60° of bank, pulling 1.7G for 40 seconds, which then set the aircraft tail-on to the blast overpressure wave with a few more seconds before explosion and this gave about nine miles separation at the moment of burst. The crew would be protected against flash by window screens to exclude all light – only the bomb aimer having a view during the run-up and placing his screen in position immediately after release. To meet the existing requirements of the tests, over 2,000 modifications had to be incorporated in the production aircraft and eight Valiants were prepared to this Grapple standard. All the other types of aircraft had to have extensive modifications as well, both to do their job and to fly the very long routes, much of it through American airspace where the requirements were different. As for the prototype thermonuclear device itself, that would be contained in the only available bomb case of suitable size in proven ballistics, the Blue Danube case to which Sir John Rowlands referred. There was a real problem in that there was absolutely no meteorological organisation in the central Pacific, none at all, so we had to set up a very extensive weather reporting and forecasting organisation.

Eventually, it was already and on 1 February 1957, a few days less than a year after I was given the job, No 160 Wing moved into Christmas, Shackletons began weather flights, soon followed by PR7s at high-level and radio Sonde from ships and shore, plus reports from many Grapple island outstations. Be 'met' team began to build up the necessary background knowledge of the local weather pattern. The first Valiant, Wg Cdr Hubbard, arrived on 12 March, followed quickly by three others, to commence immediately a period of intensive

training and co-operation with the scientists and the naval ships. In due course, the Blue Danube cases, and all their guards arrived by sea and the special components of the first device to be tested arrived in two courier Valiants. So, in the early morning of 13 May 1957, the decision was given to start the 48-hour programme leading to a live drop. It took 48 hours' meticulous activity to be ready for the drop – which was thus to be on 15 May. Hubbard and Valiant 818, the very aircraft, which is today in this Museum, would do the drop with 824 following below and behind to give another crew the experience. Bear in mind that we didn't know we might only get one shot, and we wanted to get as much experience as possible. On D-1, with the final assembly of the bombs completed, the two Valiant were flight tested and 818 was taxied over to the weapon assembly area where, behind security screens, the Short Granite device in its Blue Danube case was loaded into the aircraft. At Malden, all equipment other than the installed instrumentation was buried in pits, and all personnel other than the last minute switching on party were lifted off to *Warrior* or *Narvik*. At midnight – that was H-9 hours – weather flights began again, then the danger area search, a line abreast sweep by four Shackletons at 30-mile spacing right through the area, and then two more to do a more detailed meticulous search around Malden itself, and these last two also later on to do photography and, if necessary, air sea rescue. At 0530 hrs on the morning of the 15th the decision was confirmed and Bill Cook, the Scientific Director, and I left by Dakota for Malden where a Navy 'chopper' was waiting to take us and the three remaining ground crew out to *Narvik*, the control ship, some 20 miles to the north. There, in the control room, we checked that all units were in position. We had three search Shackletons, and one away to the south, with two more Shackletons within a 30-mile radius of Malden. We had a PR7 circling overhead, keeping check on the wind and weather, and the Dakota we had come in – that was outbound to the spectator area, and halfway to Christmas there was a radio relay Canberra so that VHF could be carried from Malden to Christmas. There were two New Zealand frigates on station 30 miles away, ready to follow gradually behind a cloud, keeping radio Sonde checks, because our 'met' flights – PR7s – only went to 54,000 feet, and we needed information up to 100,000 feet, so the radio Sonde was the answer there. *Warrior* of course, I should have mentioned, was dead

on the bomb line; interestingly enough, the Navy had never been asked before to fix their position within 100 yards and so they kept their position by Decca and transit on two tethered balloons on Malden, which worked very well indeed.

On Christmas, all personnel, except those on essential duties, were assembled at designated points ready for rapid evacuation in case of a crash on takeoff. All the Gilbert Tees natives were safely embarked in ships at the anchorage, batteries in the Blue Danube case were hooked up and by 0850 hrs, the two Valiants started engines and taxied to the runway. The danger area was reported all clear, so there was nothing left to do, so I ordered the Valiants to take off; 40 seconds later 818 was airborne and climbing away followed by 824, and then by Canberra. 'Sniff Boss' – this was the codename of Air Commodore Wilson, the sampling controller. Forty minutes later, 818 joined the Malden pattern at 40,000 feet, 824 – 1 mile as stern and 2,000 feet below. Once down the bombing run to check wind and bomb sight settings, around the bottom of the racetrack and then a second run down, opening the bomb doors, switching on the master switch and checking telemetry, both in the aircraft and in *Narvik*. Round again, and that .Charlie, which was around half way up the plot on the right-hand side, northbound, the instruction was given to drop on the next round and, as 818 came down the bombing line, tracked by *Warrior*, we watched the displays in the control room. It was a pretty tense few minutes, I can tell you. The telemeter display showed the bomb doors opening –.a kink in the display –.then the master switch going on, another kink, then the arming switch, another kink, and then came the bomb aimer, Alan Washbrook's voice, on broadcast both on HF and VHF, which was heard throughout the task force both at Christmas and at Malden – 'target marker inside, skipper, steer 202, 202, 1° starboard, 203, 203, steady, steady, steady, NOW' – as Washbrook pressed the bomb switch.

Grandstand 824 immediately went into the escape manoeuvre to get out of the way, 818 held straight and level for another 10-11 seconds as the computer counted off the distance for the overshoot. Bombing screen into position and the crew of 818 were now in a totally enclosed metal box. At just past 10 seconds, the computer triggered the bomb release and the bomb fell away. As the fourth step came up on my telemeter screen, 'bomb gone' was broadcast and

Hubbard and rolled into the escape manoeuvre. 53 seconds to go to explosion. All instrumentation on Malden was now switched on by telemetry from *Narvik*. Rearward-facing cameras in 818 were also switched on. All spectators on ships sat on deck with their backs to the bang, eyes shut and covered with their hands. Crews in aircraft looked away from Ground Zero; pilots shut one eye – we didn't know what the dazzle effect was going to be. The AWRE expert by my side in *Narvik* called off the seconds to go – 30 seconds, 20 seconds, 10 seconds, then Hubbard's voice from 818 'Rolling out on070', 5 seconds, 4, 3, 2, 1 and the telemeter display went blank. Then the count up – 5 seconds, 10, 15. 'You may turn and look now,' said Bomford and everyone who could did so to gape at the awesome sight. Some minutes later, the three Canberra B6s arrived from Christmas, and as soon as 'Sniff Boss' judged the cloud to be cool enough – remember it starts at some millions of degrees – at about H+35 minutes, Wg Cdr Bates in 'Sniff One', passed through the cloud without trouble at 54,000 feet and then 'Sniff Two' at a lower level, both collecting samples of gas and debris. They returned rapidly to Christmas where crews and aircraft were thoroughly decontaminated, while the cloud samples were extracted Are packed into heavy lead pots and loaded into a special carrier in the bomb bay of a waiting PR7. This, accompanied by a standby Canberra, immediately took off for Honolulu, and, refuelling and slipping crews at the staging posts, on to the UK, where the samples were delivered in only a few minutes over the 24 hours.

Back at Malden, *Narvik* was saving back towards her boring, A. 'chopper' from *Warrior*, picked up the scientific re-entry team from *Narvik* and, after checking the radiation level, delivered them to the instrumentation site, at about H+1 hour. Records were collected, flown to *Narvik*, copied, collated, flown over to *Warrior*, loaded into a waiting Avenger, and so back to Christmas and into a waiting Hastings shuttle to Honolulu, and thence by civil air back to the UK. So that was the first test. Two more followed exactly the same pattern on 31 May and 19 June; all very successful, we thought, and the whole job having been achieved as directed with the greatest economy, the whole task force – both personnel and material – was now absolutely exhausted. So this was the moment to tell us that a WRE hadn't got it quite right and would we please do it all over again

as quickly as possible – that is to say, within three months. There was no question of doing that at Malden in such a short time, but with the experience now gained, we reckoned we could do it safely at the south east tip of Christmas itself, about 30 miles from the main camp and base. So there began an immense logistics exercise to replenish and set up a task force for another test – 'Grapple X'.

Warrior, *Narvik* and the New Zealand ships went home, but most other personnel were replaced. Valiants and Shackletons returned to the UK for major servicing and continuation training, Canberras and Dakotas to Australia to support Operation Antler – three more kiloton tests at Maralinga. The instrumentation set-up was moved from Malden to the south east point of Christmas and a forward control bunker to replace *Narvik* was built midway between the camp and the target area, and by the end of October everything was back in place again, including the operational aircraft. Intense rehearsals and check runs – and I mean intense – quickly brought the force back to operational readiness. Bad weather defeated us for a few days, the weather factor wasn't nearly as good a Christmas as at Malden, but on 8 November there was a fleeting opportunity to fire, which was nearly missed because of a stray ship in the area.

After some considerable drama, we were able to do the drop following a pattern very similar to that of Maldon. The bombing run then came over the north eastern tip of Christmas, over the south east corner, in the same race track pattern which was now pretty well routine. Around the sea, it was very satisfactory to AWRE, the cloud samples got back to the UK in good time with no problems so no further drop was needed at that time and the task force dispersed, leaving a care and maintenance party on Christmas. As the Test Ban Treaty had still not happened, the Government decided to continue with further tests in the following year, but it was time for a change of management. I handed over to John Grandy and a new team took over the now almost routine running of the tests. In April 1958 'Grapple Y' was successful with another megaton test carried out visually as before, but there were also some very interesting experiments in blind bombing under radar control. Again, in September 1958, 'Grapple Z.' carried out two further megaton airdrops, and also two kiloton shots suspended under tethered balloons, and that was the end of the Grapple trials.

Sir Frank Cooper

I can actually see a number of people around this room who are infinitely better qualified than I am to give this talk so I regard myself as the 'fall guy' in this context. What I'd like to do to start with is, very briefly, remind you that the deterrent and the building up of Bomber Command was but one thing in an amazing number of things that were happening throughout the period we are discussing. If you just think for a moment, there was the end of the war, a tremendous run-down – Bomber Command itself was reduced from a figure of about 1,700 aircraft to 150 aircraft, very, very rapidly – there was the whole of the Berlin Airlift, then there were a mass of colonial and other wars, incidents of one kind and another, plus the setting up of CENTO and SEATO, together with Suez, Iraq, Jordan, etc, etc. It was an extraordinarily active time in our history – I think not only in the context we are talking about today, but generally, and it is worth remembering, I think, that in the middle of the period, we had a very large Air Staff. We had 120 officers above the rank of squadron leader – which was quite a lot in those days – and, above all, we had a very cohesive Air Ministry where the Air Council was a real body, where the standing committee was very effective, and from Korea onwards, we had an equipment and re-expansion committee, which the Vice-Chief of the Air Staff and presided over and which drove things forward. These were real, live things in the context that the Air Council and its standing committee used to meet at least once a week, and were very much a focal point through which so much policy and decision-making took place. But, above all, I think we had – which has been illustrated by what has already been said earlier today – people of vast experience, people who really knew what they were talking about right the way down the line, but particularly at the top; I think we had quite outstanding leadership from the Chief of the Air Staff, Commanders-in-Chief, and their senior colleagues, who really did command confidence because they had acquired the right to that confidence throughout WW II.

I think the other point that one ought to mention right at the start is the extremely close relationship despite the McMahon Act, between the RAF and USAF; because everybody knew each other through travelling throughout the war together in many different theatres of

activities and this too made an extraordinary difference. Furthermore, we had a scientific community of outstanding merit which had also been forged in the same battleground and, of course, British science in those days was a very powerful force in world science as a whole. I am picking my words very carefully because I shall get into trouble from Margret Gowing, if I don't. But these things were, I think, of the highest importance. Now, we have heard about the decisions to develop the bomb, but what I would like to talk about, first of all, is deterrence theory. As Humphrey Wynn said, Clement Attlee has some claim to say that he was the inventor of deterrence, although he did not, in fact, use the word at all. What he talked about was that bomb must be answered by bomb: retaliation. It was quite early after that, I think, that the Chiefs of Staff had taken very clearly on board the need to be able to retaliate, and recognised the possibility of mutual destruction. It is interesting that the Soviet Union did not come to that position until some years later, and I remember reading some years later an interview that the then British Ambassador had with Marshal Zhukov, who said something like, 'As has been my duty, I have been reading about the terrible effects of a nuclear explosions and how it's going to change the whole of warfare.' So, in fact, we were quite early off the ground in the context of looking at the idea of deterrence and, indeed, in 1946, there are references to the deterrent effect that the possession of the means of retaliation would have on a potential aggressor.

What is also very interesting about the 1945, 1946, 1947 period, which is the period of real gestation, is the very large unanimity of view between the politicians who, again, had got a great deal of experience of WW2, the Chiefs of Staff of the three Services, all of whom believed that we had to go forward to the nuclear world, and the scientists, who were, of course, very eager to see what could be done with the enquiring minds that they all possessed. The new policies owed an enormous amount to Lord Portal and Lord Penney, two of the most extraordinary men I think I have ever been privileged to meet, with that blinding ability to simplify things which were difficult in one short sentence, and make you feel how stupid you were that you hadn't thought of it for yourself. But Lord Tedder, and, particularly Sir John Slessor had very strong views themselves on the need to establish the theory of a deterrent and, indeed, the practicality

of it. But this was so from 1947 and throughout the seven-year period which those two outstanding airmen were Chiefs of the Air Staff.

The crucial issue was argued by Lord Tedder who said, 'We have got to have a bomber strike force, and we have got to have that established in the policy of the Chiefs of Staff' and, of course, if you look at the document that the Chiefs of Staff produced in 1947 on future defence policy, they referred then to the supreme object of British defence being to prevent war provided that could be done without prejudice to our vital interests. The RAF and the Air Staff subscribed 100% to the first part of the sentence; the second part of the sentence was really very much a product of the Navy and the Army and was, in fact, to cause arguments over the next 15 or more years about the amount of effort to be expended. That document by the Chiefs was also set very much in the context of the Commonwealth, the three pillars being the UK base, sea communications and the Middle East, and even though we were on the point of leaving India, there was a cry saying '…well, couldn't we keep the Indian base in some way or another?' But, it was a major platform in the sense that the two priority tasks on a long list of tasks were, first, research and development and, secondly, the ability to strike through, and provide a strong deterrent through, development of air offensive forces which had got to be given high priority.

Moving on through 1952 to the Global Strategy paper, which was very much the brainchild of Sir John Slessor. There was a right old punch-up between the Chiefs down at the Royal Naval College in Greenwich, but John Slessor largely won the day as he could write much more quickly and more effectively than his two fellows in those days, and he wrote most of it, if I remember rightly, on a Sunday at somewhere not too far from his home. But, again, the interest in, this was that there was still this pervasive belief that if you had a small number of nuclear weapons which you could guarantee the delivery. You would not merely not have a war but also you needed very much smaller naval and air forces, and he believed in that passionately. There were arguments then produced by the Navy, particularly about the theory that there would be a long period of broken-backed warfare, and the Army tended to subscribe to that view. So in a sense you could date from about 1952 the fact that the Air Staff was actually fighting for the deterrent very largely by itself but with heavy political

support. And, indeed, heavy economic support because it was proven to be much cheaper than spending money on conventional forces. But from then on, as I said a few moments ago, there was really Parliamentary disagreement with the Navy and Army as to how much should be spent. And, of course, the Air Staff's position was further established and, if one looks for example, at 1954, there were clear statements about the primary deterrent being the atomic bomb, and how the intention was to build up our force of nuclear bombers in the RAF, thus placing a greater emphasis in future on the RAF.

But then, of course, a little later in the decade, we had Mr Sandys, who made a lot of trouble for everyone, but was there basically to try and get the defence budget, as it had then become known, under some degree of economic control. He really went very much down the road of saying, 'What we need is deterrence and missiles'. While recognising that the US was a major strike force, he went very clearly on the record saying that Britain must possess an appreciable element of nuclear deterrent power of her own. And that the V-bombers were to be supplemented, in due course by ballistic rockets. At the same time, Bomber Command also began to receive the Thor missiles. There is also a clear reference to his saying that, apart from developing and delivering thermonuclear warheads, British nuclear warheads would also be developed for ballistic guided missiles.

So, we have got really are some very clear markers and one could go on in the same vein. I was looking at Field Marshal Lord Carver's very recent book, when he was saying, in 1958, how difficult it was to be a member of the Joint Planning Staff, because it was impossible to agree a position on the future of the strategic deterrent. The issue then was how long would the V-Force be able to penetrate Soviet defences, even though at that time, they were not fully in service. The RAF wished, through the Air Staff, to improve the V-Force and also to develop Blue Streak, but the Army did not believe in the need for an independent strategic force and the Navy resisted the RAF's plans to develop missiles as well as bombers. In essence, he writes, the RAF took the view that too much effort on conventional forces implied lack of confidence in nuclear deterrence and were against Naval broken-backed warfare. The Army disagreed with both the Navy and the air force and, at the time, quite uniquely, I think, the individual members of the JPS had to submit to the Chiefs separate papers of their own.

So we had this developing argument throughout the ‘50s, which, I think, showed up very much in a fight over resources. That fight was, I think, well carried by the Air Staff, but they were fortunate in the sense that things were running their way – nobody had any better ideas, the writing was on the wall as far as the removal from the British Empire was concerned; you could prove that the force which we were well down the road with was increasingly cost-effective in terms of what it could deliver. Though we had to take in our stride some major changes and particularly the whole question of dispersal and readiness where we moved from ten Class 1 airfields to ten plus forty-five dispersed airfields, which seemed an abominable sum of money at the time, it still proved to be a remarkably cost-effective policy.

It was also a very straightforward policy, in that we were going to build up the V-Force and were going to have as many aircraft as we could possibly get with a maximum of 240. The Air Staff stayed on figure of 240 V-bombers for a very considerable period of time. They then came down to 200, and eventually ended up, with 180 –.or was it 184? –.but that really was, in those days, a very good target to hit. My own view is that the Air Staff themselves came to be much happier about 180 because the priority given to the V-Force meant that other parts of the air force had to suffer. Of course, we had also problems with the Navy about its continued use of Coastal Command and REF ownership, and we had arguments with the Army about their transport, so we had to purchase some Britannias to keep them quiet. But the Air Staff was remarkably cohesive, remarkably coherent and remarkably consistent in the sense that it said that we were going to build up the V-Force and that was what its policy was, apart from the other things it had to deal with en route. Of course, there was a price to pay: Fighter Command – even in 1957 – had over 700 aircraft, and 2nd TAF, as I think it was in those days, had over 350 combat aircraft, and those progressively diminished over a period of time.

So, was the policy successful, in the sense that it achieved what it set out to do? It was very skilfully managed. The V-Force was given priority, but not formally, in a marvellously Carthusian device, which I think the Air Council adopted, that there should be priority but it shouldn’t actually be regarded as priority. If I am asked what was one of the greatest achievements, I think it was the ability to bring

together, despite continued delays, the aircraft, the ancillary equipment, the ground equipment, personnel, materiel, works, training and every other kind of task that was needed to bring together an effective striking force. That was the situation from 1954-55 onwards until the peak of the operational effectiveness of the V-Force in the early 1960s.

From the Floor.

Sir Arthur Hockaday. Quite rightly, we have been centring on deterrence. The question I'd like to take further is – what were we deterring? You've got to keep these things simple. There is a quote from McGeorge Bundy, President Kennedy's national security adviser, in an article in *Foreign Affairs* in 1968 where he says that most of the theorising and academic think-tanks.and what-not had very little contact with reality, and that any action by a real-life political leader that brought so much as one hydrogen bomb on his people would be a political disaster. Keeping it comparatively simple, the quotation that we heard from Clem Attlee was absolutely on the ball that the best reply to a bomb on London was a bomb on somewhere else. But, given that a great part of the exercise was the deterrence of a nuclear attack against the United Kingdom, and that that had to be a prime objective, were we really thinking very much beyond that. And, if we were, should we have been? Once one gets into the wider questions of what you would do in the event of a conventional attack in Europe, or how you would deter a conventional attack in Europe, the relevance of the British strategic deterrent to this, I think, comes considerably in question, because most studies have suggested that the nuclear weapons, in the event of a major conflict on the continent, would more or less cancel out: you would be very little better off at the end of the day that you were at the beginning. Which comes round to a point that Frank was telling us about, and historically he was correct – the pull that there has always been for resources between the nuclear and conventional. The trouble was that we needed both because the conventional, I think, had to be the primary deterrent to the possibility of major conventional attack and only if the conventional deterrent was inadequate would the nuclear deterrent become relevant. Unfortunately, however, resources were not unlimited, therefore, there had to be the conflict that Frank has

described and the argument as to how British resources would best be deployed has gone on ever since. I had better stop at this point because I worked for Mike Carver for five years, and his view would probably not get a very wide response within this hall.

Air Mshl Sir Frederick Sowery. Would Arthur Hockaday not envisage that in the general public's eyes and minds. The tripwire of John Foster Dulles had extended through to this period? It appeared that, to many people, at that particular stage, a conventional attack would be met by a nuclear response. And that was, in fact, what was holding back, in the public's mind anyway, one of the major threats which existed in Western Europe at that time – the very considerable Soviet conventional superiority.

Sir Michael Beetham. That was a point that I made in my opening remarks relating to massive retaliation. When the Force was vulnerable on the ground, massive retaliation was a very credible, in fact the only, strategy, but once you had a second strike capability, you would ask the question: if the Russians came over the frontier, are you really going to blow everything up, because once you start, what have you really achieved? So, then there was the build-up of conventional forces, and we moved into the strategy of flexible response. Flexible response wasn't really a credible strategy in the early days when you had a force that was vulnerable to being knocked out on the ground and you couldn't afford to have it knocked out. That's the problem. Of course, the conventional forces were cut down. Remember, it wasn't only the Army and Navy that were cut back, the rest of the Royal Air Force was cut back as well. Indeed, we are now trying to rebuild what was Fighter Command, and we still have only about 100 fighters to defend this country. If we hadn't had our strategy, we would have probably had many more as it happens – it's always a matter of resources, as Sir Frank was saying.

Gp Capt Ken Batchelor. Sir Frank Cooper mentioned the close co-ordination between the United States Air Force and the Royal Air Force. In early 1956, whilst serving in the Pentagon, I went with Air Marshal Selway as observer to the American tests in Eniwetok and Bikini. I hope, from what we studied and learnt, it was of some help to us when we launched Grapple. The whole purpose of the exercise was

to examine the navigational procedures and cloud penetration and cloud sampling. We saw from the air, before dawn, wearing goggles which only enabled us to see the cabin lights as pinpoints, something like an eight or nine megaton device fired from a pylon in Bikini; it really was, before dawn, an awe-inspiring sight, which I shall always remember. A great hemispherical golden sun burst out and lit the sky up like daylight, which rapidly changed to a vertical vast column, iridescent pink, rather like the carbon monoxide flame you get round a fire, that went up to the stratosphere and because the conventional mushroom; then everything died and all colour went. It really was quite incredible. The second device was on the other side of the Eniwetok Atoll, I think it was just over 20 miles away. We wore goggles again and turned our backs of the explosion – again, on a pylon – and I then turned round and I think I can remember feeling the heat, but I am not sure. We flew over a dark patch on the sea near Bikini, which was where the whole was, where the small island had in the previous year been sent up into the heavens and, caused Strontium 90, fallout all over the Pacific. As a result, the Americans then decided, they would go for clean devices. I think we learned quite a lot, which may have been useful.

Sir Frank Cooper. Could I just say, another couple of words about relations with the Americans because they were cut off quite soon after the end of WW II, and the Quebec Agreement and the Hyde Park Agreement were largely disowned. They began, I think, to improve with the arrangements for the USAF to use airfields in this country post the Berlin Airlift, but the ability to get back to nuclear co-operation with the Americans eluded us for quite some time. After the 1952 Chiefs of Staff meeting, to which I referred when I was speaking, Sir John Slessor went over and really got very much a ‘cold shoulder’ from the Truman administration. But he did rather better when Eisenhower came to power, and the Americans throughout the period said - look, we will do business with you, we will really co-operate with you, will go very much more to some kind of joint planning and some joint targeting, but only when you have delivered the goods. This was absolutely fundamental, and what has just been said is proof of what actually happened because around 1955, when we had two or three Valiants in service, the Americans said, ‘well yes,

we'll start talking to you again.' I think the agreement for Air Vice-Marshal Selway, and you to go and visit them was part of that process and led on eventually, to the repeal of the McMahon Act in 1958. Throughout this there was a close friendship, but a very strong ban on the passage of information and one of the important thing is that we ought to remember is that we did it ourselves, very largely, with some help from our friends. I wonder what might have happened after the 1962 Skybolt debacle, if we had gone on doing it by ourselves.

AVM W E Oulton. Nobody else has said it, so I'll be brave and saved. There was no question of repealing the McMahon Act until the Americans saw that we were going to succeed with Grapple. Without the repeal of that Act, there would have been no close relationship. Without the close relationship there would have been no moderating British influence on the American side of the superpower confrontations. Without that moderating influence, Gorbachev and *Perestroika* might never have happened. I think that Grapple perhaps was a turning point in political history.

Gp Capt Ken Batchelor. Could I just make a comment on what Frank Cooper has just said. I went to America for a NATO Standing Group meeting in 1954 in the aftermath of McCarthy-ism, when all the Americans were looking over their shoulders, and I wondered what the difference was between Washington and the Kremlin. We had over hundred RAF officers on exchange posts – I was in MOD so I was quite safe – and they were all gently railroaded out of operational jobs and put into training and so on. The result was, even when we went to Eniwetok, we got very little of any sort of paper. But what we got on the 'old boy' net was something quite different.

Lorna Arnold. I would like to point out, in connection with these very interesting remarks about the turning point of Grapple and the immense influence of the successful British tests on world history that, in fact, none of this would have been possible without one very small group of people. We have heard almost nothing about the fairly small number of people operating in very great difficulties who produced the fissile material and the whole of this was totally dependent on two very overworked, overstrained reactors at Windscale, which produced all the material that was needed and

which operated practically on a knife edge from 1952 to 1957, in order to do it. We shouldn't forget that this was a very serious bottleneck, and that it was the bottom line in the whole of this history.

Margaret Gowing. I see that the title of today's seminar is 1945 to 1960, but I don't think some of the issues which have been discussed this morning can possibly be understood without the wartime story. I would remind people who perhaps aren't familiar with all the detail that the basic theory of fission was published for all the world to read on the day that Poland was invaded. So everybody was at exactly the same starting point – the Germans included – and it was two scientists, two refugee scientist at Birmingham University in England, who were the first to see how and why an atomic bomb was possible with Uranium 235. Then there was the French contribution – nobody has mentioned the French so far. We have talked about the Americans; we have talked about the Russians a bit, but nobody has mentioned the French, to whom I think we behaved very badly in the post-war years. It was two of their scientists, who had been in the laboratory of Joliot-Curie, who had been the first to discover that a chain reaction was possible and therefore these two scientists were the leaders of the Plutonium effort in this country. When they came over, the new all about Plutonium reactor is and the contribution of the two German scientists at Birmingham and the French scientists who were at Cambridge led to the British Maud Report, which was one of the most extraordinary reports that this, or any other country, has ever seen. At that report showed, in 1941, how and why an atomic bomb was possible. This was before America came into the war, and it was only when the Maud Report was handed to the American scientists who were interested in the whole thing, but hadn't put two and two together and made four – it was only when they read the Maud Report that they saw very clearly that an atomic bomb was possible. The rest of the war was a sad story of, first of all, in collaboration with the Americans, and then, once the Americans had set up the Manhattan Project, the British behaved rather foolishly in not getting in on the ground floor. When they were given the opportunity – they turned it down. Then when the Americans got going. They didn't want the British and told us to keep out. It was only after great effort in 1944, with Churchill and Roosevelt, that in fact, the British got back into the

Manhattan Project, and they felt because of the agreements between Roosevelt and Churchill that collaboration would continue after the war. In the event, thanks to the McMahon Act, all this was totally cut off. So the British had absolutely no option but to develop their own project. I think the restoration of Anglo-American co-operation in 1958, and indeed the whole British project, cannot be understood without this very complicated earlier history.

Humphrey Wynn. Could I just underline the point that Britain was the only nuclear country to explode its first megaton weapon from an aircraft and the Royal Air Force was the air force which carried out the operation. All the other countries exploded theirs on the ground.

Cecil James. Clement Attlee was a very laconic sort of chap and his 'bomb must be answered by bomb' is very much in his style. Winston was a man of rather more words, and rather more elegant words, but I think it is worth reminding ourselves of them – 'It may well be that we shall, by a process of sublime irony, have reached the stage in this story where safety will be the sturdy child of terror and survival the twin brother of annihilation'. I wish I could write like that. But the thoughts arising from a seminar like this simply crowd in on one, and we won't have time to cover every aspect of what flows from this subject. What I find quite extraordinary are the contrasts. Looking just at the British side, there is a steady progression from the basis in 1945 and 1946 to the production of the right material, to the production of a weapon, to the production of the weapon carriers, which went through relatively smoothly until about 1956-57, with all the weapon trials confirming this progress. From then onwards the rat seems to get at the whole thing; we began to have doubts about the deterrent, we find ourselves – when I say we, I mean the Air Ministry and the Royal Air Force – being sniped at by people who say we are taking far too big a slice of the defence cake. We began to have doubts about the criteria which should govern the size of the force and, at the same time as we ourselves begin to sell ourselves short on the deterrent, the deterrent in other respects begins to get out of hand. Jack Slessor must surely have been right when he spoke of the adequacy of deterrence by a small number of bombs, but in fact, from the middle '50s onwards, we are swamping ourselves – and the Russians equally – with far, far more weapons, both for tactical and strategic purposes, than make any sense

at all. We find ourselves only now, perhaps forty years on, beginning to make sense of the size of the mutual deterrents which will be satisfactory, as it were, to both sides of the fence.

Sir Michael Beetham.

For our afternoon session, we are going out into the sharp end – Bomber Command, both to the Headquarters and to station level. Our first speaker, who is going to talk about the development and deployment of the V-bomber force as a deterrent is Air Chief Marshal Sir Kenneth Cross. Sir Kenneth actually started his wartime career in the fight world when he was, of course, OC 46 Sqn up in Norway when operating the Hurricanes – he took them on board *Glorious* and was one of the Royal Air Force's two survivors when she was torpedoed. This was lucky for all of us in Bomber Command because he came into the bomber world in 1955, first as AOC 3 Group and subsequently as CinC Bomber Command from 1959 to 1963. So he was at the centre of affairs for this very crucial period when Bomber Command had the main responsibility for the strategic deterrent.

Air Chief Marshal Sir Kenneth Cross

I came to No 3 Group in January 1956 from the Air Ministry where I had been Director of Operations, Air Defence, for four long years and I can confirm what Frank said this morning about the priority which was given to the V-Force. Nothing was written down, but Air Defence, Coastal, Transport and Overseas Operations had no doubt where the priority was. We sometimes wondered whether it was worthwhile. I remember it very well when the deterrent philosophy was first expounded in the Air Ministry and how we working classes said, 'If this thing is not going to fight, we don't need to bother much about it. The test of any military force is its success in war; if this 'thing' isn't ever going to fight, what is all this priority for?' However, this was not accepted by the Director of Bomber Operations, or by anyone else in the Air Staff. I'd had some experience of commanding groups in the Mediterranean before I went to No 3 Group, but they were all tactical or coastal groups, and I had never dropped a bomb in practice or in anger. So I thought I should tell my immediate superiors when I got the posting notice that this was the fact, in case some big mistake had been made, but I got absolutely no response, and in due

course, I went to No 3 Group.

At that time and there were two groups in Bomber Command: No 3 Group with it Headquarters at Mildenhall, which had Canberras at that time and was going to have the Valiants (which had just started arriving), and Victors; and No 1 Group up at Bawtry, which was going to have the Vulcans. I will be speaking mostly from my experience as a Group Commander, because by the time four years later, I went as CinC Bomber Command, the deployment as a deterrent was a *fait accompli* and we had other tasks and problems when I got there.

It was, of course, the Valiants that were the main force to start with. Once they started coming and when I arrived in 1956, I think there will already sum at Gaydon in the OCU, and some at Wittering, they came really very fast – Honington, Marham, Wittering and Gaydon – and they were the force we started with. We were all slightly doubtful whether our old friend 'HP' could produce his Victors on time, and we weren't disappointed in that. So my task, or our task in No 3 Group, was to make the force as it existed at that time – an operational reality – first of all in its nuclear role, and secondly in its conventional bombing role. It was an education to me to see the thought which had been put into this force, which unable us to train and project it as an operational reality in a relatively short time.

The aeroplanes when they arrived, of course, were short of a great deal of the essential equipment; they had no navigational bombing system for one thing. It always seemed to strike us that everyone was greatly in favour of this policy, except perhaps the people in the Treasury, who were paying for it, because all the bits and pieces which we regarded as essential did not arrive until much later. The reality of the role was brought home to us by the test, which we have heard about this morning, which was done by the Valiants from Wittering. There was a feeling throughout the Command that this was very real and I had no difficulty as a Commander in putting across that this role was important, the most important role. Everybody, from the cooks and butchers upwards, was behind this force.

I was given something that I had never been given before or since, and that was the power to 'vet' all the air crew who went into the Valiant V-bomber Course, and I suppose that I must have seen some hundreds of aircrew in the process and, remarkable as it was, I hardly turned down one in the whole lot. They of course had all been selected

by people who knew and they were first-class people and none of them ever had any doubts about what they were about to do.

Of course in October 1956, I think I am right in saying, that the first Blue Danube, which was going to be our first weapon, was dropped and that set us going again. Now it came as soon as we have made this force of hard training into an operational force the next path we had was to demonstrate it as a deterrent and in this case of course there was already somebody in the field – Strategic Air Command – and we thought, quite rightly, it would be a good idea if we went to see Strategic Air Command to see if there was anything we could learn from them. We know that the Americans always do things differently from us, to attain the same aim, but nevertheless we thought it would be a good idea if we went to see them. And so I went off with my CinC Air Marshal Broadhurst, to Offutt, the Headquarters of Strategic Air Command; we were received with great kindness there, we had high balls every night, and we did no business whatsoever. This was before the Grapple test and it was before another significant event, our first participation in the strategic bombing competition. We had pleasantness and kindliness to all, but we did absolutely nothing and I can confirm what was said this morning. The Americans deal with everything strictly on a business basis and if you could contribute, then they are in it and they are with you; if you can't, then you will get all the kindness but you won't get any work done.

The first bombing competition in 1956, we did not participate in; we sent an observer, Len Trent, I think. At that time, General LeMay was Commander of Strategic Air Command, and he took a great interest in the Valiant, which they had taken over there. Next year at Pinecastle, down in Florida, we had been invited again and we decided to participate fully, sending a team of four Valiants and four Vulcans to participate.

I have to explain to you that the American navigation and bombing system is in a way superior to ours in that it has certain facilities, which could possibly lead to better accuracy than our navigation and bombing system, but our bombing system is completely adequate for our operational role, and with the training and the perseverance of crews there really wasn't much in it in our results. It was the first time we had participated. The Valiants finished halfway up the league, but

regrettably the Vulcans were bottom and we in 3 Group said that of course they hadn't done their homework. It was whilst I was there that the first Sputnik appeared and I was standing on the tarmac at Pinecastle when the news came through; it had really a remarkable effect on the whole of the American Air Force personnel – it was unbelievable that anybody could have passed them in this business.

That final step in making the force fully operational as a deterrent was of course the readiness one. Now we had all the squadrons on the bases; the dispersal bases for four aircraft each were ready and the only thing we hadn't got was the manpower necessary to keep the squadrons at readiness on the home bases or at dispersal bases if it was required. Perhaps Harry Broadhurst's greatest contribution to the V-bomber force was the way he badgered this through Whitehall to get the extra establishments so we could maintain this readiness.

Once this had happened, we got down to a small point. The Fylingdales 'thing' was in the offing; we understood we were going to get four minutes warning of attack, so it was essential to act off the ground in less than four minutes if the force was to be relevant as a deterrent. Well, we started doing trials at Wyton, funnily enough, with our four Valiants and despite all the practice and all the keenness of the chaps to do it, the best we ever achieved was between seven and nine minutes off the ground. The trouble was, of course, the time it took to start the four engines in rotation. So, as the AOC, I said to my engineers, 'Can't we start these four engines together?', and they said, 'It is not possible; the amount of juice they take would be the same amount as a small town to start those four engines together.' Then some flight lieutenant at Wyton came along and maybe there is somebody in the audience here today who will explain how he did it. It was a remarkable thing; with a series of relays of one millionth of a second or some such delay, you pressed the button on the ordinary start a trolley and you could start all engines together. From that moment onwards, of course, two and a half minutes became easily achievable and was achieved from then on. This was a great relief to the then Vice Chief of Air Staff, Air Marshal Hudleston, who was being told by his naval opposite number, that of course the V-Force was now a dead duck, and we didn't need to spend any more money on it.

So we then had in reality a deterrent and the next thing to do was to

put across. How were we going to do that? We could get a good yardstick from what Strategic Air Command thought about us. And this meant participating in their bombing competitions, as I have told you. I am sorry that Bob Hodges isn't here today because he took the two Valiant teams to March. In the Bomber Command competition that year, the Valiant squadrons had finished 1 to 11, and the Vulcans 12 to 15, so Broadhurst rang up my opposite number, Gus Walker, and said 'Gus, you don't rate, (*and asked me*? Ed) can you send two teams?' So we sent two teams to March Air Force Base in California, and they really did do extremely well there. On the first night we were first and third. I should explain that we had six crews and the Americans had about 120, so the odds in numbers were against us and they were grouped in teams of three. We were first and third on the first night and I think we were first and fourth on the second nigh and then there were panic stations in SAC. The Generals came from all directions. There'd always asked me to all their conferences up to that moment, and that was the conference that I was not allowed near. Of course, the odds were against us and we made one mistake. We had sickness in the first team, so we took a crew out of the second team and put them into the first team; if we had left them in the second team they would have won the whole lot. Anyway we had shown the Americans that we could rate on this bombing business, and from that time onwards, we were really well in, right in with them. The joint conferences on targeting and planning started. Incidentally, General Power said to me at the end of that March bombing competition, 'You know, Bing, you'll never win this thing', so I said, 'Well, I don't know, Tommy. We got pretty close to it this time, but I suppose the odds are against us. You're picking from goodness knows how many crews, about ten times as many crews as we have, and I suppose even if we only had six crews against six crews, the likelihood is of there being more genius in your large numbers that our small number'. 'That's right, Bing' he said, 'you'll never win it.' So I said, 'I'll tell you what, Tommy, we'll bomb the whole of Bomber Command against three targets, and you can bomb the whole of Strategic Air Command against the same targets and will take an average.' 'Oh no,' he said, 'I'd never do that. Some of my crews couldn't hit the state of Nebraska.'

Putting the force across as a deterrent in this country really was a

Public Relations exercise. We had to demonstrate and we showed numerous interested parties and individuals over the V-bomber stations. And the station is really worth something. Many of you will know, and I always thought that the electronic centres we had there were the equivalent of what I'd know as a laboratory at a university. There were splendid workshops, showing that we were in earnest about this business. The spirit of the stations seemed to permeate all ranks, and this was apparent to the visitors. We showed everybody, from the Queen and the Duke of Edinburgh, the way we intended to do the business, and also numbers of American Senators and Congressmen. I have to say to myself, 'Now what success is this force as a deterrent?' I couldn't ask the Russians, although we did have Bulganin and Kruschev. They came to admire, bringing with them their Technical Advisor. He knew a thing or two about aeroplanes. They gabbled away and the control tower and we had several people who could speak Russian listening. And I said, 'What did he say?' He said, he waved at the row of cameras and said, 'Topolov says they are a lot of dead ducks.' Nevertheless he looked at the Valiants that we had there and that was the thing which intrigued him. They said that we haven't got many – this was quite early in 1956, when we hadn't got many Valiants – and they were gambling, so I said, 'What are they saying?' and he said, 'Well, of course, they are trying to pull the wool over our eyes; they only show a few of the best they've got, this is all eyewash on the other side.' So the normal suspicion of the Russians was in our favour at this time. At the end of the business, Kruschev said, 'You must come to Moscow and we can show you what we can do.' And one of the people said, 'Well, of course, that won't be us, it will be the Whitehall boys that will go.' Kruschev asked his interpreter what he had said, and when invitations came, they came to us by name, so there were no flies on the Russians. We all went there, I think the following year, and we learnt very little.

So I didn't know what effect the V-Force was having on our potential enemies, and I had to wait until 1989. Before I knew. In that year with *Glasnost* and *Perestroika*. We had General Garivska, who came to the Royal United Services Institute to address us on the Soviet Armed Forces, we listened to all this and at the end of it there was a pause, and I thought here was the opportunity. So I asked the interpreter to ask the General wear that he believes the nuclear weapon

is a deterrent to war. There was a slight gamble, and he said, 'I believe in the abolition of all nuclear weapons,' and I almost said, 'Thank you, you do.'

Sir Michael Beetham. Thank you, Sir Kenneth, for that account of the build-up and development of V-Force. And now we come down to Station level and Air Commodore 'Cyclops' Brown is going to talk to us about a Station Commander's view. A fighter pilot in the early days of the war, he later flew as a test pilot. commanded a Shackleton squadron, was at Boscombe Down and came into the bomber world in the early 1960s to command Waddington. a Vulcan Station at that time, and then subsequently to serve at Bomber Command.

Air Commodore C B Brown

This view from a V-Force station. Waddington, can be barely more than a glimpse: a commentary rather than a full and balanced account. I have chosen three aspects of this view which, I believe, will be of most interest to this seminar: alert and readiness, the switch to the low level role, and the flying crews.

Most of the V-Force was deployed on the old pre-war stations with their distinctive clutches of box-like hangars and very attractive Lutyens-style messes and married quarters. The three-wing station organisation was retained. and the flying squadrons bore much-loved numbers with their record of endeavour and sacrifice. At Waddington there were 44, 50 and 101. The station had a total of 24 aircraft. So it looked like the old firm: Bomber Command with a new aircraft and a new weapon. But it was not quite like that: some things were very different. For example. the station's task and the way in which it functioned represented a fundamental others were changes of emphasis. A few have to be mentioned.

First, a nuclear armed force, poised and ready to go. has to be kept well in hand. So command and control were tight. This meant that the Station Commander had greater and more detailed involvement, and more direct, responsibility.

Secondly, there were procedures. At the start of any new war, or the launching of a largely untried major operation, one thing is certain above everything else, that there will be a 'balls-up' of some sort. For Bomber Command in its nuclear deterrent role, such a thing would

have been unthinkable. To minimise the risk, at higher level this was a matter of close attention to operational philosophy and plans, whereas at station level it depended mainly on procedures. These had to be well thought through. tried, tested and continually practised. If that smacks of rigidity. then I must add that they had to be flexible and adaptable

Then there was security. Security is like flight safety: you get precisely what you are prepared to spend on it. Unfortunately. also like flight safety, there is no finite limit. Security consciousness was generally very good, but continuous alertness imposes strains. Physical security was less good and there were some worrying vulnerabilities that I do not propose to expand upon here. The best protected and most secure piece was the weapons compound. Unfortunately, at Waddington this was on the other side of the main Shea ford-Lincoln road. So whenever there was a major exercise, half the population of Lincolnshire watched, goggle-eyed as strange and sinister-looking shapes were trundled across the road in front of them!

Any Bomber Command station was closely linked to the local community with all sorts of people coming and going for official and social functions: Open Days when hordes of the general public were invited in: and a continuous stream of pilgrims, mostly officially sponsored - journalists, politicians, Arabian princes, Turkish generals, lovely old Australians who had flown Lancasters from Waddington long ago, and James Bond! Believe it or not. part of his film *Thunderball* was made at Waddington; several weeks of tightly-controlled chaos. If you remember the appearance of the chief villain in that, film, you will understand why the director was so excited at being able to use the Station Commander as his stand-in. I suppose all these distractions were necessary in the interests of public relations, and some of them were quite fun. But they hardly contributed to an image of security excellence!

I now come to my three main themes, firstly alert and readiness, which had four phases. In the Quick Reaction Alert Force, one aircraft from each squadron had to be held at continuous readiness and able to be launched in a matter of minutes: there had to be rapid generation of the rest of the station's operational strength and mobilisation of its manpower, the ability to deploy to the dispersal airfields, and to bring the entire force to readiness at the dispersals.

Generation and mobilisation required two things: keeping up-to-date information on everyone's movements and whereabouts so that they could be called in, rather in the fashion of lifeboat crews: and closely controlling all engineering activities and servicing functions so that aircraft and weapons could be quickly recovered and brought into the line. At Waddington. with its Vulcans and free-fall weapons, most of the force, say 16 to 18 aircraft. could be brought to readiness in 10 to 12 hours, and one or two others could be expected to trickle in soon after that. But some were far outside this time scale, deeply committed to modification programmes, at Waddington's conventional support base in Malta, or on low level training flights over northern Canada.

While all that was going on, the Administrative Wing would be making up balanced contingents of 50 to 100 men to be sent to the five dispersal airfields and gathering together the pre-prepared paraphernalia to go with them. Admin. Wing had its small control centre for this purpose. This brings me to the two most important things I want to say:

(a) The process of generation and dispersal involved about everyone on the station: not only the flying and servicing crews but the policemen, cooks, butchers, admin orderlies, operations clerks, ACH/GDs, and so on. The station functioned as a complete and totally-integrated operational entity.

(b) Like it or not, the key was complete centralisation. The luxury of autonomous, or semi-autonomous, flying squadrons would not do, without risking the possibility of the 'balls-up' I have already referred to. Squadrons with their own aircraft and servicing people may have been fine for a privileged few, but now all were in the limelight. The beneficial effect throughout the station was remarkable.

Waddington had five dispersal airfields in the UK - Prestwick, Machrihanish, Brawdy, Filton and St Mawgan: and a forward base in Malta to provide conventional support for the Middle East. For operations and major exercises, a planned airlift was provided by Transport Command. But, in the UK, for day-to-day administration, servicing the ground support equipment, and turning over the rations, the station had to use, its own MT, or British Rail, It was quite a task!

A valuable link, enabling, the.Station Commander and the Wing Commanders to keep watch over their far-flung empire, was the station Anson! It was taken away to save money. Imagine, the cost of a single Anson! So we used a Vulcan instead, and it 'joined the Station Flight' The purpose of this vast undertaking? To get the whole of the V-Force off the ground in two minutes or less.

Secondly, I must say something of the low-level role. From the beginning it was inevitable that the V-Force would have to switch

For training, the aircraft was flown at 250 knots at 250 feet; for the penetration stage this was pushed up to 325 knots; and in anger it could be increased further to over 400 knots. The range, or radius of action, was still adequate.

There were three components of the flight system that are relevant here, the TFR, or terrain following radar, Doppler, and the main radar. The TFR was Simplex type. It provided no terrain, or contour, information but indicated 'go up, go down'. It had three modes – flat terrain, medium, and rugged – and it 'failed safe' in the 'go up' position. It was valuable when used in conjunction with the other equipment and as part of the navigation and terrain following process. The Doppler, like all Dopplers of that period, sometimes unlocked at low-level over smooth sea or very flat terrain. Here also its value lay in being used judiciously as part of the complete system. The performance of the main radar at low level was good. Its range was, of course, much reduced but in conjunction with the normal navigation process of anticipating and timing selected features in a narrow band either side of the required track, it could be used very effectively. As a bonus, it could also present a terrain contour profile.

All I will say about the weapons, because I am on less certain ground here, is that like conventional bombs and their fusing, they could be programmed for a variety of tricks, air burst, ground burst, and delayed to match the escape manoeuvre.

The V-bombers, both Victor and Vulcan, emerged from the transition as an even more viable and potent force – in relation to the air defence environment of the period.

Finally, I must mention the flying crews. It was ironic, but certainly foreseeable, that just as the advanced aircraft and weapon systems were coming into service in both Bomber and Fighter Commands, the experience level of the pilots available to fly them

dropped dramatically. The old sweats with thousands of hours of flying experience were fading away, or being promoted! There was no alternative, therefore, but to face up to the necessity of having first tourist Lightning pilots and V-bomber captains,

For the latter, an enlightened and imaginative training programme had to be devised to progress the first tour co-pilots, by stages, to captaincy; and this process was greatly helped by the advent of flight simulators. It proved to be outstandingly successful. The poor relations, as always, were the capable co-pilots for whom there were no captain slots (because many of the first tourist captains were kept on for a second tour). Many of these co-pilots went to CFS and did well as flying instructors; and one Waddington co-pilot went off to fly Lightnings. But we suspected he had an uncle in the Cabinet Office!

A question sometimes asked by visitors, sometimes in an embarrassing way (to them), was 'What about your flying crews and their attitudes?' Quite reasonable. What about them? The first thing to be said is that people do not change much over generations. Thus the V-Force flying crews would not have been at all out of place in the old Bomber Command; or, for that matter, in a dugout on the Somme or in the bivouacs of Wellington's army in the Peninsula! They might have been regarded as more sophisticated, arguably better educated, and much better off. They were much better trained because there were more time, more resources, and much improved training programmes. They had no special introspection, complexes or hang-ups – hangovers, maybe! What blemishes there were, were the good old ones: booze, women and an inclination to spend a little more than they were being paid, in that order. I would have been worried, and suspicious, if that had not been the case. Sloppy usage has greatly devalued the word 'dedication', and 'motivation' is taken for a prime mover. I would prefer to say that all the people at Waddington had a strong sense of purpose.

The V-Force experience might, in retrospect, be regarded as something of a paradox. In terms of striking power it was the culmination of the main Air Staff philosophy going back to the Great War; but it was also the swan song of the British strategic bomber. It lifted the Royal Air Force into a new era, and then withered away. But it left a considerable legacy.

From the Floor

Sir Michael Beetham. Thank you, Air Commodore Brown for that vivid picture of life and the problems down at Station level. The floor is now open and I know we've got a lot of experience in the audience, so over to you, whoever would like to make a contribution.

Sir George Edwards. I have been absolutely fascinated by today's performance; I really am most grateful for the opportunity to come as your guest and take part in this. The problem is that you can go on like old men for a long time and, roughly speaking, say nothing. I suppose the biggest single thing that struck me this morning and this afternoon is what the Brits do (a) when they decide that they are going to do it and (b) when all the normal clogging machinery gets out of the way and instead of clogging up the works, pushes. And there is no doubt from my own experience of the situation, during the time the V-Force was being built, that once the work came from up topside in Number 10 – and it wasn't inhabited by Boadicea in those days, but the result would probably be much the same today – once the word came from Number 10 there was to be a deterrent, then everybody decided that this was a good thing to do and got on with it. Now we were lucky, I think, in that simultaneously with a fairly clear-cut directive, there were some people in the line of command down from Number 10 that were not only jolly capable, but were pretty determined to see the thing did get done and having worked my way through my long and chequered career through layer upon layer of Civil Servants, we weren't half lucky to have old Frank Cooper up there as a case in point.

Having also spent a fair amount of my later years in coping with international programmes like Jaguar, Tornado, Concorde, and all that, there is one thing that is for sure and that is that had the V-Force been an international programme, then it never would have been done. It wouldn't have been cancelled but it never would have been started. Although I am so old now that I can have no influence on anything, I think every time that one rushes into an international celebrity programme, one needs to weigh up in advance the difficulties when we are seeing a highly, very technical job through, when we've got four or five masters to serve. It is a fact that the ones that I have been connected with came out in the end. But the end is a hell of a long way

from the beginning and the one thing about the Valiant, the contraption with which I was connected, is that the end and the beginning were very together and there was no mercy. I thought that the Valiant technically was more difficult than the Concorde and I say that not only as the chap who had to get it done, because I was then a device called the Chief Designer, which doesn't exist now – you have Technical Directors and so on, but you don't have Chief Designers anymore. The Chief of the Air Staff at that time left me in no doubt. Stubbing his finger firmly into my chest, he said 'Look, George, boy, there are going to be no flying models, there's no fiddling about, we don't want any excuses for the fact that we can't get it right because it's too difficult. You have to fly the prototype at a date in 1951 and there is going to be no mercy.' And we flew the prototype in 1951 and, within reason, it did what we said it was going to do.

Now, at a time when we are constantly worrying whether we are doing all right or not, it's no bad thing to look at the time when we did something and it really worked. Now the bit that I did was small in relation to the whole story as it has been unfolded today. The total determination of the Government and the Services to make this thing work was something that, in my opinion, we alone in the world were capable of doing and I don't think we ever want to forget it. I made a great contribution to the American scene with the Valiant because the requirement was – like a lot of these potty OR requirements from time to time, like the TSR2 in a way – for it to take off from airfields with an LCN number that was so low and with an undercarriage designed in which the wheels were spaced apart so that you never got two wheels on one bit of concrete. Now can you imagine that the basis of carrying the nuclear bomb had to be governed by the fact that you couldn't have two wheels on one slab of concrete? Well we did it and it worked. When the Americans heard of this strange device, they came along with our Chief of the Air Staff and with General Vandenberg and the redoubtable General Le May, and looked at this thing which we had just flown for the first time – let me add, off a grass airfield at Wisley. Having the B-47 at their back and the B-52 in prospect, they thought it was pretty remarkable, but the only thing we ever did was that they went back and bullied Wellwood Beale into giving the B-52 side-by-side seating instead of the tandem arrangement that the B-47 had existed under, so maybe there was

some continuation to the relationship between Kirby May (Curt LeMay? Ed) and our Bomber Command that bore fruit in the years ahead. I will not pursue this theme any longer, Chairman, except to say – and I'll try not to be sloppy while I'm saying it – out of all the years I spent working on aeroplanes – and I worked on a good many – there was nothing that gave me more technical or professional satisfaction than doing the old Valiant, because I could see the job that we were setting out to do, I could see that it was going to make a contribution to the task that the Royal Air Force had been given, it gave me the opportunity to get to know these great leaders of Bomber Command, who, again, you wouldn't find anywhere else except perhaps over here – Hugh Lloyd, Broadhurst, 'Bing' Cross – and then I got to know Portal – and at this stage, if he were here, and he's not quite, but I'm very happy to say that I am wearing Portal's cufflinks – Chairman, he'd have said 'George, old boy, you've said enough.' Thank you, very much.

Cecil James. There's just one point, Sir, that I think might require a little correction, and that is this question of just when it was that we really got into bed with the Americans on joint planning between SAC and Bomber Command on targeting and route co-ordination and all that sort of thing, the last thing I wish to do is to decry or in any way diminish the importance of Grapple, but I think it is true to say that the key breakthrough had occurred before Grapple and it arose because of the tremendous effort that the CAS at the time, David (Dermot? Ed) Boyle, put into his relations with the Americans. It's quite true, I think Sir Frank was saying, that the Americans weren't prepared to play ball until they could see the British had got something really coming along which was substantial but the key date, is about the turn of 1956/57 when Sir David Boyle had got an agreement with the Joint Chiefs of Staff that joint planning should go ahead and that agreement was ratified very, very quickly indeed by Duncan Sandys and Charles Wilson when the MacMillan government came in January 1957; that was actually ratified further, as it were, by Eisenhower and Mr MacMillan at the March Bermuda Conference and I think that really must be on the record, otherwise people might have gone away from here with the wrong impression of just when this important breakthrough on joint planning actually took place. Could I just

mention some very minor things in a way; one can't hope on an occasion like this to cover everything, but nobody has in fact mentioned the importance of the overseas capability of Bomber Command and the arrangements that were made at Akrotiri and Tengah, and I think at Mafraq, to use those overseas airfields possibly as part of the whole deterrent posture.

One thing was said earlier about the importance of the production of missile material, Windscale. I think we were certainly appreciated in the Air Ministry and the sort of programme of visits which we arranged for the then Secretary of State for Air, started off with Windscale in early 1952, and then we to talk to Penney at Harwell. We then started our visits down to Weybridge to see what was going on with the Valiant. One thing I remember of those visits to Weybridge was George saying that if you want to identify a Valiant pilot, you can do so from the callouses on his backside, But those visits to Weybridge were very encouraging, and particularly when one reached the point when Jock Rice said, 'it's becoming just another aeroplane.'

Anon. Chairman and gentlemen, can I just make a very brief comment on the conventional support role? Waddington had a permanent assignment for providing conventional support in the Middle East. They'd had a fairly sophisticated and well-equipped dispersal area set up on the airfield at Luqa. But I think one has to make a very clear distinction between the effectiveness as a V-Force in its deterrent role and in its conventional role. Twenty-four V-bombers in their deterrent role at low level were very effective indeed and we all believed the whole force throughout its life was an effective deterrent, that it could in fact achieve what it was supposed to do. Conventional role was quite different because there, a V-bomber really wasn't much better than a Lancaster. It carried exactly the same load, thousand pound bombs and I think under most conditions, bombing visually was a sort of 200 yards/50% radius. The reinforcement for the Middle East was 24 Vulcans. When you think it took 200 Lancasters carrying the same load and bombing with the same accuracy to neutralise the tactical airfield for 48 hours, it certainly took over 100 Lancasters to take out a bridge, and at times we had our heads in the sand because we thought a handful of V-

bombers in the conventional role would have been as effective as they were in their main nuclear deterrent role, but that wasn't the case.

Sir Michael Beetham. We come to our last formal presentation where Professor Lawrence Freedman is going to review the significance of the Force. He is well known, I am sure, to you all as Professor of War Studies at King's College, London. He previously filled academic appointments at York University, Nuffield College Oxford, and the Institute of Strategic Studies. He was also Head of Policy Studies at the Royal Institute of International Affairs from 1978-82.

Professor Lawrence Freedman

First let me say, on behalf of King's College, how happy we've been to be involved in this event. Arthur Hockaday has put academics in their proper place before, and I hope we don't quite suffer from the tendencies which McGeorge Bundy was quite rightly railing against of getting so caught up in modelling and abstract theory that we lose sight of the proper character of warfare and strategy in general. However, I think it is the case that for an academic, and perhaps somebody of my age as well, however much one looks at the papers or reads the books there is nothing quite like hearing those involved talk about their experiences, convey the flavour of their personalities, their interests, and their preoccupations with the candour that we have heard today, and at this sort of event you really can't have too many of them. We need to get these thoughts and recollections down and to convey to a generation of academics, and also to serving officers and Civil. Servants, the sort of things that drove those who came before them. We've certainly had many testaments to the professionalism, the dedication, the endeavour of those who created the V-Bomber Force.

We have had a lot of the flavour of the squadrons of the early 1960s but I think there is a peak in 1958, when we've demonstrated the hydrogen bomb, we've got co-operation back with the United States, the bombers are flying, and there is a credibility in the British military effort that impressed all those who had anything to do with it. The rot seems to set in 10 years later: Bomber Command is no more, the Valiants are out of service, and we have lost Skybolt, TSR2 and Blue Streak.

So really the mood of today has been shaped by the fact that we've been talking about the period up to the peak of the V-Bomber Force in the early '60s, We've also heard about the rivalries and the various points of influence that affected those involved. We haven't heard very much about the Russians who were clearly perhaps marginal to much of this activity, nor about the most important battles with the Army and with the Navy, nor the rivalry with Strategic Air Command and so on. *Plus ça change*. The feelings are always strongest with those closest to you, but the Russians were there and again I think the sense of timing is illustrated by the fact that just before the end of that period in October 1957 we have Sputnik, warning us of the technical strength of our adversary and one of the clouds on the horizon in terms of indicating where the next stage of the arms race was going. Also in mid-1957, as we were testing our first hydrogen bomb, the Soviet Union was testing its first inter-continental ballistic missiles.

Now what I'd like to do is to talk a bit more about the reasons and the rationale and the context for the British Nuclear Force, because inevitably today there has been a lot of talk about the practicalities, the sheer effort of putting the programme together and the need to galvanise people into action, and as has been noted, what were really quite remarkable periods of time in terms of what one now thinks of as necessary gestation periods of major programmes.

So let's go back to 1945 and 1946 when some of the key decisions were taken. Why? As Margaret Gowing in her work has indicated very clearly, it was a natural decision to build the bomb. Indeed it almost wasn't a decision. Britain was a great power, great powers have great weapons, and this was a great weapon and therefore Britain should have it. There was really nothing surprising and it was largely a question then of practicalities, but there was no doubt later on that the bomb became a way of demonstrating that Britain was still a great power and of prolonging the period of great poweredness. Once the thing was set in motion there was no doubt at all about why Britain should participate, But further than that Britain was a compact vulnerable country, and the potentiality of an attack was there from the start. We have had mention of Attlee's immediate perception of Britain's vulnerability, and if we talk about deterrence, what Britain thought it was trying to deter at the start was a nuclear attack on the United Kingdom. It seems to me that there was a much more

defensive orientation to the British nuclear effort in its early stages, than there was by the '60s. The Americans were already in the 1940s starting to see nuclear weapons as a way of deterring war – full stop: any sort of war. But the initial impulse was slightly narrower, and of course, as Margaret Gowing has drummed into me in the past, one really does have to distinguish between the impact made by the atomic bomb, and the impact made by thermo-nuclear weapons. They were very different orders. These were the real city busters coming along; you can compare an atomic bomb with the consequences of the two hundred aircraft raid, but there was nothing with which to compare the hydrogen bomb. So again that is something we need to bear in mind and not, as we could very easily do, collapse the nuclear age into one undifferentiated whole without recognising the important shift in perception brought along by the hydrogen bomb,

Now Britain might have had these perceptions about being a great power and the need for a way of deterring somebody else's nuclear weapons, even before the start of the Cold War. People were aware that things weren't so easy with the Russians, but as the Cold War developed and became more intense then it was clear that the Soviet Union was the problem and the United States the solution. The major effort of British foreign policy of the late '40s was to bring in the United States, and this succeeded brilliantly: it created the context of British nuclear power. On the other hand, before we brought the Americans in -while they were still in their post-war phase 'we don't want to have anything to do with those wretches again' – we had the McMahon Act so that we were excluded from co-operation. One gets a very clear sense that non-co-operation produces the same sort of reaction as you read about after the fall of France in 1940 – 'thank God we're alone' – it's a moment when you do not have to be worrying about somebody else's feelings and sensitivities: you can get on with it yourself. I am not sure that was a very powerful impulse but it was clearly one that disturbed the policy-makers. Given a choice they wanted co-operation with the United States but it may be that without that period away from the United States we still would never have generated the momentum to maintain Britain as an independent nuclear power even into the 1990s.

The object of policy throughout was to restore co-operation with the United States, and that happened in the late 1950s. And there is no

doubt at all from the documents that the British bomb was directed as much towards Washington as to Moscow; it was a political weapon to gain influence over American policy. To do that it was necessary to show that we could do it ourselves, but the prime objective was gaining American attention and credibility, and in this it succeeded. The 1958 Amendment to the McMahon Act was evidence of its success, with what happened thereafter probably the 'Golden Age' of co-operation between the two countries on nuclear matters. There was the area of arms control – the test-ban treaty negotiations – which, as we have heard, spurred on the British effort in anticipation. Then Britain was able to play a leading role in securing a military non-proliferation treaty, and there was the Nuclear Planning Group in the mid-1960s. These are in a sense the fruits of co-operation and other elements of this special relationship. Later on it became more difficult because the British deterrent was never quite strong enough for us to have much freedom of manoeuvre, much to bargain with; we either had it or we didn't. This was always the problem later in the Strategic Arms Limitation Talks.

Now although eventually in that sense it succeeded by the time of the late '50s the problems of doctrine were already arising. It was one thing to understand in Whitehall, perhaps in parts of Westminster and even at the top of Bomber Command, that the purpose of this thing was to influence the Americans, to work with the Americans, to gain the co-operation of the Americans, to influence the trend of American policy. It was quite another thing to say that on the hustings. The H-bomb tests were not long after Suez, and the idea that this was a way of rescuing our status as a great power was not unimportant then. So the sense of independence, of making us count for something, of independently taking on the Russians, was undermined both by the tendency in Whitehall to think very much in terms of relations with Washington but also by an awareness that during this period in which Britain had struggled to create a credible nuclear strike force the Americans had forged ahead into an age of nuclear plenty when the weapons were coming at a rate of knots off the production lines. This created the question: what was the British Nuclear Force going to do? What could it do, different to what the Americans could do?

To start with in this sort of back-of-the-envelope calculation of the late 1940s, it was possible to show that the British nuclear deterrent

might be necessary in order to make up a total NATO deterrent. The total would be an Anglo-American nuclear co-operation; otherwise there wouldn't be enough, for the Americans couldn't do it by themselves. Then in the early and mid-1950s we started to talk much more about how there would be certain targets of particular interest to the United Kingdom: the submarine pens, the medium airbases and so on. Then the Americans eventually had enough for those as well. Then of course Bomber Command had a specific role, coming in in front of Strategic Air Command, paving the way for it. Finally we end up with the second decision-centre argument, a wholly political argument, so there was a sort of law of diminishing rationales that started to hit the Nuclear Force and undermined its political position, because there had been no great political debate about the Nuclear Force until the late '50s.

The other thing that was affecting it was the ambition of nuclear deterrence itself. It was one thing to talk about nuclear deterrence as a way of deterring the nuclear forces of the other side, it was quite another to talk about nuclear deterrence as deterring conventional war – especially conventional war against a third party. Now, and I disagree with Arthur Hockaday on this, I actually think people are sufficiently lacking in confidence about escalation that they don't believe that when you start a war you can contain it at the conventional level, and that therefore the problem of nuclear deterrence in some ways is not as great as many academics have suggested, but that actually it works on a simple basic human emotion which anybody who has tried to bring up children well understands. There is a certain awareness of how things can get out of hand and you do not want to test it. So the problem was not necessarily as great in practical terms as it was thought to be in political and strategic terms, but that it was thought to be a problem from the time of massive retaliation there is no doubt.

It is quite interesting that Slessor's effort with the Global Strategy Paper of 1952 was directed again at the United States. Much of the policy outlined in that document was not a policy for the United Kingdom (in 1952 we didn't have the wherewithal); it was a policy to be taken to Washington, where it was rejected at the end of (*the*) Truman administration because they were putting their emphasis on conventional forces. It was picked up as part of the package that

influenced the Eisenhower administration as it moved in towards massive retaliation and the emphasis on the nuclear deterrent, but no sooner had Dulles in January 1954 propounded this doctrine than he was being forced to backtrack. By trying to be as ambitious on behalf of nuclear deterrence as Dulles was in '54 and Sandys was in '57, the opportunity was created for the arguments, the doubts, the dissension, which played such an important part in opening up the debate in the late-1950s around the Navy's attachment to broken-backed war. Although this was not one of the most distinguished contributions to strategic thought, none the less it had an important political impact throughout the 1950s.

By the end of the decade in some ways the political rationale was working, the bomb had come along, the V-bombers had come along, we had influence on the Americans. We were able to stay in the business longer than otherwise would have been the case, we had demonstrated our independence in this effort, we had an infrastructure that sustains us even to this day, but already the sense of interdependence was giving way to a sense of dependence. Skybolt, or the experience with Skybolt, both for the fact that we went for it in the first place and then lost it when McNamara decided it was a bad deal in November '62, meant that there was a challenge created for the longevity of the nuclear deterrent. But in a way it only was able to survive by creeping back into the shadows; there was a moderate rationale, a moderate expense, a political consensus to be quiet about the subject rather than to brag about it in the way the French did. Somehow the thing survived.

What we haven't spoken about much today is the development of the political argument during the 1950s. I think we've heard about a remarkable period of policy-making through the Labour Government of Attlee to Churchill's Government and beyond, a commitment to the nuclear deterrent, a readiness to find resources at a time when resources weren't easy to find, an understanding of why this was important. Gradually two things happened. First, an academic and intellectual and ethical debate began to develop about whether this was a right and proper thing to do, and this eventually affected the political debate with the arguments in the Labour Party at the beginning of the late 1950s, the Aldermaston marches, and so on. Clearly the Aldermaston marches didn't have an enormous impact on

the recollections of some who spoke, but none the less they indicated the way that things were going. The consensus was never quite recreated again and I think, as Air Commodore Brown indicated, this was the 'swan-song' in a way of Bomber Command. It was a remarkable achievement and I think those of us who have been here today cannot but be impressed on hearing about the extent of that achievement in technical, logistical and operational terms. Again, as Air Commodore Brown said, it allowed the doctrine of strategic bombardment, which in a sense had almost been created by Trenchard in the inter-war years, to last longer than might otherwise have been the case; in a sense it still, in its own way, continues; and it created an *elan* amongst those who flew the aeroplanes that still carries on. So there is an important legacy of this story, and, for a period of time, it was extremely influential. But I fear the Society perhaps will not be quite so cheery when looking at the next decade.

Sir Michael Beetham.

Professor Freedman has given us a thought-provoking review and he has concluded and summarised the day for us in an admirable way and I have really little to add. I think you'll all agree this has been a most interesting and most important seminar. No military subject has evoked such widespread interest and emotion world-wide as nuclear weapons, though really, as we all know, the very future of civilisation depends on man keeping proper control of them. That we've not had a major war since 1945, in Europe we've had peace in spite of much international tension and I think, most importantly, no one has exploded a nuclear weapon in anger since 1945, at least demonstrates that so far mankind has managed to maintain that control and has recognised their deterrent value.

RAF HISTORICAL RESEARCH

by Air Commodore Henry Probert

A number of members of the Society have asked for the publication of some advice on how to undertake RAF historical research, and from my experience as Head of the Air Historical Branch I have agreed to put some thoughts together. My immediate reaction on receiving this request was, of course, to echo Professor Joad and say, 'It all depends on what kind of research you want to do'. When I then go on to consider how many varieties of research there are I am inclined to tell the potential historian to start by consulting an expert in relation to his own particular project. Certainly anyone who is contemplating serious work should seek guidance at an early stage; this may be obtainable from the staff of such organizations as AHB and the RAF and Imperial War Museums, or alternatively from individual authors and researchers who are already experienced in the field that interests one.

That said, I think it may be helpful if I now outline the more important sources of information that are available, in the hope that some at least will be of relevance to your particular project. Broadly, we can divide these into three categories; the operational and policy records, the personnel records, and those relating to aircraft and all the other 'hardware' that the RAF has used over the years.

An essential thing to remember about the first type of documents is that, as public records, they are all closed to the general public, normally for thirty years, under the terms of the Public Record Acts. Consequently, while such material is available for official use, including the writing of official histories, for all practical purposes private researchers cannot at present obtain access to primary documents originated since 1959. While some items that relate to particularly sensitive matters are retained for even longer, the vast majority of the earlier records are now open, mostly in the Public Record Office (PRO) at Kew, but here I must stress that many items that were not thought to be of long-term importance have been destroyed. When one thinks of the vast amount of paper generated in a Service such as ours over the years, the impracticability of keeping it all must be obvious, and researchers must accept that some of the papers they would like to find simply no longer exist.

Fortunately, however, one major group of RAF papers has been kept in its entirety (apart from a few that were lost through enemy action during the Second World War). I refer here to the Operations Record Books, or Forms 540, that have been compiled each month by almost every RAF unit since the late 1920s. These are all to be found in the AIR 24-29 collections at the PRO, and they contain an immense amount of detail relating to operations, more routine activities, personnel, and so on; moreover, since they include formations ranging from Commands to Stations, to Squadrons, and even some Flights, they often cover particular events from several different perspectives. For many purposes these are the first sources to consult, but like all documents they must be used with some caution. Remember that they are only as good as the men or women who compiled them; some are much more comprehensive and informative than others, and although reasonable attempts were made at the time to ensure their accuracy, this cannot be guaranteed. Often they were produced in haste under difficult conditions and errors inevitably occurred – not least in the typing. Remember too that they reflect what was believed at the time to have happened; what actually occurred may have been very different. The good researcher is always careful not to take everything he reads on trust. Even so, the F540s are very often the best evidence one can get and they remain one of the most important sources available to the RAF historian. Since the early years of the RAF – and of its precursors, the RFC and RNAS – are not covered by 540s, for World War I one has to go to a wide variety of unit diaries etc. that are held in the AIR 1 collection at Kew and start by consulting the rather complicated index, preferably with the aid of one of the resident experts.

Many aspects of the RAF story, especially those relating to policy, are not covered in the 540s but in the great quantity of official files, reports, summaries and reference documents that have emanated over the years from the Air Ministry/Air Force Department, Command and Group Headquarters, and many other RAF formations. Only the most important of these survive, but they still represent a major collection in the PRO, one which – like the F540s – is constantly being added to as documents are released under the Thirty-Year Rule. Unfortunately there is no subject index to all this material, and the researcher usually has to start by looking through the catalogues for particular categories

of documents in the hope of finding titles that appear relevant; it can be a chancy and time-consuming business. If, however, books have already been published on his subject, these will often contain specific references to sources which may come in useful, and AHB maintains an invaluable subject index to some of the documents held at Kew; this can be consulted by appointment – provided the small AHB staff can spare the time.

So it clearly helps to know what one is looking for, and it is useful to remember the existence of the many series of summaries and reference works that appeared in chronological order and are relatively easy to consult. Among these are the Air Force Lists, which contain not just names but a great deal of organizational information; the Air Ministry Orders, which cover almost every topic and are well indexed; the various Intelligence Summaries; and a wide range of statistical summaries. For the wartime years there are many more, such as the Air Ministry War Room Daily Summaries, and the operational reports and analyses issued by the various Commands. Nor should one ignore the proceedings of the Air Council, held in the PRO in AIR 6.

Thus far I have referred only to primary – or original – records, but for many purposes it is just not practicable to go back to such sources, and secondary material can often be of enormous help. Here I am thinking first of the many official histories, narratives and monographs that have been compiled over the years. *The War in the Air* by Raleigh and Jones remains even today one of the most important reference works on World War I and the Cabinet Office histories provide comprehensive coverage of World War II. Most of the latter are written on a campaign rather than a single-Service basis, and were compiled during the first fifteen years after the war; some, however – notably the *History of Intelligence* – have only recently appeared. Thoroughly researched from the official records and well referenced, these are all essential sources for the serious historian, as is the three-volume account of the RAF in the Second World War that was written by Hilary Saunders and Denis Richards. Backing up these for World War II are the many single-Service campaign narratives and monographs which were written during and soon after the war under the auspices of AHB; few of these have ever been published, but nearly all of them are now in the PRO (AIR 41 and AIR 10) and contain a wealth of detail well beyond that provided by the official

histories.

Inevitably, much of the official effort has been devoted to the two World Wars, and very little work was ever done on the inter-war years, although Montgomery Hyde's officially sponsored *British Air Policy Between the Wars* helps to fill the gap. AHB has, however, undertaken a fair amount of research and writing on the post-war period and while most of its narratives, including one recently completed on the Falklands campaign, are still closed, some accounts – notably the three-volume series on the overseas theatres by Sir David Lee – have been published openly by HMSO.

There are of course limits to the amount of work that can be undertaken officially, and we in AHB would be the first to recognise the great contribution to our reference sources that has been made by private historians, usually working with some degree of assistance from us and drawing closely on the records in the PRO and elsewhere. Obviously some are better than others and it would be improper for me to draw comparisons, but a few examples will suffice to make my point. James Halley's *The Squadrons of the Royal Air Force and Commonwealth* (published by Air Britain) is an excellent source of ready reference on all our squadrons; Wing Commander Jefford's *RAF Squadrons* (Airlife) adopts a different approach but is equally valuable; Owen Thetford's *Aircraft of the RAF since 1918* (Putnam) is a first-class starting point for all our aircraft; and Martin Middlebrook's *Bomber Command War Diaries* (Viking) contains a summary of every wartime operation carried out by the Command. While books of this kind are available in many libraries, they can often be well worth buying. It is not only the general reference works that are important; whatever subject one is working on, there are almost certain to be books related to it that have already been published, and one needs to be aware of them and the contribution they can make.

One further source needs mentioning here, namely personal papers. Not everybody leaves significant collections of personal papers behind; indeed, in more recent years, the security constraints have made it particularly difficult to do more than keep one's own log book, perhaps maintain a diary, and retain a collection of photographs and purely personal letters. Even these, however, can be of some historical value, and quite often in days gone by senior officers would

keep copies of much of their official correspondence. To the historian such archives can be of great value, and he should be aware of any collections that may be relevant to his area of study. Only occasionally, where some sensitivity applies, are these held in AHB; most are in the private establishments to which they were originally bequeathed. The RAF Museum has now become, quite rightly, the main RAF repository, but relevant collections can also be found at such places as the Imperial War Museum, the Liddell Hart Centre at King's College London, Churchill College Cambridge, and Christchurch, Oxford, where Portal's paper reside.

This aspect leads to my second main category of documents, namely personnel records. The rules governing access to these are quite different, being governed by the principle that an individual's personal affairs should not be divulged to third parties except with his permission or that of his next-of-kin. So while the RAF Personnel Management Centre at Gloucester, which holds most of the records, will provide information to close relatives, there are strict limits to what it can do for outside researchers. AHB, which holds the index to the wartime casualty records, is bound by the same ruling when responding to casualty enquiries, and because of their sensitivity all personal documents are reserved for official use only.

So clearly the researcher faces a problem when needing information about individuals. An authorised official biographer can usually obtain authority from next-of-kin to be granted access to some of the personal records, but for most purposes historians must glean their information elsewhere. Air Force Lists and London Gazettes are valuable sources, provided one has patience, and so are the F540s as long as one knows where to look. For 'the great and good' one can turn to *Who's Who* and certain other reference directories; the Dictionary of National Biography features the very greatest; and AHB has biographical information on some of the more prominent people, which has been gleaned in the past from open sources. AHB also has an 'open' list of wartime casualties in alphabetical order, and the Commonwealth War Graves Commission, too, can help on such matters. Quite often, of course, the individual in whom one is interested may still be alive, and a pre-paid letter sent to the individual c/o the RAF PMC will be forwarded to his last-known address; except for those named in the RAF Retired List, however, these addresses are

usually long out-of-date, and the chances of such letters arriving are remote. A better way is to advertise in the journals of such organisations as the Royal Air Forces Association and the Aircrew Association, or perhaps to contact the Squadron Association if one exists; indeed, it is often no bad idea to publicise one's work as a whole through such bodies, or in the columns of some of the aviation journals; information, ideas, even offers of assistance, may well result.

I come now to my third category, the information related to our aircraft and all the other artefacts. Obviously some of the material one needs is going to be found in the documents housed in the AIR collection at the PRO, and one should remember too that the AVIA collection (which begins in 1940 and in broad terms relates to the Ministry of Aviation and related bodies) includes much material, especially related to aircraft procurement. Again there are many reference works that have been published over the years, often immensely detailed, and one should make oneself conversant with them. AHB can offer only limited assistance in this field, though its aircraft record cards (one for virtually every airframe in squadron service since the late 1920s) and its aircraft accident cards are a prime source and have formed the basis for many of the published reference works. Microfilms of these cards are held at the RAF Museum and researchers who wish to consult them are usually urged to do so at Hendon.

Undoubtedly it is there that one will find the main source both of information and expertise in this respect. As the keeper of the artefacts (in co-operation with its sister museum at Cosford), the RAF Museum holds most of the associated technical documents, including drawings and many of the manuals, and the researcher should make this his first port of call. The Museum has also built up a large photographic collection which may be consulted and from which prints may be bought for reproduction. There are, of course, many other sources of photographs, not least the Imperial War Museum, which holds the official collections of air photographs from the two world wars; AHB, which has the rest of the official RAF collection, covering the inter-war and post-war years; and the University of Keele, which possesses the Air Photography Collection. Here are the aerial photographs taken by our PR aircraft during World War II over much of Europe and the Mediterranean area, and many air historians both UK and foreign take

advantage of it. These prints have proved particularly valuable to the West Germans in their attempts to determine the locations of still unexploded bombs. Note that Keele does not hold any coverage of the United Kingdom, but their leaflet does give guidance on the other sources.

Before concluding, I should like to mention one or two other sources which the air historian should bear in mind. Particularly for the earlier days of our history, the regular journals such as *Flight* and *Aeroplane* contain an enormous amount of information on almost every subject, and I am tempted to observe that standards of accuracy were perhaps higher than they are now. Such journals, together with regular publications like Jane's *All the World's Aircraft* should always be borne in mind, as should official RAF publications like the wartime *Tee Emm,* the post-war *Air Clues* and *RAF News.* For more recent history the official Statements on Defence contain much useful material, and the official Commanders' despatches that have always followed significant battles and campaigns are also invaluable. Then there are the records of our allies and those from 'the other side of the hill' – some of the latter are obtainable at the Imperial War Museum, but otherwise one has to go to the West German Military Archives. And so I could go on, almost indefinitely, but at this point I think it better to draw my article to a close, in the hope that it has given at least a few pointers to those who are keen to set out along the research road. I have not tried to advise on how to plan and organise one's work, for this depends so much on the individual and the nature of his project, and advice on such aspects really needs to be tailor-made.

Finally, I should say that although the resources of AHB itself are small and already fully committed to its official tasks, AHB is always interested to hear of research projects which are underway and – to the extent that circumstances allow – will try to offer advice. Naturally we have a vested interest in the field and, as the Acknowledgements pages of many of the respectable histories will testify, its assistance in the past has not been deemed inconsiderable.

BOOK REVIEWS

THE IMPACT OF AIR POWER ON THE BRITISH PEOPLE AND THEIR GOVERNMENT 1909-1914

Professor Alfred Gollin

MacMillans, 1989, £40.00 **ISBN 0-333-49320-6**

Despite the fact that this title appears in a series entitled 'Studies in Military and Strategic History', the major part of the book is concerned with the politics of air power in the years before the First World War. Professor Gollin is an accomplished political historian, with a particular expertise in the political and journalistic figures of the time. The present volume has clearly grown from his research for his previous aviation volume on the Wright brothers and the British Government (No Longer an Island, Heinemann), but in the present volume the author draws illuminatingly on his wider knowledge of the Press and politics of the period. The depth of research is particularly impressive, but Gollin's mastery of his material is such that the reader does not become weighed down in a mass of detail.

Gollin shows how the rising tide of public concern at the time over the progress of aviation on the Continent, and especially in Germany, was reflected in the emergence of such bodies as the Aerial League of the British Empire, and the Parliamentary Air Defence Committee. He demonstrates effectively the tremendous influence of R B Haldane, then Secretary of State for War, and shows how Haldane's determination to establish the foundations for aviation in Britain on a firm base of research and organisation was later to stand Britain in such good stead. He concludes that Haldane's great achievement in setting up the Advisory Committee for Aeronautics ensured that 'his country was better able to confront the German challenge when it came in August 1914'.

The author is at his best in demonstrating the interrelationship between the Press and the politicians of the period. He examines both the effect and the reality of the Phantom Airship scare of 1909, and the Air Panic of 1913. He also brings home to the reader the extent to which the intense bitterness of the domestic political scene at the time affected the development of aviation, in spite of attempts to maintain a non-partisan approach. Professor Gollin also includes a lucid account

of the course and effects of the Paris Conference on Aerial Navigation of 1910, an event which has been largely ignored in the context of British aerial development. The latter part of the book concentrates on the early agitation for a national air force, (pace those who believe the idea arrived with Smuts) and the parallel arguments over the need for improved air defences in Britain. Winston Churchill, and to a lesser extent the Royal Naval Air Service, emerge with much credit from this period, but the author disappointingly fails to explore in the same depth the reasons behind the Royal Flying Corps' narrow obsession with the reconnaissance role. There are clear heroes, notably Haldane and Churchill, but few real villains. Some, however, emerge with greater honour than might be expected, most especially Lord Northcliffe, who, for all his manifest faults, is credited with an honest and informed interest in the subject, and whom Gollin absolves of the charge of mere sensationalism for the sake of increased newspaper sales.

This book should be required reading for anyone with a serious interest in the development of British air power. Objective, scholarly, and well written, it is long overdue as a companion and counterweight to the narrow military focus of Sir Walter Raleigh's first volume of Official History. It is a matter of regret, however, that the author carries his commendable economy of style to the extent of omitting any concluding chapter. The book thus ends rather abruptly, and leaves the reader with a lingering sense that he would like to know more of the author's own interpretation of many of the events which he so ably describes. There must also be real doubt that the book will reach the wider audience it deserves when it is priced at £40.00 per copy.

Sebastian Cox

THE BATTLE OF BRITAIN – A JUBILEE HISTORY

by Richard Hough and Denis Richards
Hodder and Stoughton, 1989, £16.95 **ISBN 0-340-42903-8**

The Battle of Britain has already been well chronicled and there will no doubt be those who wonder whether there is room for yet another book on it. But it was after all one of the turning-points in history, and as such we may expect that it will continue to be written about, probably for a long time to come. Even so, one approaches a new book with some trepidation, half fearing one of those works which seeks to claim a place on our shelves merely by rearranging the history so as to mount a hobby-horse. Mercifully this is not one of those. It eschews polemics and provides a straightforward and scholarly coverage – fresh, balanced and comprehensive. Furthermore it is up-to-date; notwithstanding the fifty years which have passed, it is only recently that one could say that all the accounts are in (if, in historical terms, one can ever say that). The intelligence story, for example, did not come out until 1979.

The book is in three parts. The first, 'Before the Battle', is a survey of the developments from World War I onwards which led to the state of play on both sides as they faced up to each other in July 1940. It is particularly good on the evolution of the fighter operations room system. The main part of the book deals day-by-day with the unfolding of the battle itself. It is an admirable narrative which weaves first-hand accounts into the historical details and is illuminated with a wealth of incidental material along the way. The third part is retrospective. Whilst it pays due regard to subsequent controversies, it keeps them in perspective and does not let them run away with the action. The 'Big Wing' affair surely owed much to a confused mixture of both motives and meanings and the authors carefully separate out some of the different issues which were at play.

As for the circumstances of Dowding's departure from Fighter Command, there still remains what appears to be an incompatibility. Was he relieved of his command summarily over the telephone, or was he properly informed by Sinclair in a meeting between them? Dowding claimed the former: documentary evidence favours the latter. What is the answer? Lesser authors have imputed prevarication, monstrous and unthinkable with either of these men. Others, among

them A J P Taylor, Maurice Dean, Slessor and the authors of this present book suggest the fallibility of an old man's memory (although as Dowding himself said in a letter to The Times of 19 January 1970, this is hardly something he was ever likely to get wrong). Is it not possible, though, that both stories are true?

When Sinclair saw Dowding on 13 November 1940 he presumed he was telling him that he was to be moved on. The next job was described, and the successor was named. It should have been open and shut, but Dowding did not take it that way. He demurred, and asked to see Churchill. Sinclair, considerate as ever, acceded. Clearly, at this point, if the changeover itself was in question, the date was immaterial. So no date was mentioned, and for Dowding the rest would have been hypothetical. The next day he saw Churchill, who did not allow him the option of refusing. Sinclair was informed and he then concluded the matter by phoning Dowding to confirm the date. For Sinclair that was merely the confirmation of an incidental, but for Dowding it was an incidental which made the hypothetical become real – the 'posting over the telephone'.

But all of this is of little account beside the story of the battle itself, and this is one battle – perhaps one of the few – where controversy and reassessment have never clouded the sweep of events or their significance. The authors call their book A Jubilee History; fifty years is a far enough remove to allow an objective view and that, most ably, is what they provide.

Ian Madelin

BUSINESS IN GREAT WATERS - THE U-BOAT WARS 1916-1945

by John Terraine

Leo Cooper, £19.50 **ISBN 0-85052-7600**

Few, if any, members of the RAF Historical Society will be unaware of John Terraine's history of the RAF in the European theatre during the Second World War, The Right of the Line. He has now turned his attention in more detail to one particular aspect of this war, that in which the RAF and the Royal Navy co-operated so closely and to such effect: the campaign against the U-boat.

Business in Great Waters takes full advantage, not just of the available British source material, including the intelligence story related in Hinsley's recent volumes, but also of much German work on the subject, including that of Jurgen Rohwer; moreover, as in The Right of the Line, the author makes much of the commonalities between the two World Wars. Indeed, a long section of the book is devoted to the U-boat war of 1914-1918 and a further section to the developments between the wars, thus enabling the reader to put the experiences of World War II properly into context.

While much of the book will be primarily of interest to Naval audiences – particularly the frequent detailed descriptions of convoy battles – there is much here for RAF readers to ponder. For example, there are some telling conclusions about air power at the end of the First World War – lessons which were there to be learnt but were in fact forgotten until the Second World War taught them all over again. One of these was that the most useful role for aircraft was convoy protection rather than trying to kill U-boats, something which was certainly not properly appreciated in 1939/40. To be fair, John Terraine reminds us that the Germans too had little understanding of the value of air-sea co-operation, a state of affairs which lasted throughout the war.

The Battle of the Atlantic is, of course, fully described, with its fundamental importance to the whole Allied strategy being properly stressed. While the conventional wisdom holds that May 1943 saw the climax of the battle, the author suggests with Rohwer that the true turning point came as early as late 1941, when the re-routing of the convoys with the aid of Ultra saved 300 ships by avoiding battles. He

reinforces his point by reminding us that British doctrine held that the primary object of a convoy was to ensure safe and timely arrival at its destination, in contrast to the American belief that the convoy escort should concentrate on hunting and destroying U-boats. Terraine also disputes the traditional view of Roskill, Slessor and others that the Battle of the Atlantic was a defensive victory, and he again sides with Rohwer in calling it an offensive victory, essential in order to make Overlord possible.

Running through the whole story is the constant interplay of advancing technologies; we are reminded that nothing is ever static, and that in the later stages of the war the new types of submarine being introduced by the Germans fortunately came just too late. It is a pity that John Terraine was unable to devote more space to these new developments, for it really is quite remarkable how much German inventive skill was able to achieve in the face of steadily increasing difficulties. One can rarely, however, have everything, and overall he has again given us an invaluable book containing a great deal of food for thought.

Henry Probert

DARKNESS SHALL COVER ME - NIGHT BOMBING OPERATIONS OVER THE WESTERN FRONT

by Humphrey Wynn

Airlife, £12.95 **ISBN 1-85310-065X**

The publisher's 'blurb' tells us that this is the true story of Lieutenant Leslie Blacking, who flew Handley-Page O/400s of 207 Squadron on long-range night bombing missions in 1918. It grew out of the author's conversations with Leslie Blacking over many years, and is in the nature of a tribute to the brave crews who undertook those hazardous missions. Like all 'faction', however, it is impossible to separate the weft of fact retailed by Blacking from the warp of fiction provided by the author, but the author does succeed in giving some insights into the peculiar world of a pioneer night bomber squadron on the Western Front, and in reminding us of the RAF's first attempt to carry out a strategic bombing offensive. The pressures on the crews, the dangers posed by flak, fighters, weather, and primitive navigational aids and techniques, are all vividly portrayed, and if the author's sense of chronology seems at times a little wayward, he gives us plenty of food for thought.

Sebastian Cox

BOOKS RECEIVED

FROM NEEDLES SEWING TO IRONS SOLDERING

by Amy Bridson WAAF.

Reminiscences of a WAAF radar mechanic.

Merlin Books, £2.95.

PILOT DIPLOMAT AND GARAGE RAT

by Air Cdre H M (Toby) Pearson.

1928 Cranwell contemporary of Bader and Whittle – career story.

Merlin Books, £8.95.

FLYER'S TALE

by William W Hall.

Bomber pilot and POW.

Merlin Books, £2.95.

UNITED STATES MILITARY AIRCRAFT SINCE 1909

by Gordon Swanborough and Peter Bowers

Putnam Aeronautical Books £35.00

SHORTS AIRCRAFT SINCE 1900

by C H Barnes, revised by Derek James

Putnam Aeronautical Books £28.00

Revised and updated versions of two Putnam classics. If you do not have the earlier editions, then these are well worth buying – if you do have the originals, there is still much new and revised material of interest.

THIRD ANNUAL GENERAL MEETING OF THE SOCIETY

Monday, 13th March 1989

Extract from the Chairman's Report

The Chairman welcomed members to the Meeting and said he would ask the General Secretary to mention some points of detail before he asked for their consent to take the Notice of Meeting as read.

The Chairman stated that once the formal business of the Meeting was concluded there would be a brief discussion period on the Society and its future prior to the lecture by Mr Denis Richards and Air Commodore Henry Probert.

The Chairman said he hoped that members would consider that it had been a good year. Since the last AGM, when Cecil James had given members an enlightened view of the impact of the Sandys' Defence Policy on the Royal Air Force, we had had Dr Horst Boog, who is the Air Historian of the *Bundeswehr*; he made the very important point that the *Luftwaffe* were a superb tactical innovative fighting force at squadron level but lacked any strategical and long-term policy perception as to where they were going. He thought this point was something worth hammering home to the mid-rank and mid-career officer in the Air Force today. It was that history does have relevance, not perhaps so much in his day-to-day operating sphere as it might have done in the past, but what individuals can do and what has been done by individuals or groups of men or women in face of incredible difficulties when everything might have led them to think that the impossible could not be achieved. This was followed by a fascinating seminar on the Royal Air Force and clandestine operations in NW Europe. Later this year we will have another seminar on the Berlin Airlift and on 23rd October, for the first time with the academic world, a one-day seminar on the origins and development of the British strategic deterrent 1945-1960. This is going to be chaired by Marshal of the Royal Air Force, Sir Michael Beetham and is in conjunction with King's College, London.

In 1990, inevitably, we must cover and look at the Battle of Britain, but we intend to do that early on in the year before the

pressure of events in the latter half, which we can see already growing and we obviously must be very careful here in co-ordination with the RAF Benevolent Fund and the Battle of Britain Fighter Association, all of whom are going to be heavily involved. We are also looking at the possibility of covering the USAF/RAF co-operation since the war. We have discussed with Cranwell about what we can do to meet the commitment which the Committee has recognised to the members of the Society who live further north of the Thames. We in fact also wish to make some impact on the young officers, both male and female, of today, who are at the formative stage of their careers, to give them a sense of Royal Air Force history. We have also tried to keep the subscription rate at a reasonable level, the Treasurer will in fact cover that himself. He has been helped to a considerable degree by the sponsorship which we have had from a number of firms in the industry. I must mention British Aerospace, Rolls-Royce, Ferranti and last, but certainly not least, because last week there arrived a cheque for £1,000, from GEC Avionics. The membership numbers are well over 450 at the last count, but your Committee is convinced that the original approach which was adopted by the Society of covering policy, personalities and operations has, from the feedback we have had from you, been a successful one. If it is not covering what you wish, please say so. From the point of view of the historians, it is providing something which is unique and indispensable in clothing the framework of existing history and Air Force history which, in many instances, has already been written, with the personal views and personal experiences of people who took part in a way which it could not otherwise be done.

All this again could not have been achieved without a lot of work by a voluntary committee who, to a man, put in a tremendous amount of time on your behalf. I am grateful to them because they do all the work and it has been, I hope you will feel, a successful year.

Appointment of Committee

It was RESOLVED that the reappointment *en bloc* of nine members of the existing Committee of the Society (excluding ex-officio members) for a year to the end of the A.G.M. in 1990 be and is hereby approved.

RAF HISTORICAL SOCIETY – USEFUL ADDRESSES

General Secretary:	B R Jutsum FCIS 28 Clavering Walk Cooden Bexhill-on-Sea East Sussex TN39 4TN
Membership Secretary:	Cdr P O Montgomery VRD & bar 28 Shirley Drive Worthing West Sussex BN14 9AY
Treasurer:	A S Bennell Esq, 81a Ashley Road Walton-on-Thames Surrey KT12 1HQ
Editor of Proceedings:	Brian J H Blancharde 5 St Helena Road Westbury Park Bristol BS6 7NP

ERRATA

The following errors in *Proceedings 5* eluded the Editor, but not Group Captain Hugh Verity:

p.15, para.2, last line - for ‘hydrogen’ read ‘Heydrich’.

p.25, para.3, first line - 400 was the number of people picked up by Lysanders. The total number picked up by RAF aircraft of all types landing in France was approximately 650 (including 23 in one Dakota!).

p.28, line 8 - for ‘Reviere’ read ‘Rivière’.

p.48, line 3 - for ‘Antic’ read ‘Hentic’.