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PHOTOGRAPHIC RECONNAISSANCE IN WORLD WAR II

Sir Frederick Sowrey:

Good morning to you all, we are well-met, Members of the Royal Air Force Historical Society, the Benson Reunion and also the Medmenham Society, we are here by courtesy of the Royal Air Force Museum whose Director, Dr Michael Fopp, is a member of the Society and who lets us use this facility for nothing; a remarkable generosity which materially helps the finances of the Society. He mentions to me that Adrian Warburton's medals and log book are coming up for auction in the not-too-distant future and he hopes to acquire them for the Museum.

Our subject today is Photographic Reconnaissance in the Second World War. Aerial photography of course was one of the earliest uses of the air. In the First World War it was largely used for artillery spotting or in support of the Army; in the Second World War I would suggest that it was used tactically, strategically and for economic and political purposes.

We have a marvellous gathering of those who were participants in this field; this morning we have Sir Neil Wheeler who is going to talk on the early PR operations of which he was a great protagonist; we have also Sir Alfred Ball who is going to talk on the Spitfire operations, and Air Vice-Marshal Dodd talking on Mosquito operations; all under the chairmanship of Professor R V Jones. He was our first speaker at the launch of the Royal Air Force Historical Society some five years ago so he was in at our birth pangs, therefore we owe him a special debt of gratitude, not only for that particular launch, which I know drew people who might not otherwise have come, but also for taking the chair today. He is acknowledged as one of the great scientists who, at a very tender age, if he doesn't mind me saying so amongst this audience, made an inestimable contribution to the victory in the Second World War. The officers of the Society will make administrative announcements from time to time to hopefully guide you in the right direction. Sir, it's all yours.

Professor R V Jones:

Thank you very much, Sir Frederick. Ladies and gentlemen, any of us, all of us in any way associated with Photographic Intelligence in World War II will be gratified by the fact that the Royal Air Force Historical Society has organised this seminar. I go back to a day in 1944, I think; a meeting in the Air Council Room to discuss the future of our air defence and one of our most senior scientists, Sir George Thomson, who was scientific advisor to the Air Staff, almost innocently asked the question, 'One thing that I cannot understand, why was it that the Germans had not conducted any photographic reconnaissance over London from, as it turned out, 10th January 1941 to the 10th September 1944, and yet our aircraft, and particularly as he had seen the photographs, were going hundreds of miles every day into Germany'. Well, there was a bit of a silence which was broken by a voice shouting out, 'You may well ask!'. This was from one of the most excitable of my scientific colleagues. We had been together at Oxford before the War and he had gone into Fighter Command to become Chief Radar Officer; Derek Jackson was not only a Fellow of the Royal Society and a rider in the Grand National but was also no respecter of ranks, and it was of great amusement for me to see him subdued to some extent in the early days, as he was in uniform and should show some deference to senior officers. But the outburst 'You may well ask!' stays in my memory as one of the great moments in the Air Council Room and, in a way, what this seminar today is I hope doing is to throw some light on this extraordinary fact. Sir George Thomson, a Nobel Prize-winner, had been a pilot himself in the first war and his opinion was very much to be respected.

Why was it that, if you had looked at the situation that you had in 1938 or 1939, which of the two sides would you have backed as regards photographic reconnaissance? I for one would have given the Germans a strong lead. We knew they had better scientific instruments, we knew they had better cameras, they had the marvellous Zeiss lenses, they also had, as it turned out, a very promising photographic aircraft in the Heinkel 119, they were able to produce photographs on a relatively large scale of high quality. We had the F8, F24 cameras with 5-inch and 8-inch lenses – whilst the Germans were up to 75 centimetres. How was it that the war should have seen this complete reversal of the state of competence? Well of course, there are many answers; one that I believe will come out in our

first talk from Sir Neil Wheeler gives part of the answer and it is a great pleasure for me to meet him again and to be introducing him because, again my memory goes back to a very deep night at Bomber Command in 1940 – 16th November, two days after Coventry – when everyone at last was trying to do something about the German beam stations and the question was; could we bomb them out of existence? The first thing was to know where they were, although I knew from Enigma precisely where they were, we had no photographs from which 2 Group could be briefed as they would be mounting the attack. There weren't any.

That day a photographic Spitfire had gone out and so here were the photographs, here was the pilot who had flown the sortie, a Flight Lieutenant Wheeler; sadly we couldn't make the attack in the end, for the weather had been too bad for good photographs and so it had to be postponed; one thing that I remember about this was seeing the flight lieutenant, a very young man in those days, getting a little bit restive; it was a Saturday evening and my suspicions turned out to be right. He had a date back in London and there was no obvious way in which he was going to get there. Fortunately, at that stage I had the benefit of a staff car and I had a word with him and was able to give him a lift back; we have been the firmest of friends ever since. Here he is now to tell us about those early operations in which he took so prominent a part. Sir Neil Wheeler.

Sir Neil Wheeler:

Mr Chairman, ladies and gentlemen, I would like to continue with some of those reminiscences, but I don't have the time. Before I start talking about the early days, I think it is as well if I explain when I intend to end the early days. I know that my old friend Geoffrey Tuttle, whom I frequently met until he died about two years ago, felt that a very considerable change took place in PRU at the time that it left Heston and went to Benson. It is true that it had ceased to be Cotton's circus in the summer of 1940 but it certainly became Tuttle's circus. It was a strange unit to say the least of it, and Heston, where Geoffrey Tuttle also commanded the station, was quite unlike any pre-war RAF station that I knew! In short, on Boxing Day 1940, PRU went to an ordinary Royal Air Force station to become an ordinary Royal Air Force unit under, if I may add, a very ordinary RAF Station Commander – and I think it was a good thing for the RAF. So let me go back to the beginning.

In 1919 a Member of Parliament said, 'We have beaten the Germans in nearly every invention or development of engines of war. But it is in the realm of aviation photography that our supremacy has been most conspicuous'. The official history of air warfare in World War I, entitled *The War in the Air,* stated: 'The camera pictures only what is there, omits nothing, provides a record which can be easily duplicated and supplies a means of recording'.

Despite all that, aerial photography was to be sadly neglected between the wars. In the First World War most photography was connected with the land battle and, for far too long, remained within the Royal Air Force one of the main duties only of Army Co-operation squadrons – usually hand-held obliques taken from the open rear cockpit of a relatively slow aeroplane, in 1939 the Lysander. It is interesting to note, for example, that the interpretation of photographs remained an Army responsibility in the years between the wars and the School of Photography at the same time remained at Farnborough close to the home of the Army, Aldershot, where there was an Army Co-operation Squadron. No. 4 Group Bomber Command almost confined its interest to using photography to check on practice bombing attacks. My only photo was from a flight on 12th April 1938 from Worthy Down to Newcastle in a Wellesley at 8,000ft lasting about 5 hours. Perhaps the best use was abroad, where dependent territories were surveyed by RAF air photography, a good topical example being Iraq.

This background of photographic reconnaissance was far removed from the concept of operations we knew in World War I. The basic initiative for change came from one Wing Commander Winterbotham, Chief of Air Intelligence in the Secret Intelligence Service. Winterbotham had been receiving the photographic results of some clandestine French flights in the late 1920s and early 1930s and it gave him ideas. He started looking around for somebody prepared to undertake such work in the late 1930s. He was steered towards a very remarkable man, Sidney Cotton, best described as a buccaneering entrepreneur. At the time, Winterbotham was working closely with the French and jointly they employed Cotton to undertake a number of secret photographic missions over Germany in a Lockheed 12A chosen by Cotton. Cotton based himself and his aeroplane at Heston and certainly produced some truly remarkable results.

The next great milestone in the development of photographic reconnaissance was the coming-together of Cotton and Flying Officer Maurice Longbottom, better known as 'Shorty'. Cotton had gone to Malta to cover important Italian targets in the Mediterranean area and he met Longbottom who was an enthusiast about aerial photography. Cotton enlisted him as an assistant – after a few administrative problems with the AOC Malta! As a result of working with the dynamic and determined Cotton, Longbottom produced a memorandum entitled 'Photographic Reconnaissance of Enemy Territory in War' and he submitted it to the Air Ministry in August 1939. It divided reconnaissance into two categories: tactical work in the immediate vicinity of the front line and strategic reconnaissance of enemy territory behind the area of conflict. The memorandum was remarkable in the manner that Longbottom foresaw the problems of reconnaissance – in his view, more dangerous than bombing – and suggested the solution. In his words: 'This type of reconnaissance (*strategic*) must be done in such a manner as to avoid the enemy fighter and aerial defences as completely as possible. The best method of doing this appears to be the use of a single small machine relying solely on its speed, climb and ceiling to avoid detection.' To my mind, this was a most profound statement and it's worth remembering that it was not made in the Air Ministry. It was made by a flying officer. He was saying, in effect, do not try to outfight the enemy but use stealth. It took a long time for that to sink in and for the Air Ministry to accept reliance on altitude and speed.

Longbottom's boss, Cotton, had the problem of getting the right aircraft. Both wanted Spitfires, but in 1939 they were like gold dust. Every possible alternative was examined because official opposition to Spitfires being used for anything other than air fighting was both strong and understandable. Fortunately, the Unit at Heston came under Fighter Command and, moreover, Dowding had been impressed by Cotton's work in improving the speed of the Blenheim. It is recorded that Dowding – perhaps rashly – asked if there was anything he could do for the Heston Flight, and the persuasive Cotton immediately said, 'Lend me two Spitfires.' And he got them! They landed at Heston the next day – that was in October 1939. CAS had already personally appointed Cotton to command the Heston Flight and now the flight had the aircraft it wanted.

Just a few words about the name of the flight. Within less than a year it had been given many names. The reason for the changes was, of course,

security – most certainly the frequent change of name must at least have confused the enemy! In fact we were to learn in time that one of our aircraft landed at an airfield near St Omer in the summer of 1940 – obviously forgetting to check on which side of the road the traffic was driving. The Germans must, therefore, have been well aware of our activities in the summer of 1940. The Heston Flight had been formed on the 22nd September 1939 and by 1st November it became No 2 Camouflage Unit. Then, in November 1939, a detachment known as the Special Survey Flight moved to Seclin in France and almost immediately became No 212 Squadron at the request of the Commander of the British Air Forces in France, and it remained so until the fall of France. In the meantime, on 17th January 1940, the parent flight at Heston was renamed the Photographic Development Unit. Finally, in July 1940, the Unit moved from Fighter Command to Coastal Command and was renamed the Photographic Reconnaissance Unit.

You may wonder, as the unit expanded, where the pilots came from. At Heston, after midsummer 1940, when Geoffrey Tuttle took over command from Sidney Cotton, we had four flights, each of about six pilots. We were a strange lot because almost everybody was an experienced flight lieutenant. Geoffrey Tuttle personally hired and fired. He had commanded a Battle squadron before the war and that's where he looked for most of his pilots. They were, after all, used to handling Merlin engines and, I would add, because communication with one's navigator in the Battle was so poor and the navigator's view even worse, it was always as well to do a bit of navigation yourself. When we left Heston, recruitment changed completely like everything else and we received some pilots with very limited experience. Frankly, the RAF has always tended, when something new is being introduced – a good example is V-bombers – to presume that only special people can fly them. We soon learnt that postings in the Service are best when not restricted. After Christmas 1940 PRU. became a relatively normal unit and postings followed suit. At one stage I believe we even boasted a pilot officer or two.

Longbottom had always felt that the Spitfire was robust enough to carry a large load and certainly had the power. Without its service load as a fighter it could carry a considerable amount of extra fuel, oil, oxygen and cameras. The original two Spitfires were prepared in the Heston workshops by removing all armament, radio and surplus weight such as

the heavy bullet-proof windscreen. Gun holes were filled by metal plates and all cracks were blocked with plaster of Paris, as well as polishing all external surfaces in a hard, sleek gloss. All of this raised the top speed of about three hundred and sixty miles per hour to three hundred and ninety. Camouflage was obviously going to be important and Cotton remembered that, in May 1939 at Heston, he watched the Maharajah of Jodphur depart in his private aircraft, and, despite good visibility, he lost sight of it very quickly. The aircraft was painted duck-egg blue and merged into the background. That colour was registered commercially by Cotton as Camotint and became the initial PR colour. But it did not last for long and, quite early in 1940, the sky-blue that we all know so well was introduced. However, Camotint was retained for low-level sorties, which I will come to later.

But, of course, the important thing was range. All major modifications had to be approved by the Royal Aircraft Establishment at Farnborough and the RAE were only willing initially to allow an extra twenty-nine gallon tank behind the pilot. That was obviously going to be a great help, because the first Spitfire sortie had been carried out by Longbottom from Seclin in France on 18th November 1939 using a Spitfire PR1A (without extra fuel). Bad weather forced him to return, but it was clear that more fuel would be required. Twenty-nine gallons took the fuel to one hundred and fourteen gallons and, with the wing cameras, it was known as the PR1B. The first was collected from RAE on 16th January 1940. It had a range of about seven hundred and fifty miles.

Pressure for distant areas to be covered, particularly for naval targets, gradually led to the fuel being increased by thirty-gallon stages. Ultimately this led to the F-type with twenty-nine gallons behind the pilot and thirty under each wing. The cameras were also behind the pilot. Finally, in October 1940, we received the PR1D, designed as a Spitfire for PR. It had sixty-five gallons in each wing leading edge. It was, in other words, a wet-wing aircraft, an unusual thing in those days. The fuel load went up to two hundred and fifteen gallons and the range to about one thousand seven hundred and fifty miles.

Naturally this great extension of the range of the Spitfire and the Merlin engine brought other requirements. We had to have considerably more oil tankage and a tank was designed to fit like a large chin under the

nose just behind the propeller. But most of our early problems came from the altitude at which we were flying. It has to be remembered that there was not much flying before the war over about 20,000 feet. (My log book shows thirty times over 10,000 feet in five years before 1939.) Most of our Spitfire PR sorties took place between 25,000 and 35,000 feet where temperatures were around minus 50°C. In the early days we had problems with, for example, the vent of the oil tank and some form of heating was required. The same was true of the cameras. Cockpit heating was an obvious necessity. Because we did not appear to be experienced in flying in low temperatures, nobody seemed to think of harnessing the hot air from the coolant radiator until 1942 when, at long last, cockpit heating was provided.

Frankly, I found the extreme cold most uncomfortable. On my feet I wore a pair of ladies' silk stockings, a pair of football stockings, a pair of oiled Scandinavian ski socks and RAF fur-lined boots. On my hands I wore two pairs of RAF silk gloves and some special fur-backed and lined gauntlets which I had to buy for myself. It was essential to retain some fingertip control, particularly for the camera control box. Otherwise, I wore normal uniform (RAF battle-dress had not been invented in 1940) with a thick vest, roll-neck sweater and a thing called a Tropal lining which was stuffed with a form of kapok.

But to me the most serious shortcomings that the lack of high-altitude flying brought were the use of oxygen and the almost total ignorance about condensation trails. Before the war it was mandatory to turn on oxygen at about 10,000 feet on the rare occasions that you went to that great height, but the supply system was primitive. We had a crude, very leaky cloth mask and a form of continuous supply. In other words, once you turned it on, you got it whether you were breathing in or out. To say the least, it was most wasteful; and oxygen cylinders are heavy. We had to change things since we were using oxygen for about four or even more hours. We had our own doctor and, with RAE's help and the use of other masks including a captured German one, we designed a good rubber mask. In November 1940 the oxygen economiser was introduced which worked with a form of bellows and only gave you oxygen when you inhaled. Inevitably we called it 'Puffing Billy'. Even here we had low temperature problems with the fabric used in the construction of the early economisers. Nonetheless, all these things greatly helped our operations.

Until the Battle of Britain I have to admit I had never heard of a condensation trail. In PRU we had removed the fighter bullet-proof windscreen plus the rear-view mirror on the top. We had fashioned teardrops in the side of the canopy, principally to get a better downward view and in them we fitted small rear-view mirrors. The mirrors were less to see approaching fighters than to prevent one producing a condensation trail over enemy territory – signing one's name in the sky was a certain route to disaster! From Heston we carried out a great deal of research work into the formation of condensation trails, aided by Oxford University, before we established that it was the exhaust and not the propeller that produced the tell-tale trail. Normally one endeavoured to keep just below condensation height, but, on rare occasions, one could pass through the layer and fly above with the advantage that one could see enemy fighters climbing up.

Needless to say, we faced great problems with weather forecasting and navigation, but, in general, they were no worse in the early days than the later Spitfire operations. I will therefore leave the subject to Air Marshal Ball to cover.

What I would like to end on is a few words about low-level operations. Apart from any other considerations, it was our Chairman today who first interested me in these operations in the autumn of 1940. But, before talking of Spitfires, I should add that, from the outset in 1939, we had used Hudsons and Blenheims for low-level operations when cloud cover was available. They did not become a regular activity and I will comment no further.

After the evacuation of Dunkirk, it became essential to get photographic cover of the ports from Flushing to Cherbourg on at least a daily basis to monitor preparations for invasion. If we could not get high-level photographs we went at low-level and took obliques. The aircraft generally had an extra thirty gallons behind the pilot, the standard armoured windscreen and the full armament of the fighter version. As I said earlier, they were camouflaged duck-egg blue, although we did experiment with off-pink. When the threat of invasion decreased towards the autumn of 1940, these low-level sorties continued in order to meet the other requirements of intelligence. I did some low-level sorties in late 1940 at the request of Professor Jones to assist in his work on *Knickebein*

navigation systems.

I have been speaking on a subject that I found personally very fascinating. I had volunteered for the duty and never regretted spending over eighteen months in PRU where I was a Flight Commander and a Squadron Commander. I could drone on for a long time, but others follow me and I must leave more to the Discussion Period.

Professor R V Jones:

I imagine there will be quite a number of members of the audience who would like to ask questions and there will be time for these after the next two addresses so that we can discuss the whole of the operational picture all in the one session before lunch; for example, people might like to ask more about Sidney Cotton and what happened to him, but before we do that we have Air Marshal Ball to talk on Spitfire operations and, after that, Frank Dodd to talk about Mosquito operations. Let us congratulate Sir Neil for keeping to time very well indeed.

Sir Alfred Ball:

Mr Chairman, ladies and gentlemen, I'll take over at that point and continue for the next four and a half years at Benson. Benson was, as Sir Neil pointed out, an ordinary RAF station when No. 1 PRU arrived from Heston but, as he also said, it was what PRU needed after those strange, unique years at Heston; it needed to settle down to demonstrate its full potential, to expand as may be required in a normal administrative and logistic environment, and that is precisely what Benson had to offer. It is interesting to think for a moment because, in fact, No 1 PRU was not an ordinary unit, it was never an ordinary unit, and because of that, Benson too was to become an extraordinary station. It took about two to three years to get there. By 1943, Air Commodore John Boothman, of Schneider Cup fame, had taken command and the station was poised to become the headquarters of a full PR Group with commitments to PR units in all theatres, both at home and overseas; this was a marked advance from those early days in 1941.

In 1941 and 1942, the great bulk of photographic reconnaissance was flown by Spitfires, Blenheims and Maryland were used occasionally to meet certain specific requirements, as indeed were other aircraft such as Hurricanes, but mostly in a limited way and overseas, and the PR

Mosquito came into service only gradually during 1942. I will, therefore, concentrate on Spitfire operations, and particularly the problems facing the pilot and how he resolved them. I will, in the main, focus my remarks on the operational doctrines and procedures developed and used in No 1 PRU with its HQ at Benson because, as you will appreciate, they formed the basis of those used in all theatres of the war.

Operational practices overseas inevitably tended to follow similar patterns. For example, when I formed and took No 4 PRU (later No 682 Sqdn) to North Africa for the TORCH landings in October '42, we found that our Benson experience was invaluable and thoroughly applicable throughout the Mediterranean theatre and we advised the American 7th Photo Group, straight over from the States and with whom we formed a joint PR Wing, accordingly. These practices were adjusted and developed with local experience as the wing advanced from Algiers through Tunis to San Severo in Italy. In Malta and the Middle East operational experience and practice were not dissimilar -when all is said and done, it was the same enemy and often the same pilots and aircraft that we came up against wherever we had to operate. Moreover, the Middle East (680) and Malta (683) PR squadrons joined up with the North African PR Wing in Italy to form No 336 Wing. Furthermore, from 1942 onwards, replacement pilots and aircraft came from the UK PR OTU and Benson, where European operational experience and tactics were part of the daily curriculum.

In the Far East, of course, there were differences for we were dealing with a very different enemy, Japan, but even there many of the same factors applied, and Benson had a long arm. Also, the Commander of the PR Force (681 and 684 Sqns) was Group Captain Bill Wise (whom we are fortunate to have with us here today) who had been one of the early Flight Commanders at Benson. And then, in 1943, No 106 Group was established at Benson to control all RAF PR training, operations and photo-interpretation (PI) in the European theatre, and to co-ordinate the despatch of all PR aircrew, photographic and PI personnel, and PR aircraft and equipment requirements on a worldwide basis, thus ensuring the Benson lineage.

Before going any further, I think we should remind ourselves of the air situation over Europe during 1941. Apart from short-range fighter sweeps

over coastal areas in NW France and Belgium, there were virtually no RAF daylight operations over Germany and occupied Europe, and the *Luftwaffe* had complete control in the air. The Spitfires of No 1 PRU were the one daily exception. This situation changed gradually during 1942 and, more so, as the US 8th Air Force started daylight bombing, but by and large it remained broadly true during that year as well.

In 1941 No. 1 PRU. comprised four Spitfire Flights, two at Benson, another at Wick in the north of Scotland covering Norway and a fourth at St Eval in Cornwall looking after Brest and western France down to and including the full length of the Franco-Spanish frontier. The flights at Benson were responsible for PR over Germany, the Low Countries and the remainder of France plus northern Italy.

The number of aircraft in each flight varied to meet requirements, but usually there were about six long-range, unarmed sky (PR) blue Spitfires fitted with a number of differing fuel tank installations. These were the outcome of some of the experimental developments at Heston already described by Air Chief Marshal Wheeler – not surprisingly, it was decided to equip all PR units with the longest range configuration, experimentally a 'D' type, colloquially a bowser! This had integral fuel tanks in the wings, 65 gallons a side plus the standard 85 gallon main fuselage tanks, giving a total of 215 gallons and a range of some 1,400 to 1,500 miles.

Additionally, the flights at Benson and St Eval had one or two standard fighter Spitfires with guns for low level reconnaissance below cloud, and camouflaged a pinkish or greenish white (affectionately known as 'Dicers'). These were dispensed with in '42 when we standardised on the 'D' Type for the high level role and it, of course, was PR blue. From then on, we used the one aircraft for low as well as for high level operations – in my opinion its blue camouflage was just as effective as the earlier white variations whilst the extra range was all-important and of far more significance.

Let me now turn to the specifics of PR flying which were very different from all other RAF roles. First and foremost, we always flew alone and far from the madding crowd which encouraged a very independent and individualistic frame of mind – it was the ideal job for a 'loner'. The pilot was given his targets and any possible alternatives adjacent to his track in case he had film left over or cloud covered his

main targets; he was then left to plan his routes and methods as he wished. He was on his own for long periods, five or six hours on the longer sorties; the one thing he did not want was to meet other aircraft, enemy or friendly produced the same reaction when one met them in the middle of Germany. One of my worst frights occurred when a fighter came out of the sun and passed 50ft away going in the opposite direction near Munich – it was another blue Spitfire!

Throughout the war, most PR was flown at high level to ensure maximum survivability and to achieve the required radius of action, around 30,000ft in the early years and, later in the war with more powerful engines, up to 44,000ft. Low level sorties (Dicing) were relatively few in number when compared with those flown at high level. They were ordered only when very large scale pictures were needed or when, in an emergency, high level photography was impossible for one reason or another. They were, however, keenly sought after for the targets were invariably high priority and exciting, and usually given only to the more experienced pilots. Some fascinating low level sorties were flown, such as finding the *Bismarck* and *Tirpitz* in Norwegian fjords, assessing new types of radar, and locating flying bomb and rocket sites in the Pas de Calais.

High level operations had one severe and unavoidable restriction, condensation trails. Depending on air humidity, these could occur down to about 20,000ft. We obviously could not fly over enemy territory dragging contrails along behind the aircraft, it would be asking for trouble, and those who forgot invariably found it. We were, therefore, forced to fly just below the contrail level, unfortunately this was inclined to vary and so one had to keep a careful watch in the rear-view mirror – it was a particular problem in winter. Moreover, having to fly at lower than optimum heights had a retrograde effect on our range, tactical flexibility and, as it happened, our relative performance to enemy fighters. On the other hand, there was an advantage; if there was anyone above you, with luck, you should see his contrail! The concept of flying five thousand to ten thousand feet up in the contrail belt, or hopefully above them, was tried out in the last nine months of the war on the assumption that you would see the trail of anyone climbing up to intercept you. One of the Mosquito squadrons (544) employed this tactic with some success, but it was not taken up generally.

At height outside air temperatures were between minus 30°C and minus 50°C, very cold indeed when you had an ineffective cockpit heating system. Fortunately, by the middle of 1942, this problem was largely behind us. Until then, however, apart from on very short sorties, we had to fly in heavy leather Irving suits, both jacket and trousers, making it impossible to climb into the aircraft on your own or move much when you were in. Electrically-heated gloves were also necessary and they were inclined to burn your hands or not to work at all!

Another factor which impaired pilot efficiency was the lack of cockpit pressurisation. As a result, and despite using 'full' oxygen all the time, we were always anoxic in varying degrees dependent upon how long we had been at high altitude. It was not until early 1944 that a pressurised version, the Mk X became available. Regrettably it was not a success and was unpopular due to poor visibility through its strengthened yellowish canopy, and reduced performance due to its extra weight – it was withdrawn from European operations towards the end of the year. Despite anoxia, however, young men seemed to get by and, as I have indicated, preferred good operational visibility to physical comfort.

Until late '42, we had no radio fit. Ironically, and at that time, this may have been a blessing in some ways. All was quiet and we could concentrate on the job in hand, we could not hear the disconcerting whine of enemy radar, and we became very aware that we depended entirely on our own skills to get back to base for we had no aids, other than a P4 magnetic compass, maps and a watch – not much to range far and wide over Europe in all weathers. However, we coped reasonably well and accepted the difficulties philosophically, even those that arose on the last legs of a return flight to base in really bad weather! Nevertheless, when VHF radio was fitted and became standard, it was a great step forward, particularly overseas where facilities were fewer and farther between.

Often one had to fly without any sight of the ground for several hours – meteorological forecasting was reasonably good considering the facilities and weather information available in those early years of the war, but it could be very wrong at times, and was, particularly as regards the high level winds. We had little knowledge of jet streams in those days and the term was not even used. Many times pilots have had to fly above 10/10ths (nowadays 8/8ths) cloud for four or more hours on uncheckable forecast

winds, using elapsed time and dead reckoning only, before descending through twenty to thirty thousand feet of cloud, hopefully over the North Sea or Channel to avoid the risk of hitting the ground in a low cloud base situation. Furthermore, if the forecast winds were badly wrong, instead of making a landfall as planned on, say, the Norfolk coast, you could find yourself in Yorkshire, or heading out into the North Atlantic if you were operating from Wick. VHF radio, thankfully, largely solved these problems – until then, however, there were a number of very unexpected and disconcerting landfalls! Incidentally, I believe the longest Spitfire sortie flown during the war was from Benson to Danzig (now Gdansk in Poland), about 1,500 miles including photography, in August 1941 by Flt Lt David Salwey – happily the forecast winds were reasonably accurate and the sortie was entirely successful.

In these circumstances, it was essential that the pilots selected for PR duties should have some operational experience and not be straight from the training machine. Vetting was thorough and volunteers were always preferred – usually not less than 500 hours and a previous squadron background was required. In 1941 there was no proper PR training unit. The Blenheim/Maryland PR Flight at Benson had, as a secondary role, the conversion of newly-arrived pilots to Spitfires, by means of a dual Battle! A period of about two weeks was allowed and, hopefully, this enabled them to get some ten to fifteen hours on Spitfires (conversion to type, two or three high level cross-country flights and some photography) before they joined their operational flights. Later on, a full PR operational training unit (No 8 OTU) was established at Dyce near Aberdeen. Courses were of three months' duration and some fifty hours were flown. Accordingly, the experience requirement for new pilots was reduced, but volunteers continued to be sought, particularly if they had operational backgrounds.

After listening to all this you are probably wondering how so much was achieved by Spitfires on photographic reconnaissance. Indeed, you might well ask why any pilot would want to volunteer or remain on PR in such demanding and uncongenial circumstances. However, many did, and they came back for more. Perhaps it was the Spartan trait in the British character, but also PRU was regarded as a somewhat elite club where aircrew, particularly, but other Branches as well, such as photographers and photo interpreters, when moved from one war theatre to another found

other branches of the club. But above all, it was the fascinating nature of the role which was closely involved in every operation of the war, land, sea and air, overt and clandestine. I certainly found it so and remained in PR continuously for six years.

It is a long time ago, but my memory suggests that the more difficult and uncomfortable things were, the greater the challenge and the more determined were we to succeed – when all is said and done, that was the spirit of the time in all walks of life – we had just seen off Hitler and the *Luftwaffe* in the Battle of Britain and now, come what might, we were going to carry on the good work, God willing, and He was. Perhaps an insight into the mind of a PR pilot in those days can be gleaned from the words of an old PRU rhyme:

> When you're seven miles up in the heavens
> That's a hell of a lonely spot
> And it's fifty degrees below zero
> Which isn't exactly hot
> When you're frozen blue like your Spitfire
> And you're scared a green shade of pink
> When you're hundreds of miles from nowhere
> And there's nothing below but the drink

There were fourteen PR units and squadrons established and operational at varying times throughout the war, namely:

> Nos1, 2, 3 and 4 PRUs
> Nos 540, 541, 542, 543 and 544 Sqns
> Nos. 680, 681, 682, 683 and 684 Sqns

Let us now look at the life of a typical pilot in a flight in No 1 PRU at that time. There were eight or nine pilots in each flight. An operational roster, rather like a squash ladder, was used to indicate when you were next to fly on operations, and when you had flown a sortie your name went to the bottom of the roster. Pilots flew on average about two or three sorties a week and so usually knew when they were likely to fly on the next day although, regrettably, it did not always work so smoothly with the inevitable availability problems – in operational emergencies, however, I have seen pilots fly six or seven sorties in a week, and one needs to remember that these were not just short sorties.

The day started at 7am, later in winter, with a briefing in the Met Office attended by all pilots. It was a very civilised starting hour, this was because photographs could not be taken successfully before 'first photographic light' (to avoid shadows, haze, etc.) and this was about three hours after dawn. Similarly, one aimed to finish photography some three hours before last light. In emergency we operated outside these but the results were never very good and usually had to be done again with all that that implied.

Prior to the Met briefing, the Flight Commander was given a copy of the daily target list allotted to his flight. The weather in the target areas, *en route* and at base throughout the day was then carefully studied. Targets and times were then allocated to pilots. Those who were flying went to the Intelligence briefing room to be given details of their targets and information on any other activity taking place in areas through which they might have to pass (this became increasingly important in later years when US aircraft were operating all over Europe in daylight; in 1941 it was not very significant). They then drove to the flight offices at the aircraft dispersal, marked their maps, calculated their tracks, courses and times, and made out their flight clearances, specifying UK crossing out and in times and places to prevent interception by our own fighters.

One went out to one's aircraft about twenty minutes before take-off and then climbed away, not forgetting to turn on the oxygen (there were several tragic and quite unnecessary fatal accidents as a result of this forgetfulness), aiming to be at operating height by the crossing out point on the coast (eg Coltishall, Clacton, Dungeness, etc.). Then the sortie really began.

Perhaps the most important operational and survival requirement on PR operations throughout the war was the ability of a pilot to keep a really effective look-out for all enemy activity throughout a sortie, and even more important to know how to. It ranked with turning on the oxygen. No matter how good his aircraft, if the enemy saw him first, he was liable to become a dead duck. Unfortunately, seeing before you were seen tended to come with experience, which was why so many PR losses were amongst relatively newly-arrived pilots, even though they were introduced to operations as gently as possible.

It took only a few minutes to cross the Channel and immediately one

started searching the sky for enemy aircraft. The coastal belt was always dangerous for it contained many *Luftwaffe* bases and one expected to see fighters; however, provided one saw them in good time, one could evade them. The same situation obtained on the return flight and one could not afford to relax when crossing out of enemy territory (we lost some of our best pilots due to this temptation; it was particularly risky coming out of NW Germany with the fighter bases in the Frisian Islands).

The interception threat, of course, continued all through a sortie, but there were high risk areas, such as the coastal belt and over key industrial cities, particularly if they had just been bombed. Furthermore, having to concentrate on map-reading and navigation *en route,* made keeping a continuous and effective look-out difficult, but it was essential. One always had to remember that for a sortie to be successful, one had to bring back interpretable photographs of one's targets, not merely to get back in one piece having successfully evaded enemy fighters, although that had its points! It was, for example, inadvisable to fly in a long straight track to a major target area, such as Hamburg, Stettin or Frankfurt. Irregular feints and doglegs were much more sensible and pragmatic. Although they complicated navigation and used a little extra fuel, they made interceptions far more difficult for the enemy (it was extraordinary how, if one did so, one often saw nothing *en route* even when, from listening to his radar or from seeing his marker *Flak*, you knew that he was attempting to intercept you). Unplanned doglegs definitely paid off.

Over major targets, such as the Ruhr and Brest, one was almost invariably shot at, sometimes with remarkable accuracy (one of my chaps was hit at 37,000 feet over Hamburg, and another shot down at 30,000 over Brest), but on many occasions it tended to be some distance away and low. A PR pilot was particularly vulnerable during long photographic runs when we was concentrating on accuracy and did not see a fighter or *Flak* until too late.

However, there were ways of overcoming this problem. When the *Scharnhorst, Gneisnau* and *Prinz Eugen* were in Brest, a standing patrol of Me 109s, circling up sun over Ushant, used to wait for us coming into Brest every day (only a German mind could plan like that!). The Navy wanted photographs of the ships and port area every day at the same times, first and last light (only a Naval mind could plan like that!). We

usually saw the fighters in time and raced in to Brest flat out. We had to get the job done very quickly and so, to avoid having to do two or three photo-runs, we turned the camera time interval down to its minimum and rocked the wings (about a two second cycle) as we crossed the port, thus covering the whole port area in one run (not the classic style for PIs, but perfectly satisfactory for confirming the presence of the three ships). Then we were off home, still flat out, with the '109s, hopefully, not yet in range – I was caught only once in 25 sorties, but got back to St Eval with the necessary photographs and some rather unnecessary holes.

Another tricky task was large area photography. For example, where maps were out of date or poor, we were sometimes required to cover areas calling for forty minutes or more over target. Inevitably interceptions took place and we lost a number of aircraft. On one occasion, I had to fly eight overlapping runs about 25 miles long, some forty to forty-five minutes' photography from twenty-eight thousand feet on the northern outskirts of Berlin. Two fighters appeared at about the halfway stage but I managed to lose them as there was some cirrus cloud about and, although they came up again, they seemed to be badly controlled and never got really close. Incidentally, it was their contrails that gave them away in the first place. I completed the task, but the extraordinary thing was that for the next two hours on the way home I saw nothing and had an unusually uneventful trip – I must have been badly anoxic or blind or both – but I like to think that there was an Angel on my wing tip.

In Tunisia at the end of '42, we had a lot of this sort of work to do, mostly front-line mapping for First Army. It was very costly and on one occasion we lost four aircraft in three days from a squadron of nine. The difficulty was the great concentration of FW 109s and Me 109Gs and standing patrols in the battle area (our own fighters were also having a bad time just then, December '42 and January '43). In this case the problem was solved by the replacement of our Mk IV Spitfires (tropicalised Vs) by Mk XIs whilst our fighters got Mk IXs – I will cover the relative aircraft performance situation in a moment.

The winter of '42/'43 was certainly a difficult time in Tunisia, with its great concentration of the latest German fighters and its very bad weather which brought contrails down to 20,000 to 24,000 feet which emphasised our problems.

Let me outline an experience in a Spitfire Mk IV at 24,000 feet (a bad height for the Spitfire but ideal for the FW 190) near Tunis. I was just completing some forty-five minutes of Front Line photography when I spotted four FW 190s some three to four miles away and about one thousand feet below going in the opposite direction. They turned towards me shortly after I saw them and I opened up to full throttle and dived slightly to gain speed as quickly as possible. Within a very few minutes, however, they were on to me and the first of eight attacks took place. My only chance lay in out-turning them. In the event I was hit by the very first burst of fire – having left my turn (maximum possible) a fraction too late – but although the aircraft was hit in a number of interesting places, the damage was not catastrophic. This one-sided combat went on for five to ten minutes until the FWs broke off, either out of ammunition or short of fuel. This sort of occurrence was by no means unique but the outcome was not always as happy.

I have touched on interception risks but not on the capabilities of PR Spitfires and enemy fighters, Me 109Es and Fs until mid 1942, then increasingly '109Gs and FW 190s. Until the end of 1942 we were still flying the old Mk Vs (Mk IVs overseas) with RR Merlin 45 engines. We could match the 109E's in speed and cope with the Fs too, provided we saw them in time for we could out-turn them, but we could not afford to lose much height as they could always outdive us. It was another story with the 109G and the 190. They were both faster, but the 190's best height was around 24,000 feet and provided we could stay at 30,000 feet, we had a chance at full throttle, but it depended on an early sighting of the enemy fighters, and preferably well before they saw you. The 109G had a better ceiling than the 190 but we could out-turn them both, so an experienced pilot could get away with it so long as he got his time to turn just right, but it was touch and go until we received the Spitfire Mk XI in early 1943.

As a result of these developments, the PR loss rate, which was just about acceptable during the first two years of the war, became quite serious in the last six months of 1942 and in early '43, particularly over NW Germany where experienced pilots only were allowed to operate, and in Tunisia, where there was that unusual concentration of 190s and 109Gs covering Rommel's last stand against Montgomery in North Africa. For the remainder of the war, however, Mk XI (Merlin 60 Series engine) and,

later, Mk XIX (Griffon engine) Spitfires were able to range freely over Germany, and indeed worldwide, with acceptable losses, even when they came up against the jet-engined Me 262 and the Me 163 rocket-powered fighter.

I have not mentioned Mosquito operations which over the last two years of the war contributed some 50% of the total PR effort. Air Marshal Frank Dodd as a Flight Commander in No 544 Squadron played a major part in this and I will now hand over to him to deal with the remarkable achievements of that aircraft.

Professor R V Jones:

Air Vice-Marshal Frank Dodd will tell us about Mosquito operations. I think it is true that the Air Vice-Marshal conducted the longest Mosquito flight in World War II against the *Tirpitz.*

Frank Dodd:

Mr Chairman, ladies and gentlemen: if I dare, and I don't think I dare, I will not contradict the Chairman but I don't think I did the longest Mosquito trip from the UK because I think somebody added in the refuelling hop to Sumburgh; but never mind, it was quite long.

My qualifications to speak on Mosquito PR operations are limited to Benson-based experience in the last eighteen months or so of the war. Happily there are many here today with much longer and more varied experience who will be able to fill in the large gaps in my own knowledge during the discussion. For detailed performance figures, dates, etc. I am indebted to Andrew Brookes, author of the book *Photo Reconnaissance;* and to Messrs Martin Sharp and Michael Bowyer, authors of that very comprehensive book *Mosquito.*

One of the greatest tributes to the Mosquito came from the enemy in the person of *Reichsmarschall* Goering. I quote: 'I turn green with envy when I see the Mosquito. The British knock together a beautiful wooden aeroplane that every piano factory over there is building. There is nothing the British do not have.'

As is generally known, the Mosquito was designed as a private venture by De Havillands in 1939. It speaks volumes for the foresight of Sir Wilfrid Freeman, then Air Council Member for Research and

Development, that he was able to persuade his Air Council colleagues to back this revolutionary project of an unarmed wooden aircraft for front-line use. The first contract, for fifty aircraft, was issued on the 1st March 1940 and such was the overriding importance now being attached to longer-range PR that twenty were switched from bomber to PR fit.

Before tracing the development of the PR Mosquito, it might be helpful to recall the war situation at the time the first Mosquito, W4051, was flown into Benson from Boscombe Down by Geoffrey de Havilland in July 1941. Pearl Harbour and the United States entry into the war in December 1941 was still nearly six months away, the German Armies were rapidly advancing upon Leningrad, the Crimea and the Ukraine, and the turn of the tide in North Africa at Alamein in October 1942 was almost eighteen months in the future. The two overriding priorities at that time were to keep the Atlantic supply routes from America open; and the necessity to keep Russia in the war by sending supply convoys to Murmansk of whatever we could spare. The German capital ships were a major threat to both our immediate objectives and success in containing and ultimately defeating it depended heavily upon intelligence derived from long-range PR. The disaster which befell convoy PQ17 to Murmansk on the 6th July 1942 illustrates the dangers which existed.

Before the advent of the Mosquito, PR coverage of Norwegian ports and anchorages north of Trondheim was very dependent on the co-operation of the Russians and use of airfields in the Murmansk area. From there the Spitfires were able to cover the most northerly targets but detachments took time to set up and coverage throughout the year was not feasible. The early Mosquitos could extend coverage from UK bases as far north as Narvik, using Leuchars as main base and Wick and Sumburgh for forward refuelling. Narvik was a vital intermediate port between Trondheim and Alten Fjord, used by Admiral Raeder's ships in developing their convoy attacks off the North Cape, and the intelligence derived from its PR coverage could give vital early warning to the Admiralty of likely enemy intentions. The Mosquito was also able to give virtually complete coverage of the Baltic.

So far as the threat to Atlantic shipping was concerned, Air Marshal Ball has already spoken of the very comprehensive coverage of Brest and other French ports by PR Spitfires operating from St Eval. The Mosquitos

were able to help as regards coverage of the more southerly ports and airfields which were near the limit of the Spitfire's range – Bordeaux, Marseilles, Toulon, for example. The extra range provided by the Mosquito was a godsend at this critical juncture.

The Mosquito had other advantages. The bomb bay provided room for additional cameras. W/T could be fitted as well as VHF. The second engine was a great comfort, especially over the long sea crossings. But, best of all, it could carry an observer who combined the duties of navigator with those of W/T, GEE, and camera operator. However, perhaps most vital of all was his job of keeping a lookout over the tail when over hostile territory, leaving the pilot to carry on with the navigation. On countless occasions this extra pair of lookout eyes ensured the safe return of the crew even if on occasion, very rare of course, it deprived the pilot of having someone to blame if they got lost. It was all very much a team effort.

At one time, early 1943, the euphoria in the Air Ministry concerning the PR Mosquito, especially as a camera-carrier, was such that the Vice-Chief of the day was almost persuaded by DD Photos to re-equip entirely with them. Fortunately the CinC Coastal Command backed the view of PRU, that retention and further development of the PR Spitfire was essential. In his paper to VCAS he made the point that the Spitfire enjoyed three significant advantages over the Mosquito. I quote:

> 'a. Quicker rate of climb, shorter warning to enemy radar, and reduced risk of interception on the shorter range tasks.
>
> b. Greater manoeuvrability and smaller size of the Spitfire makes evasion of enemy fighters at high altitude easier, and decreases vulnerability to AA at low altitude.
>
> c. The smaller size and comparative quietness of the Spitfire increases the chances of passing undetected through enemy radar networks, sound locators and visual reporting system.'

I have jumped in time a little from the arrival of the first Mosquito at Benson in July 1941 so it may be appropriate now to trace its development as a PR aircraft.

The PR Mk 1 version went operational on 17th September 1941 with Sqn Ldr Rupert Clerks as pilot and Henry Sowerbutts as navigator in

W4055. It was powered by two Merlin 21 two-speed supercharged engines, giving it a top speed of 382mph, max ceiling 35,000 feet, and range of 2,200 miles with a capacity fuel load of 690 gallons.

Only ten Mk ls were produced and they were closely followed in April 1942 by the PR Mk IVs which were essentially on-line conversions of the Bomber Mk IV to the PR role. They had the same engines as the Mk Is but their fuel capacity was increased to 760 gallons which included two 50-gallon drop tanks giving a range of 2,400 miles. John Merifield covered the Baltic as far east as Konigsberg on March 3rd 1942 and Fg Off Higson covered Narvik on May 15th.

Then followed the Mk VIII, essentially a prototype for the Mk IX which arrived off the production line in May 1943 and marked a significant advance in performance in all respects over the Mk IVs. The ceiling was raised to 38,000 feet and the top speed to 410mph at 26,000 feet. The cruising speed went up to 365mph at 30,000 feet. The Mk IXs and Mk XVIs, the latter essentially a pressurised version of the Mk IX, became the workhorses of longer-range PR in the European theatre until the German surrender. They were powered by the Merlin 72 two-stage, two-speed supercharged engines and had a standard fuel capacity, including 50-gallon drop tanks, of 860 gallons; 100-gallon and 200-gallon drops could also be fitted. They had the advantage of being designed from the outset as PR aircraft with purpose-designed camera bays permitting a better and more expensive camera fit. (split pair F52 36", F24 14" behind pilot, and oblique F24 8" or 14" in the bomb bay.)

A few Mk 32s came into service in late 1944. These were primarily high-fliers with lengthened and lightened wings, powered by the even more powerful Merlin 114 series engines, pushing the ceiling up by another 4,000 feet to 42,000 feet, which helped somewhat against the Me 262 jet fighter threat.

The Mk 34 was the last of the PR line during the war, designed primarily for the very long ranges required in the Far East theatre. It had a belly tank as well as two 200-gallon drop tanks, giving a total fuel capacity of 1,260 gallons as compared with the 690 of the original Mk Is. Lightly laden, its performance was comparable to that of the Mk32s.

It is a great tribute to the original designers that the basic wing and fuselage structure of the Mosquito remained the same despite the great

improvements in performance.

I make no apology for having laboured the importance of performance because, as Air Marshal Ball has already pointed out, it was vital to the successful completion of PR sorties. Inevitably, compromises had to be made. For maximum height over target, a high aspect ratio wing, somewhat like a glider's, is required; the American U-2 is a prime example. But invulnerability to fighters and ack-ack is no good if the resulting photographic success rate is unacceptably low. On a high proportion of PR missions it was necessary for weather reasons to operate below cloud at medium levels, and often for special requirements at low-level. A U-2-type aircraft could never have existed in such an environment but the Mosquito was a superb all-rounder of robust construction.

This is perhaps the right juncture to move from general considerations to day-to-day operations. These followed very much the same pattern as described by Air Marshal Ball and indeed all Mosquito crews owed a great debt of gratitude to the Spitfire pioneers who developed the procedures and tactics which were to stand the test of time.

Crews would report to the Ops Briefing Room where the sectors allotted to each squadron would be shown, with targets depicted by pins of appropriate colour depending upon priority. The Squadron or Flight Commander would allocate targets to crews who would then be briefed by the Intelligence Officers on target information, enemy defences, and likely Allied operations in the target areas. The detailed routing was left very much to individual crews with the more experienced giving the newer ones advice and help. Planned heights obviously depended on forecast cloud bases, contrail levels, and opposition expected. Where fuel and range permitted, feints and dog-legs would be built in to the flight plan.

Whilst the navigator worked out the flight plan details, the pilot would report to the flights and order the appropriate fuel load and camera fit for his allotted aircraft. Assuming a good weather forecast over target, take-off would be about an hour after initial briefing. Earliest and latest take-off times would be determined by minimum photographic light requirements. Determination of fuel load required a balance between a low figure for maximum height over target, and a higher figure for maximum range and cruising speed.

Rather than attempt to generalise on detailed operational procedures, which in any case differed from sortie to sortie depending upon weather, range and likely enemy opposition, it may be of more interest to quote from actual operations records. I have chosen three. The first is of a medium-range, high-level PR sortie covering a number of targets in Germany in ideal photographic weather conditions when, happily, everything went well. The second is of one where the enemy had the audacity to interfere. The third is of one shortly after D-Day of a tactical nature when coverage of the French railways and marshalling yards was of paramount importance.

I quote from the first.

'Date. 30th May 1944. Mosquito PR Mk XVI; MM231. Primary targets – airfields in the Berlin area, Schwarzenberg, Wernigerode area, Hanover marshalling yards, Vechte airfield.

Airborne 10.30. Crossed out New Hunstanton 11.00 and set course Sylt. At 11.40 two Lightnings passed 4,000ft below on our reciprocal. At 11.45 large formations of Fortresses 5,000ft below off the Danish coast apparently waiting for fighter escort. From Sylt set course Berlin and took photos of seaplane base and airfield north of Lübeck. A smoke-screen was visible over the Kiel area. Contrails were at 30,500ft and photos taken just below at 29 to 30,000ft. Did two runs over each of the three airfields on the northern outskirts of Berlin. Visibility was good but a slight haze covered the city itself. On the last run of the airfields four bursts of flak were seen below and miles behind. Took photos of airfields near Brandenburg and set course Schwarzenberg. Two line overlap runs of the target area and went on to Rudestedt airfield north of Erfurt. On the way to Wernigerode the Nordhausen airfield was photographed. Two runs were done over each of the two targets in the Wernigerode area and a suspected dam south of Blausthal Zellerfeld was covered. Two more areas were covered in the Quackenbruck area and then we set course for home. Fine weather everywhere. Crossed out south of Texel at 15.30. No trouble from fighters and the aircraft behaved exceedingly well except that we had to cross the North Sea at 25,000ft to get the drop tanks to feed. Landed Benson 16.40. Sortie length 6hrs 10mins.'

Two points arise. Contrails. In 10/10ths clear conditions with a contrail layer just over 30,000ft it would have been crazy, I think, to have given our position away by going for extra height. Secondary targets. We were very lucky to have been able to clear so many secondary targets; no Brownie points for this – no more than expected by Benson with clear weather and no enemy interference. Nevertheless, had it been possible to slide back the Mosquito canopy, I think we might well have been tempted to give the Third Reich a two-finger Churchillian salute as we crossed out at Texel.

The second example illustrates the Me 262 hazard.

> 'Date. 16th September 1944. Mosquito PR MkXVI; NS639. Priority targets in the Brunswick/Magdeburg area.
>
> Airborne 10.40. Crossed in at Zeebrugge and noticed a V2 trail ahead and to port. 5/10 cloud over Brussels and flew on flight plan over several layers of cloud doing a goodish number of dog-legs. Eventually at ETA Grieben just north of Magdeburg we found a break and pin-pointed dead on track. The two targets there were covered and just as we finished the second the pilot reported two aircraft ahead and to port. Coming back to the blister the navigator saw them well behind and to port. Max power applied – 16 lbs boost and 3,000 RPM -giving 265 IAS at 28,000ft. The aircraft turned in to follow but one was temporarily lost to sight. The other one dived, then went into trails coming out of them when three miles behind and 10,000ft below. It climbed very rapidly to our height and when about 1,000 yards away the navigator gave the order to turn. The enemy aircraft, now recognised as a Me 262, was unable to hold the steep turn and it overshot under our starboard wing. Rolling out of the turn both aircraft were seen behind and one of them came in again in exactly the same manner with the same result, the other jet standing off in a somewhat clueless manner. The third attack started the same way but having turned inside we got on his tail and followed him; he pulled away quickly. In all six attacks were made, with firing observed on three of them. In one case both attacked from behind, one above and one below, but another steep turn did the trick. After the sixth attack we were able to dive in earnest for the cloud and eventually at 6,000ft we reached it. Just as

we entered cloud about 20 bursts of flak, accurate for height but to port were seen. After about 10 minutes in cloud we came across a break and saw a 262 about 300 yards to port and 200ft above. We altered course away from him and mercifully the cloud closed in again. He probably never saw us. After a further 10 minutes low cloud gave out and we climbed to the next layer at 22,000ft. Eventually we crossed out at Helder, landing at Benson at 15.00hrs.'

The point here is the importance of lookout. This was not the first 262 encounter by a PR Mosquito and we were lucky to escape without damage. Bertie Wall and Jock Lobban were not so fortunate when bounced in the Munich area on the 25th July – and neither was Captain Pienar of No 60 SAAF Squadron the following month. Both Mosquitos were damaged but the crews returned to tell the tale. Others were even less fortunate and probably never knew what hit them for the 262s had a closing speed of 50 mph or better. In some ways the rocket-propelled Me 163 with its three-minute climb to 30,000ft was an even greater menace and by autumn 1944 PR losses were increasing significantly. It illustrates the importance of technical superiority to successful PR even in conditions of improving air superiority.

My third example goes back in time to the week after D-Day when we were doing PR of the French railway system.

'10th June 1944. Mosquito Mk IX; MM233. Railway coverage Orleans to Chateau du Loir.

Airborne 7.35. Climbed through cloud to 30,000ft and set course Orleans. Homed by GEE to a point SE of the town, descended to below cloud base of 4,000ft and did a run over the marshalling yards. Flew along the railway line to Chateau du Loir, covering Chateaudun, Pont de Braye, la Chartre on the way west and south. Cloud down to 1,500ft at the end of the run. A pranged train was seen and photographed at la Chartre. Climbed back to height from Chateau du Loir, GEE u/s on the way home, but made the grade to Farnborough with help from Gingerwine. A bad oil leak from the starboard engine found on landing but otherwise a successful sortie with no interference from the enemy.'

We were fortunate here to have encountered no flak; we gathered later

than No 140 PR Mosquito Squadron of 2 TAF lost three aircraft on four sorties. Loss from enemy aircraft was unlikely with our own fighters keeping the skies clear. The temporary tactical role brought home the importance of constant coverage of communications to enable Intelligence to keep track of all enemy movements and dispositions. Time was of the essence and unlike most strategic PR, scale and quality of photographic prints was of secondary importance. PR was never boring but the change made an interesting break.

I am conscious of having covered only a small part of the totality of Mosquito PR operations. In particular I have not touched upon night PR , a very important element of tactical PR, especially prior to and following the Normandy invasion. The Mosquito proved as capable of adopting this role as well as so many others and by March 1945 No 140 Squadron had carried out 627 night missions below 10,000 feet without loss. Again I have not covered some of the specialised operations, for example use of the Mk VI with forward-facing camera for low-level photography of V-weapon sites and new radars.

Nor have I attempted to cover overseas-based operations of the PR Mosquitos, especially those of 336 Wing in the Middle East and 171 Wing in the Far East, later to be incorporated under the command of Bill Wise in the Photographic Reconnaissance Force. I am assured that the old No 1 PRU genes ran strongly through both wings so perhaps one may assume that operations followed a similar pattern as in Europe but suitably modified by geography, weather and requirements.

May I finish with a quotation, this one from Sir Walter Raleigh's book of 1922, *The War in the Air.* He wrote, 'Reconnaissance, or observation, can never be superseded; knowledge comes before power; and the air is first of all a place to see from'.

As with the Spitfire, it was fortunate that we had the Mosquito to enable us to do just this.

Professor R V Jones:

I think those of us who have been associated with the programme are very conscious that besides the very real experts that have been speaking, there are other real experts on various aspects of these operations present in the audience so we hope, those of you who feel able to give the benefit

of your experiences will now do so.

May I make a comment before starting this session; one of the factors that influenced me a very great deal was that for all the difficulties of navigation that the Air Marshals have spoken about, the way in which they triumphed over them always struck me as quite remarkable. Time after time when we'd asked for a sortie, the target was found and photographed, which was in complete contrast to what was happening elsewhere, particularly in Bomber Command but also in Fighter Command. On the question of having a fighter escort, I note Air Marshal Ball's recollection, and indeed Wheeler's too, about the dangers of this for a photographic aircraft. I was at one stage proposing the reverse of that, or the inverse of it. In the Air Council Room we were discussing the pre D-Day operations and I of course wanted to see attacks on the German radar; they would have to be low-level attacks and Fighter Command said that these couldn't be done. When I asked why, they said their pilots would never find the targets, so I said, 'Look, the PR boys do it every day so what I propose is that every fighter squadron should have a PR pilot attached'. The effect was considerable; by D-Day Fighter Command was able to find its targets. It had been thrown on its mettle entirely by the fact that PR pilots were doing it on a routine basis. Again, I was discussing this with one of the most famous of all the low-level pilots, Tony Hill, and I said, 'How is it you can do it and the chaps in Fighter Command say it is impossible?'. He said, 'It's very simple, I have one rule, trust your instruments and don't lose confidence in them'. Of course, this really came down to the compass but time after time he told me he had just navigated across at low-level by compass and always found this target. Trusting instruments was one of the lessons that, simple as they were, in the hands of people like Tony Hill, certainly produced remarkable results.

Charles Crichton,

Mediterranean Allied Photographic Reconnaissance Wing.

I would first just like to comment on what Air Marshal Ball has said. He was Chief Flying Instructor when I went through the OTU and I joined a squadron that he had just been commanding. We did exactly what he has just told you, all the time. If I may attempt a feeble pun, we were 'on the Ball'. I would like to say something that he hasn't covered. In the Mediterranean PR Wing, we had four or five American squadrons, one

French squadron, 682 Squadron (Mosquitos) and 60 Squadron from the South African Air Force also with Mossies; our operational area covered from Ploesti to Toulouse and the main problem was pronouncing foreign words in our briefings. In fact we went totally Anglo-Saxon, much to the dismay of the French.

One very interesting application of camera use was that the American Army found that we had a 36" camera; this would not go into the fuselage of their workhorse, the P-38, and being totally without side in the question of nationalities, they insisted for the benefit of their soldiers that we went two-by-two aircraft to their squadrons where, with three of our chaps in two aircraft and perhaps a dozen ground crew, we operated for the Americans photographing their front-line stuff, of course improving the scale on their 24" cameras from 15,000 to 10,000. When you are a soldier in a country like Italy trying to find minefields and blown bridges and so on, this was of vital importance. I don't think I have much more to add except that the German radar always followed us. Perhaps, Mr Chairman, you can tell us why the *Giant Wurzburgs* sounded so loud in our VHF sets. I agree that we fought three air forces at once; when we came home over the bomb line, the *Flak* began to trail because our gunners weren't as good as the German gunners and we did not carry IFF, which usually resulted in a nasty 'ding-dong' on the VHF with the local controller, who was normally convinced by a command of four-letter Anglo-Saxon words that we weren't German.

Fray:

I was at Benson. Air Marshal Ball raised three most important points for any successful sortie by a Spitfire pilot and I would like to add a fourth which I am sure will be appreciated. If you were in Bomber Command your sortie was finished once your bombs had been dropped but a PR sortie was never finished until you had landed back at base; this was very important from the interpreter's point of view.

Glover:

Air Marshal Ball gave a good summary of the tactics which we adopted from 1 PRU days, particularly stressing that the comparative aircraft performances dictated our flying tactics. As the Me 109 approached the Spitfire in performance, where as we had used the contrail belt as an umbrella overhead, we now had to use it as a carpet by flying at

40,000 feet to all the major targets in Germany. Air Marshal Dodd mentioned the effects of anoxia and the sense of well-being that you got after two or three hours, which did in fact affect your eyesight; you really had to keep on the lookout the whole time if you wanted to survive. One thing that he really didn't touch on was the tremendous growth in accuracy of the German *Flak*. At 40,000 feet it was absolutely wonderfully accurate and of course very frightening; over targets like the Ruhr, Berlin and Hamburg, it was all accurate, and you had one hell of a job to get out of it. For the future, this could probably have greater significance than comparative aircraft performance.

Frank Dodd:

I would like just to say a word or two about *Flak*; I should have mentioned it. Yes, the situation with ack-ack did get very tricky and there were a remarkable number of people who were in fact hit. Over Brest we lost one with a direct hit and I had two chaps, one of whom is here now, Gordon Puttick, who was hit at 31,000 just north of the Ruhr; another, Flt Lt Powell, was hit in a Mosquito at 37,500 feet in the Hamburg area. Time and again, the *Flak* came very close and one of the pretty obvious answers when you were being fired at over the target area was to alter speed and height continually while you were doing your runs. When you were doing these runs the photographic interpreter was the last thing that we thought about. We thought they were lucky to just get photographs and when we went over Brest we used to do it in one run; normally it would take about three to do it properly, but if you turned your time interval to about two seconds and went across the port sharply, you could do it all in one.

Taylor:

I was in 16 Squadron. I was one of those who volunteered by going to Benson, walking into the headquarters and asking to join PR. I believe I saw a Flt Lt Jenkins. Now he ran a private air force, and he lived in a small cottage the other side of the airfield. A rather attractive WAAF drove me over in a car and he asked, 'What do you want?' I replied, 'I want to fly on PR work,' Then he asked, 'Spits or Mosquitos?' and how many hours I had on twins. As I hadn't many, he said I should go and fly Oxfords and then onto twins, as singles were out. I did my time on Oxfords and was going to be posted to Bomber Command so I ran back to Benson and asked to see Flt Lt Jenkins because I was being posted to

certain death. He said he would forward my posting to Air Ministry and if it got there before the one from Bomber Command, I would get PR; if not, it would be Bomber Command. When two hundred of us on Oxfords were eventually hauled out into a hangar, the CO ran through all the names; everybody was going to Bomber Command except Taylor, who was off to 8 OUT at Dyce. At this point he stopped reading and said, '8 OUT, Dyce – where's that? What's that?' He was furious that one of his birds had got away. When I got to Dyce and saw Spitfires and Mosquitos parked round the airfield, I thought, 'Golly, this is a high-flying place,' and on arriving in a flight they asked what I was going to fly. When I said Mosquitos they asked how many hours I had and on hearing 'Forty in Oxfords', they said 'Not enough, you will have to fly Spitfires'. The next question was how many hours I had on Spitfires and so I said, 'None'. 'How about Hurricanes?' 'None'. At this point they said, 'What the hell have you been flying?' I said, 'I have one thousand hours instructing in America on Vultee BT-13As with fixed undercarriage and manual flaps.' They then said, 'We don't have a two-seat Spitfire here; we haven't even got Pilots' Notes, so you'll have to learn how to fly in a Master.' I eventually went to 34 Wing, 2nd TAF: we were an independent wing with a squadron of Spit XIs, and IXs for 16 Squadron.

Anon:

How was it that the Spitfire boys, who couldn't see beneath them, continued to fly on photographic missions in competition, shall we say, with the Mosquitos, which had a navigator/camera operator lying in the nose following everything? The only way we could look beneath us was by turning on our side and I am very dubious about how many of our targets were actually hit in the way that was intended. The Mosquitos should have had every advantage. Why wasn't the Spitfire phased out in favour of the Mosquito?

Sir Alfred Ball:

It is quite incorrect to suggest that there was any great difficulty about taking photographs from a Spitfire. Yes you did turn it up on its side but once you had the knack, you could cover pin-points just as well as Mosquitos. I would add one thing: when I went onto Mosquitos my navigator used to spend most of his time kneeling, looking out of the back because, as Frank said, it was much better to have those eyes looking in

that direction and in that situation I found that I could take the pictures perfectly happily on my own. I think both overlap into each other's area and it is a matter of experience and know-how.

Frank Dodd:

I'm not quite sure what the speaker meant; I thought I had made the point that there was a certain amount of euphoria for the Mosquito in 1943 simply because it could take more cameras, and so on, but PRU Benson, backed by CinC Coastal, said, 'No, the Spitfire has other advantages and we should retain it'. DD Photos, I think, had started this particular thought of phasing out the Spitfire in favour of the Mosquito; if there is a DD Photos here today, I hope he will forgive me but there is always a danger that with specialists, when they see a new aircraft come along and the Mosquito looked to DD Photos, I am sure, like the ideal camera-carrier, which was just what he wanted. But if you can't get your cameras back and the film to the interpreters, it really isn't much good. There were jobs that the Spitfire could and did do that the Mosquito couldn't. There never really was any danger of the Spitfire being phased out and there were two Spitfire and two Mosquito squadrons at Benson until the end of the war.

Peter Harding:

I was with 3 PRU. I would like to comment on something that Freddie Ball said about navigating. I was sent from Benson to Frankfurt; the cloud base was three hundred feet at Benson and they said, 'Half an hour before you get to Frankfurt, it will clear'. I climbed to height and flew at 30,000 feet, blind to Frankfurt. On the way back I came on to my ETA in the middle of the North Sea and broke cloud at 600 feet, missing a house by ten feet, I then climbed back up thinking, 'What country is this? Let's go down slowly instead of at four hundred miles an hour.' I crept back down and found there was about 30 feet between the cloud and the ground so I followed a road until I found an AA box. I am still a member of the AA! I then flew east to find the coast but instead found that the cloud and land met leaving me no way out, so I had to go back. After about five minutes I thought, 'I'll put my flaps down because if I am going to hit something, I'll hit it at seventy-five'. I came in fully fine, hand on the throttle, and crept down. The cloud base was again 20 to 30 feet. I thought, 'First field, wheels up'. It was ploughed; then there was a ditch, so I went on a bit further until a big field opened up in front of me. Thinking, 'This is it,' I

gunned it over the hedge and as I touched down, runway lights came up on both sides of me. I didn't have to divert even one degree. I taxied up to the end and an airman came out to park me. I said, 'Where the bloody hell am I?' He said, 'Croydon.' I then went up to the Duty Pilot to report and the air-raid all-clear went just as I got there. 'You got a raid on?' I said. 'Yes,' he said, 'It was you, you silly sod, you came across the Channel like a bat out of hell, you hit ground somewhere near Gatwick, you were so blooming low that everybody lost you – and suddenly I see you gunning your 'plane over the hedge. We were just about to fire at you when we saw you put the wheels down and as you were dead on the runway, we thought that you knew where you were, so I turned the lights on.' Yes, it can be difficult!

There is just one further point. When flying over Wilhelmshaven on the way to Kiel, my engine stopped – petrol problems. They said this was the carburettor icing up and the only thing to do was to land, wait for ten minutes, start the engine again and take off. Of course, I baled out and put the 'plane right into the ground and was caught by the Germans, who asked where the crew was as five parachutes were seen coming down: 'You were flying a Blenheim. Where are they?' I just answered with my name, rank and number. After about three hours, the German CO called me in and said, 'You were flying a Spitfire,' and he had a small tag in his hand. 'We know why you crashed; your aeroplane was made in 1937.' This was a Mark I upgraded to a Mark V and the news shattered me, although it was a 'D' and a very good aeroplane; the engine, they told me, was ten feet in so I didn't do a bad job.

Reginald Biggs:

Air Marshal Ball, I remember very well helping to set up the library at RAF Medmenham, in the organ loft, I believe. There was a famous sortie that required oblique photographs of the *Scharnhorst* and *Gneisenau*. I can't imagine that hand-held oblique photographs were taken from aircraft in 1941, over Brest in particular, but this sortie was our pride and was produced for the many VIPs visiting Medmenham at that time, including the Prime Minister and down to Vic Oliver, or *vice versa.* Can you remember how this sortie was carried out, probably in the early part of 1941?

Sir Alfred Ball:

I must admit that, without seeing the picture, it is difficult, but the only one that I can recall was taken by a chap called Green, which was taken low-level sometime in 1941.

John Archibold:

I used to be a navigator and may be able to help you on this one. There was a picture circulated in a magazine for photographic reconnaissance which used to go to everybody; this was a picture of the cruiser *Hipper,* docked at Brest, and it was portrayed as the finest, clearest low-level photograph taken during the war by a PR Spitfire.

Sir Alfred Ball:

I should add that there were a number of striking photographs and I think most certainly the most remarkable one was taken by a man called A P F Fane, a famous racing motorist before the war, who alas later died in a silly accident when someone left something in his controls. More recently, his family wanted to commemorate him in some way and a copy of the photograph was given to the artist Frank Wootton, who reconstructed a painting of it. It is of the *Tirpitz,* though I am not quite sure which fjord it is in, but it is staggering in that it was taken from a couple of hundred feet and as well as seeing the crew, you could almost recognise them.

Crichton:

On low-level photographs, I just happen to have a copy of Constance Babbington Smith's book in my pocket and opposite page 112 there are two illustrations; the first is of a large ship in which you can easily see the crew members and it is headed *Tirpitz* in the Asje Fjord, photographed on the 28th March 1942 by Flight Lieutenant A P F Fane; immediately below is another of the *Hipper* in Brest, photographed by Pilot Officer J D Chandler on the 26th January 1941. I am afraid that this book is long out of print but it is very useful for PRU reference.

Anon:

Professor Jones, Air Marshal Ball at one point referred to enemy inflexibility, in particular operations; may I ask a fundamental question – what is this rigour, this inflexibility attributable to?

Professor Jones:

If it hadn't been for Sidney Cotton we might have had rigour and

inflexibility too, but the Germans always had, in so many fields, a more rigorous approach than we had. If one looked at their air defences, they were very well organised but also very rigorously organised and that went for their radar too. The rigour and thoroughness had its merits and I often felt that, in the field of radar that I knew slightly better, when we were thinking of something, our German opposite numbers were thinking of doing much the same kind of thing. But whereas we would think that the actual mechanical work entailed in doing it properly was so difficult that we would devise all kinds of electronic subterfuges to avoid doing the mechanical work, the Germans went straight ahead with precision work and I think in the end we went to as much trouble to avoid doing the mechanical work as they did in actually doing it. The advantage turned out to be with us in that case because of the greater flexibility; our equipment was less well made but it could more easily be altered, depending on the circumstances.

To some extent it is a difference in approach which stemmed right from the very top. When we captured General Von Thoma after Alamein, Von Thoma (who was a great tank expert) was telling us about having to show Hitler himself the captured Russian tanks and Hitler said, 'They can't be any good, look at the finish.' Von Thoma said to us that if you looked at the surfaces where the parts had to be machined, then it had been done, but the Russians had left all the rest of them rough, concentrating what effort they had on getting those parts right that needed to be right. I tell this story as an indication that right from the very top there was this emphasis – or, as it were, rigour – in doing a job properly, even doing it where it didn't really matter. Hitler himself was obviously prone to that approach. I've always rather admired it in a way but the difference in the flexibility of approach is almost a national characteristic. Sometimes one saw great enterprise on the part of the Germans but it didn't surface in photographic intelligence whereas, thanks largely to Sidney Cotton, and of course the man who recruited him, Fred Winterbotham, it completely changed the whole philosophy of photographic reconnaissance in Britain and to our advantage.

Dennis Bird:

On an historical point, I would like to draw attention to Sidney Cotton's Lockheed 12A. There is an article in *Aviation News* this month

and the aircraft is now at Titusville in Florida being restored by its new owner, Stephen Oliver; quite an interesting point as of course this aircraft is where PR began.

Brad King:

Something that was touched on earlier, a number of low-level Mosquito operations were undertaken carrying 35mm cine cameras. Were these operations considered as glamorous experiments rather than straightforward photographic operations? Were these undertaken under the auspices of the Royal Air Force Film Production Unit or were they a PRU. job?

Professor Jones:

We will be talking about cameras this afternoon and perhaps one of the speakers could answer that question.

Sir Neil Wheeler:

May I, just before we pack up this session, make one quick comment about Sidney Cotton. The point that I was trying to make whilst I was speaking is that this remarkable thing, Photographic Reconnaissance, owed its whole place in the last war to just three men. It is not often that you can speak on any subject and just mention three names, Winterbotham, Cotton and Longbottom – it is a staggering thing. Cotton was the most incredible man; I and one or two others here could talk about him for a very, very long time. Even after he left PRU – and he left it in disgraceful circumstances to my mind in that they fired him and gave him an OBE – his contribution to the war was colossal. He immediately went on to design a thing called 'Turbinlite', a Boston aircraft with a searchlight in the front that flew in formation with two Hurricanes at night, the idea being to illuminate the enemy aircraft and shoot them down. Cotton I described as an entrepreneurial buccaneer; he was no longer the CO, Geoffrey Tuttle was, but he used to turn up at Heston, flying his Boston, dressed in civilian clothes with a trench coat and a trilby. That was the sort of man he was, it didn't seem unusual to him and I think far too little has been said about him. When I went to Cranwell, one of the first things I was given was a Sidcot suit and it didn't dawn on me for years that it was one of Sidney Cotton's products: Sid-Cot. Many people here must have flown in them. The same with Shorty Longbottom,

he alas was killed in the war at Boscombe Down after he had left us. A few people have commented on the remarkable situation that a flying officer wrote a famous memorandum and sent it to the Air Ministry, and there aren't many flying officers who would dare to do that, let alone succeed.

LUNCH BREAK

Sir Frederick Sowrey:

This afternoon we shall see how the information that was so gallantly brought back, as heard this morning, was put to use, how it was processed, how the camera development took place, how it was interpreted, and some of the intelligence use that was made of that interpretation. We have Flight Lieutenant George Parry, who is going to take us through cameras, then Ray Dando is going to look at processing and printing. Next we have the early days of interpreting in a paper by Douglas Kendall, followed by Alfred Stephenson taking us through the early developments of the Central Interpretation Unit. The work of the interpreter follows when Diana Cussons tells us how it was done by a remarkable team of young people. Looking around the audience it is possible to remember how all of you and all of us looked at the time; my daughter, having seen a wartime film, remarked, 'My goodness, they were so young.' Finally, there is the role of the Intelligence Officer, the chap who sticks it all together, where we have Wing Commander John Weaver.

Professor Jones:

Marvellous, this car drives itself. Can we have the first talk on cameras, for without them there would not have been any photographic reconnaissance.

George Parry:

I am going to talk about the cameras that we used in the war, mostly British cameras because I feel they were the most important.

The Type F24 aerial camera served as both a vertical and a fixed oblique camera in most of the RAF aircraft from 1925 onwards. It was built on the 'unit principle', thus permitting its use to meet different conditions without a radical alteration in design. It employed a range of lenses – 3¼", 5", 8" and 20". The camera could be operated automatically

when in fixed vertical or oblique mode, or as a handheld camera. The shutter was an interchangeable fixed slit focal plane type with a choice of exposures from 1/60th to 1/1000th second. Magazine capacity was 125 exposures providing a 5" square format. It was a very robust and easy to service camera and when used automatically was mounted in a Type 25 mounting and coupled with a 12-volt motor and Type 35 control. For hand-held operation a Type 21 mounting was used and, depending on the focal length, a frame-sight or tube-sight was employed.

It was relatively heavy and I have a personal experience of this in that I almost dropped a 14" version at 10,000 feet over some unsuspecting Italians in Italian Somaliland prior to the war. It was fortunate that with Lease-Lend the Americans brought to us the K20 hand-held camera. It was comparatively lightweight, had an interlens shutter with a speed range of 1/125th to 1/500th second and could be supplied with daylight-loading spools. The film format was 5"×4". It had a small optical sight and hand grips to each side of the casing. Film winding and shutter setting were made with a single forward and backward motion of the right-hand grips which also accommodated the shutter release trigger. The lens had a focal length of 180mm.

To return to the F24 camera, on the outbreak of war it was the camera in general use and employed in many guises. For low-level day reconnaissance it was fitted with a 45° mirror attachment and was also adapted for night photography. A word or two about that role later.

With the introduction of the Spitfire as a high-altitude reconnaissance vehicle, the scales provided by the F24 were far too small to be really effective for detailed interpretation and a Mk IV version of the previously discarded F8 camera was introduced. We had to scour the world for these and in fact most of them came from India; the camera had a 7"×7" format, soon to be superseded by a 'blown-up' version of the F24 – the Type F52. It had a 8½"×7" format, focal length lenses of 14", 20", 36" and 40", dual voltage of 12 or 24 volts, providing the necessary adjustment was made to the gearbox solenoid and correct choice of motor and Type 35 control. Magazine capacity was 250 or 500 exposures, the former reducing the overall length of the camera to suit certain aircraft installations. The cycle of operations was the same as the F24 but was completed in 1.6 seconds by means of a 3-start high-speed worm drive. Incidentally, the body which

housed the shutter and formed the junction for the gearbox, lens cone and magazine was fitted with a dyed register glass equivalent in transmission to a Type 4 filter. A Type 38 mounting supported the camera in the aircraft installation.

Of course, it wasn't only day-cameras that were used in the reconnaissance mode; we also had to think about the night role. Operational night photography as such was instituted by Bomber Command in order to furnish the Air Staff with photographic cover of the target throughout the attack for purposes of raid analysis, and also to provide a means of determining the accuracy of individual crew performance. I was staggered the other day when I was reading Roy Nesbit's book where he mentioned 'creep back'. Those of you who flew in bombers would know about that, but I was astonished to read that if the bombs were dropped and the photo flash was discharged prior to the actual target, that particular sortie was not counted against the operational tour total. That really did upset me a bit.

The apparatus consisted essentially of a modified F24 camera in which the focal plane shutter had been replaced by a louvre type to which was attached a metal canister containing a photo-electric cell, valve amplifier and relay mechanism.

The operations were controlled through a modified Type 35 control which, when set to the correct time interval, wound over the film and opened the louvre shutter approximately five seconds before the flash was due to explode – warning the pilot and operator at the same time. The light from the 4.5 photographic flash, acting through the photo-electric cell and amplifier, operated a relay and solenoid, closing the shutter and winding on the exposed film.

The F24 night camera MK I was replaced by the simplified night F24 camera. This camera was not fitted with a main shutter blind for exposure control but employed an auxiliary blind to close the shutter aperture during the period of the film wind. The camera operation was fully automatic with bombing, being electrically operated from the bomb firing key – the circuit to the camera and photoflash release unit being 'made' through the Type 35 control No. 20A.

The night photograph was required to record the point of strike of the first bomb released and in order to give some tolerance for obtaining

synchronisation between the camera operation and flash explosion, the camera was operated by the Type 35 control to wind in a frame of film two seconds before the flash explosion and wind that frame out two seconds after the flash explosion. Thus a frame of film was actually in position for four seconds, in the centre of which the flash should explode to record the target area.

In order to secure maximum cover of any other light sources in the target area that might be recorded incidentally on the 'bombing frame', additional frames of film were wound through, two of which were covered by a colour insert.

The value of colour film lay primarily in identification of the colour of the markers, in distinguishing types of incendiaries in separating fires from incendiaries, in detecting decoy target indicators, and in recording various phenomena.

We had, of course, night cameras in use with Coastal Command during the Battle of the Atlantic and I well remember being posted down there and being rather taken aback by the fact that, in order to fire the Very pistol, which contained the photograph cartridge, they had a length of twine which the starboard gunner had to pull when he received due notification from the bomb aimer in order for it to be fired. It had a built-in delay of two seconds which intended the flash to illuminate the U-boat under attack. You can imagine the problems there with the excitement, etc and so I wasn't very impressed by that, thinking that we should get some sort of electro-magnetic release attached to the Very pistol so that we could tie it in with the bombing key and the camera could be operated through a special Type 48 control. This went ahead and we carried out various trials on a special exercise called 'Oasthouse'; we used to meet up with returning submarines off the southern coast of Ireland and at about a mile distant we would switch on the Leigh Light and carry out an attack dropping eight-pound tannic acid bombs. I don't think any of them hit but if they had I don't suppose there would have been much damage. These trials had to be co-ordinated by 19 Group where one senior officer, whom I shall not name, thought that things were going a bit slowly and thought he would carry out his own trials; I did mention to him that all trials had to be co-ordinated through the Group, a suggestion that he ignored, so finding out there was a sortie on that night, I went along to have a look at

the aircraft. It was quite an ingenious idea really, in that he had worked out the length of cord necessary to attach one of the depth charges to the Very pistol. What he failed to take into account was the breaking strain and so this was one aircraft that I thought I must meet when it returned. At three o'clock in the morning, I was there, greeting the pilot as he came from the aircraft with an enquiry as to how it had gone. There was no reply but his looks were as black as the night sky and on looking in the aircraft, there was a jagged hole and a missing Very pistol.

Ray Dando:

'Very rudimentary' was Paul Lamboit's comment on the darkroom equipment he found at RAF Heston in the autumn of 1939 when he arrived as a newly-commissioned member of the Cotton 'circus'. Working with the motion picture industry in the USA, where continuous processing machines were in general use, he found the lack of mechanisation in air photography surprising. The rewind spool-tank system for F24 film he had just inherited was one example of this. It had been developed at RAE before the war and was inspired, no doubt, by the practice of rolling a long strip of film to and fro when processing in a dish. It consisted of an assembly of two spools with handles at their end with which film was wound backwards and forwards in a tank of processing solution. To obtain even development, a fast, regular rate of turning was needed and operators were known to render a song to provide a good rhythmic pulse (the tune was that of a popular hymn but it seems that the words were more secular!). This system worked well with 50ft lengths of F24 film but there were drawbacks with longer lengths. To compensate for the lack of developer between convolutions in the fully-wound condition, process times needed to be disproportionately long and this led to disparities in sensitometric performance between the middle of the film and the ends, and an increase in blemishes such as bar-marks. For drying, the film was festooned on a large slatted drum. Numbering of the negatives was by hand at first but numbering stamps became available and with the use of titling strips on the contact printers, the time required for this phase was made much shorter. Prints were dish-processed and dried on a commercial glazing machine.

There were many who felt that more mechanisation and automation was needed to handle the greater bulk of processing and printing that was

anticipated with the introduction of the F52 camera and also further extension of the war. Paul Lamboit had already discussed the possibilities with Kodak Ltd at Harrow early in 1940 and, later, Ministry funds had been voted to the RAE research programme which covered development work in this area (both film manufacturers, also, felt that there must be better ways of handling their film than `dunking' it as a dry roll into liquid!) By 1941 Kodak had developed the first continuous film processing machine (CFPM or 'CP') and it was soon in production. RAF Benson was equipped and installations were made in 45ft Brownhall semi- trailers to become part of the photographic 'trains' – later Mobile Field Photographic Sections (MFPS) used in North Africa, Italy and in North-West Europe after D-Day. The machines made processing of films from the larger cameras (F52 and the American K17) easier and consistent and there were also economies in chemicals since solutions could be maintained by replenishment for long periods. It is interesting to note that the USAAF continued to use rewind systems to the end of the war and afterwards. As a form of reverse Lease-Lend, a 'CP' machine had been given to their unit at Mount Farm, adjoining RAF Benson. Gerald Brock recounts that he saw it later on a visit to the base, obviously never used – confirmed by seeing strip-lights (heating elements from the dryer) in the adjoining washroom, arranged beside mirrors as a shaving aid!

Automation of printing followed soon after with the introduction of the Multiprinter developed jointly by Williamsons and RAE. This combined the two operations of printing and processing in one machine. A negative grader designed by Reid at RAE was later fitted to give better consistency of printing by using a photo-cell to balance the lamp intensity against the density of each negative. This required a quick mind and some dexterity from its operator – though he was probably more comfortable than the chap at the other end of the machine. His job was to guillotine prints 'on the run' while sweating over a hot, steaming dryer. This had many heated rollers contacting the back of the paper, arranged around a large, slowly-rotating drum. The hissing noise as each roller hit the paper and the flurry of steam earned it the nickname 'witches' cauldron'! These machines were used in many static installations and became an important element of an MFPS. An example of the output obtained is recorded in the history of No 4 MFPS – 34,000 prints were produced in the first twenty-four hours after they had landed and set up in France.

Less well-equipped units than this had to use a team approach to meet their printing tasks. At CPIC (Command Photographic Interpretation Centre) Delhi, five or more two-man teams were needed. Printing and dish-processing duties were exchanged every one or two weeks, leave had to be taken at the same time and a rapport would be established between the two so that a muttered comment (a grunt or even an oath!) would be enough to ensure that prints were of even density despite difficulties such as ice floating in the dish to keep the temperature steady. If a song was used with this task, it must have been 'We've been together now for three long years '!

A number of areas have had to be omitted to keep this account as brief as possible but two applications are worth mentioning. First, close support operations – an F24 camera was modified so that exposed film was taken up in a light-tight cassette, then parachuted to a ground unit for rapid processing in a stainless steel spiral. The film was printed wet and within fifteen minutes the prints were with the photo-interpreter – this appears to be one of the first examples of rapid access in air photography. The second concerns processing in the air – this was carried out in Sunderlands from Pembroke Dock, using a daylight rewind tank to process film from F24 cameras. The film was then festooned down the fuselage where, according to George Parry, there was always plenty of air blowing about to dry the film quickly. Flights of up to sixteen hours' duration were common and the on-board method enabled confirmation of the results of the patrol well before the return to base.

In conclusion, two benefits accruing from the war should be mentioned:

a. the impetus for improved film stock, hardened for rapid processing which, although it only reached fruition after the war, paved the way for the introduction of high-speed machines in the Sixties; and

b. the far greater understanding of the factors governing image quality (ie balancing the effects of movement, vibration, lens and film/print resolving power). In part this had been fostered by the Air Photography Sub-Committee (APSC).

Before concluding, I must thank the 'ones that were there!' – George Parry, Paul Lamboit and Gerald Brock (my mentor when I joined Air Photography Division, RAE and a member of the APSC) – for their help

on this contribution to the seminar. I will finish with an APSC episode kindly provided by Gerald. At one of their meetings, where there had been much perusal of bigger and bigger enlargements, Dr Davies of Kodak brought the process to an abrupt halt by pointing out that he could see more in the contact prints anyhow! This was generally agreed but one member who knew his psychology said (and here, in this august gathering, I must tread carefully!), 'You still need enlargements to convince the Air Marshals!'

Professor Jones:

Our next paper is by one of the oldest and most distinguished of all photographic interpreters, Douglas Kendall; sadly he died a few weeks ago and his paper will be read by Wing Commander Oxlee.

Wing Commander Oxlee:

The effectiveness of any battle is directly linked to the extent and reliability of the planner's information on the capabilities and tactics of the enemy. This self-evident truth was brought home with fearful impact upon the Iraqi forces who sought to wage war last year without the benefit of meaningful intelligence on Coalition Force movements.

Until the First World War, information was a sketchy bag of rumours, guesses and hints from spies, prisoners and diplomats. In the 1914-18 conflict, 'planes were first used to secure unimpeachable photographic evidence of manoeuvres by opposing forces. Flying primitive aircraft at 5,000 feet, these pioneering aerial spies ventured only a few miles over enemy lines to record the layout of enemy trenches.

Air reconnaissance then went through a fallow period before making a cohesive contribution to the intelligence services in the Second World War. It was one component of the war in which the Allies maintained a clear edge over the Axis forces. From the containment of the Italian navy to the bombing of German V-1 rocket sites, cameras clicking from the undersides of Allied 'planes laid out the evidence. Dedicated expert photo-interpreters analysed that evidence. The story is one of the quiet victories of the Allies.

It was initially decided in 1939 to use Blenheim and Lysander aircraft to take large-scale aerial photographs at a scale of 1:10,000 for immediate tactical support of the Army. This method was quickly abandoned after

some twenty Blenheims were lost during the so-called 'phoney war' without the securing of a single photograph of the RAF priority area – the Ruhr Valley.

Meanwhile, with the collapse of France, our intelligence organisation was severely curtailed. We had, therefore, to develop in a great hurry alternative sources of intelligence which would be strictly under our control. Priority was consequently given to:

a. PR/PI.

b. Y services

c. Scientific intelligence

It was readily apparent that we had to change our concept of securing air photography. The RAF experimental unit at Royal Aircraft Establishment at Farnborough came up with the strategy of carrying a camera up to 30,000 feet where it could be used quickly and quietly to avoid enemy contact. A special unit called the Heston Special Flight, based in Heston near Watford, was assembled.

A new problem now emerged: roads and railways could be recognised on the photographs at 1:60,000 but the traffic on them could not be identified. From five miles up in the sky, our cameras were largely useless. DD Photos did a very good job in focal length. This gave us the desired scale of 1:10,000 from 30,000 feet, which gave interpreters a fighting chance. However, we had to persuade the powers-that-be that successful photographic intelligence was dependent on complete target coverage, comparative imagery, specialised interpreters and, most importantly, a central agency where the photographs from whatever source could be collected and collated.

Our criteria for successful photographic interpretation were as follows:

- total photography
- frequency of photography so that comparisons could be made, thus revealing any changes
- specialists covering the many different subjects to be studied
- a central point where all photographs received from the many units abroad could, in combination with the film from bomber-type

aircraft, coastal patrols, etc., give the maximum possible picture.

Once the technical problems of the camera were solved, it became possible to pay attention to the PI organisation itself. RAF Medmenham was selected as the 'central point', merging the various interests of the Air Ministry, the War Office (MI14) and the Admiralty's Naval Intelligence Department (NID). Having set up in Danesfield House, it was natural that, immediately following Pearl Harbour, the US Air Force, as well as the American Navy and Marines, also brought units into the central organisation. We now had just over 500 interpreters from all ranks, and miscellaneous uniforms. Within our 3,000-strong unit, approximately half of our officers – some 250 – were American and Commonwealth.

The daylight raids by the 8th and 9th US Air Forces were furnished with cameras, significantly swelling the large volume of photography that had to be examined each day. The night sorties by Bomber Command also flew equipped with cameras, and we developed some very effective techniques for plotting where bombs had landed on the patterns depicted by fires and incendiary bombs.

Squadron Leader Alfred Stephenson, commonly known as 'Steve', and Flight Officer Diana Cussons intend, I believe, to give a detailed description of the inner workings of the Allied Central Interpretation Unit (ACIU), so I'll limit myself to furnishing a brief organisational image of our PI operation.

The basic PI organisation that we created used a three-phase schedule for interpretation of the incoming photos.

The First Phase was the immediate reporting – often straight from the negatives – of any movements of the enemy of a tactical nature. Usually done at the airfield, where the photographic 'plane had just landed, this was a quick analysis accomplished within an hour of the 'plane's arrival.

The Second Phase entailed the amassing at Medmenham of all the photographic evidence secured anywhere within enemy-held territory over the previous twenty-four hours. We compared the isolated photographs from Phase One to the collected photography from earlier sorties in order to derive a more complete analysis of what they showed.

There were more than twenty units within the Third Phase, each of which specialised on a single, ongoing activity of the war. Many were

involved in monitoring specific battles, working closely with the other intelligence organisations. For instance, in mid-1944, we set up a separate detachment to handle the V-weapons battle. This eventually grew to eighty people. Other Phase Three battle focuses included as follows:

- a report every six months on the number of U-boats under construction and their probable dates of commissioning
- the state of enemy aircraft manufacturing
- the progress of the German Air Force in introducing jet aircraft
- the damage being achieved by Bomber Command's incendiary attacks
- the order of battle of the German Navy
- the defence installed by the German Army to protect their Atlantic coast

I have no direct information as to how PR/PI has been used in the recent Gulf War. I assume each aircraft carried a camera to locate the point of attack. No doubt, methods of plotting based on fires have been further developed. In many ways, I would describe the Gulf War as an air reconnaissance war. It seems to me that there still remains a vital need for PR/PI services in wartime, since PR aircraft have the capacity to fly anywhere and anytime, in contrast to the rigidity of satellite flight patterns. Aerial reconnaissance is still the best way to get reliable information on the movements of the enemy.

Alfred Stephenson:

Looking at the size of the Training Section of the Photographic Interpretation Unit and its final wartime production, as reported earlier, we have a total of 1,715 officers and other ranks, including Army, Navy and USAAF personnel.

Photographic production by the end of the war was as follows:

- Prints produced 15,618,588
- Rota prints 3,991,391
- Sorties duplicated 2,323
- Mosaics constructed 5,489

One wonders how such an organisation could have grown from the situation as it was known in 1940. Had we known then how things would develop, would we have acted any differently? I don't think we could have done.

Since the main object was to obtain intelligence information from air photographs, the first task was to recruit personnel deemed to be suitable and then to train them in the skills of interpretation.

There were two sources of useful material already available – the regular intelligence and photographic officers trained in official service training schools, which were few, and the academics and professionals who were accustomed to using air photos, such as commercial mapping companies, including the Ordnance Survey, oil companies, archaeologists, etc.

Making use of these existing facilities, a PI organisation gradually developed. Wing Commander Heath and Captain Churchill have been referred to in Paul Lamboit's paper and the combination of Wing Commander Cotton and the Aircraft Operating Company under Wing Commander Hemming provided a ready-made core of suitable persons.

There followed a period of unorthodox recruitment of people with expert knowledge relevant to our requirements, introduced by members within this core – Dr Hamshaw Thomas (later Wing Commander), a Professor of Botany who had worked with O G S Crawford, the Ordnance Survey Archaeology Officer, on air reconnaissance in the 1914-18 war; Norman Falcon (later Colonel) and Peter Kent, both senior geologists with large oil companies; and Glyn Daniel, a well-known archaeologist. Michael Spender, a valuable original member, was a member of the Air Operating Company but previously had been an enthusiast in mapping from air and ground photographs, especially in the use of the new photogrammetric plotting machines being developed by Heinrich Wild of Switzerland and the Zeiss Co in Germany. During the 1930s he had worked with the Danish Survey in Greenland, mapping from high-level obliques, and in that connection had come to know L R Wager (later Professor of Geology at Oxford) and myself, having worked with him briefly in Copenhagen, on one of the Zeiss plotting machines. Through him we both joined the unit, my case being a good example of the somewhat unorthodox recruiting procedures. I had been requested by a

member of a recent expedition that I had been on to find out what had happened to a certain piece of equipment; would I ask if the secretary of the expedition knew where it was? When I came to find the secretary at the Geographical Society, she had gone down to a place called Aero Films on the North Circular Road. Arriving at Aero Films, I had some difficulty in getting in and the CO, a Flight Lieutenant Peter Riddle, sitting at the CO's desk – a table in the middle of the front hall – dealt with my immediate problem and then said that he had two colleagues of mine working in the other room. They were Michael Spender and Professor Wager and he suggested that I go along to see what they were doing. I went and talked to them and on the way out he said, 'Well, are you interested?' I answered that it appeared to be very interesting work. 'Right,' he said, 'join us on Monday,' and in that way I was in the RAF, which was fairly typical of the way things went in the early days of 1940.

The first few training courses in 1940 consisted of between ten and fifteen pupils recruited in the above fashion and held in whatever accommodation could be found locally – bombed or un-bombed, – in Stonebridge Park and Harrow. After my course in October, I went into the Second Phase section for the duration of the subsequent course and then found myself appointed to run the next course, after which I was in charge of all courses until Course No 58 in 1945.

Early in 1941 we began to receive candidates who had been selected as being suitable for PI by the selection board interviewing potential Intelligence Officers. Numbers grew rapidly and the 'school' and main unit moved to much larger quarters at Medmenham.

The permanent training establishment consisted of two officers (one squadron leader and one flight lieutenant), one corporal and one WAAF clerk. We moved from Wembley to Medmenham, to a school in Marlow, to RAF Benson and finally to Nuneham Park in December 1942, where we remained for the rest of the war.

The organisation of the main unit had settled down to a definite pattern of First, Second and Third Phase interpretation, and as the Second Phase section was the most comprehensive, including all activities, we chose to base our teaching programme on the work of this phase. In addition we knew that the majority of successful candidates would initially be posted to Second Phase, joining specialised sections later if they showed some

particular interest or skill – in aircraft – or ship-building, for example.

Initially we followed the contents of the *Manual of Photographic Interpretation* compiled by Capt Churchill. This involved basic lectures on maps, scales, stereoscopy and types of cameras, in addition to specialised subjects such as ships, aircraft, industrial installations and the overall structure and working of the unit. As certain sections at Medmenham became more and more specialised, it became necessary to increase the number of visiting lecturers to talk about their own subject. One regular visitor not from Medmenham was a pilot from Benson.

The courses varied in length, ultimately three to four weeks, and tests were carried out during and at the end of the course. These would consist of writing what amounted to a Second Phase report on a particular pair or series of photos. Maps and basic information would be provided, such as previous cover information or rumours of suspected activity, etc. The instructors had the official Second Phase report to help them in the marking. Five or six such tests would be held during the course on such subjects as airfields and aircraft identification; naval and merchant shipping – including ship-building yards, commercial ports and naval bases; military and railway installations.

Marks were recorded which were used to help in the selection of suitable candidates for PI duties at Medmenham. The selection board consisted of the two, or sometimes three, permanent instructors, presided over by the group captain in charge of Medmenham.

Recommendations of the instructors were also considered, as we had been living in the same Mess as the pupils for about a month and thought it part of our duties ‘to get to know them’.

What I have said has been a straightforward statement of facts, but in retrospect one must bear in mind the very varied background of the pupils in age, nationality and expertise. The time taken to assimilate a host of new facts was, therefore, very varied. Some had not done any arithmetic for many years and found determining the scale of photos very difficult. Problems such as height determination from shadows would have to be left to the specialist and the use of Claud Wavell’s ‘altazimeter’. Difficulty in obtaining stereoscopic vision was usually overcome in time.

Other difficulties arose from the shortage of equipment – scales, slide

rules and stereos. Early French maps of the more remote areas still used Paris rather than Greenwich as the Prime Meridian, causing some confusion, and the use of the slide rule had to be taught to many. However, by Course 58 in 1945, the following had passed through the course: Royal Navy – 101; Army – 84; RAF – 657; WAAF – 247; and 224 others.

What I have said have been, on the whole, my personal reminiscences but I was reminded of many things by my chief assistant, Flight Lieutenant G D Tabraham. He was one of the original Aircraft Operating Company staff and a very painstaking man with a passion for detail, especially ships of all sorts, and consequently made a very good instructor. He also had to take charge when I was absent, such as on my visit to the PI stations in North Africa and Italy. I think that many ex-PIs would agree that without 'Tabe' the School would not have been the same.

Professor Jones:

There are many points that I am tempted to pick up; I believe that Dirk Bogarde was another distinguished person who branched out into other fields from CIU and there were others in later days. I ought to mention while we are talking of Douglas Kendall that I owe him a debt for saving me from a very hectic flap in March 1945 when we had chased the German nuclear physicists down to a small village in Southern Germany called Hessingen, I believe. We had been watching the area for some months without any sign of activity at all on photographs when, quite suddenly, on several hillsides around Hessingen, activity started and I felt for a couple of days that this was the beginning of something very big, bigger than the beams or anything like that. I was just about to go and tell Lord Cherwell over at the Cabinet Offices that we were on to something when Douglas, who was a geologist, spotted that all these mysterious signs of activity were lying on a shale-bearing seam and all this was an effort to get oil from shale at the very last moment of the German shortage. You have heard about the acceptability or otherwise of academics.

I should like to expand a little on those early days of interpretation. Fred Winterbotham and people like 'Shorty' Longbottom and Slocombe, as well as Sidney Cotton, were all men I knew in those days but I had no

real call on their services until there was something concrete to be looked for, such as, of course, the German beam stations. That was extremely difficult because even though the typical one had a turntable 100 feet across, the photographs were hardly good enough to show such a turntable, but in the course of looking, I had made contact with PRU out at Wembley and I had met Peter Riddle. It happened that I arrived in the Rolls-Royce lent to MI6, which I had for the day, and I well remember Peter Riddle's surprise when, at the end of the visit, he said, 'I will now show you to your Rolls,' and then, 'Good Lord, it *is* a Rolls-Royce!' This made my standing rather good for a time. The effort then tailed off as the photographs showed nothing; the Channel guns were much more exciting as subjects than radar stations (that is, if they existed) so gradually the interest of PRU in my work tailed off and I was given one of the junior interpreters, an awfully nice chap, very helpful but not terribly bright. Then one day in September 1940, at last, on a photograph of the peninsula up by the Cap de la Hague, I found the first one. It had changed the position of its cross-beam on the turntable between successive photographs and there it was. I was delighted with this and immediately had to write a report that went up to the Prime Minister. I had always been trained that, when you are doing a piece of scientific work or any intellectual endeavour, you thanked the people who had helped you, and so, on the credits at the end of this very short report, I thanked the pilot officer out at Medmenham, which I thought was a nice thing to do. To my astonishment, a couple of days later, I got a protest from Wing Commander Hemming who came in and said that he must talk to me and proceeded to wish that I hadn't complimented the pilot officer in my report. I replied that it was standard practice to thank anybody who had helped you at all. He said, 'Yes, that's all very well but I have been trying to get rid of that chap all this time, and now…..' Anyway, the result was that the pilot officer stayed, became more than a pilot officer and, as far as I know, stayed at Medmenham right through the war.

There is one other person that we haven't mentioned yet – Group Captain Peter Stewart who, as things got more organised, was appointed Assistant Director of Photography in Photographic Intelligence at the Air Ministry, to resolve competing priorities for photographic reconnaissance. One had heard many stories about Peter of one sort and another, of which perhaps a typical one was when he was Commanding Officer of 600

Squadron before the war. He had had an adverse report put in on him which he had had to see and comment on; his undue familiarity with his junior officers, who called him by his Christian name, was one criticism. His comment was that he would 'rather be called 'Peter' to my face than 'Stuffy', 'Sausage' or 'Ginger' behind my back'. This rather gives you the flavour of the man and I wondered how we were going to get on, but as soon as we met all difficulties were resolved. He was only too keen to see that the squadrons were not wasted but asked to do jobs that were worthwhile. One of the first things that he did was to take me down to Benson, where I started many friendships, some of which go on to today. I owed him a great deal, but the Air Force owed him much more, as it did to Sidney Cotton and others, who were brilliant individuals who would 'cock a snook' at authority to get a job done. Tragically, and particularly in the case of Sidney Cotton, they did not get anything like the recognition they deserved.

We now move on to a talk on interpretation and it is Mrs Cussons who is going to speak.

Mrs Diana Cussons:

It is for me a terrific sight to see so many people here listening to the little I have to add to the marvellous talks we have had today, from the very highly technical, through the flying side, photography and all the other facets – even my mentor 'Steve' is here – and eventually to the basics of interpretation, which was my involvement. I did a little First Phase and then spent most of my time at Medmenham doing Second Phase. In our time there we did twelve hours on duty followed by twenty-four hours off and there were never more than seven of us on duty at one time. If the day was fine and all the pilots were flying and all the cameras whirring, they came back and by eight o'clock at night we were delivered the most massive amount of material that you could imagine. There we were, the seven of us with one DIO for the whole twelve hours, battened down and with our heads down trying to cope with the amount of material that our wonderful pilots had brought in, just because the skies were blue wherever they had gone. The cover achieved was phenomenal.

Well, we started and when you get given by your DIO a pile of photographs, the first thing to be done is to find out where it is. Next you go and find the previous cover, if at all possible, for the whole amount and

compare the two, with your mind working overtime, studying the photographs, finding out what has been built, what has gone. Are there more barges in Calais? Are there more aircraft at this aerodrome? What is that strange little thing at Peenemunde that wasn't there the last time we looked? And so it went on, always comparing and getting out something new. Then came the a report; as 'Steve' said, 'All reports must be concise, brief, accurate and in good, clear English.' This was a demanding task for young things in those days to put everything down lucidly and clearly to send on within twenty-four hours. That was marvellous but if there was a day when there was no flying or very little coverage as you came on duty, it was a bonus. We finished the jobs that we had left over and I had a sideline for those occasions with 35mm film which fighter pilots used to send to me just in case I could get anything out of it which would help military or naval interests. I had quite a collection of photographs taken from that 35mm film which were very interesting, but of course nothing like as much detail as we got from PR photographs.

e all had our pet places that we loved to know about; we followed airfields mainly but also shipping, from the north of Norway through the Baltic, down Europe through France and into the Mediterranean as far as Genoa. It was a pretty hefty lot and one got to know them intimately and could see from the next cover how much had come and how much had gone. What had happened to the *Hipper?* Was she still under nets? Was the *Gneisenau* all right or had they actually broken the dock gates at St Nazaire? It was the most wonderful thing to be 'in', to be really 'in' the war; but somehow it didn't seem like war, at least not to me as I was doing something that simply fascinated me – finding out about the movement of another nation's Navy, Army or Air Force.

It really was astonishing just how much detail one could get out of photographs. We followed the elite of the German Navy and that was really so difficult. I am no mathematician but we were told to find out not only where they were but also to pinpoint them. It sometimes took hours to do this if all you had on the photograph was a rocky speck on one side and a huge German warship on the other. You had to give where it was and, if you had no indication from the pilot, it was very time-consuming, but we always managed very well, I think. We had some sort of table to help us work out the speed that these German units were going, but again it was fascinating stuff. You came off duty mentally, as well as physically,

exhausted, to live in a world that didn't really exist because, at that time, you were living amid things that were going on over the other side and not at home – a very, very unusual circumstance. I feel that photographs have an enormous contribution to make, even today, in any intelligence, whether it be for planning operations or in a war situation.

Professor Jones:

And now we have a talk by one of the earliest members of PRU and of great experience, John Weaver; we have been out of touch for many years but we have met again today.

John Weaver:

I am going to start off with a bit of reminiscence. Sidney Cotton was a great friend of mine and he operated in a most peculiar way, as you have already heard, but he got results, and quickly too. I had known him before the war when he was Managing Director of Dufay Colour and, as the Air Chief Marshal has already told you, he took some amazing photographs from the Lockheed 12A. I flew with him on several occasions in this aircraft and he was a remarkable pilot; to him it was just like driving a car. On one occasion he flew over to Tempelhof, and Goering and his lieutenants were there. Seeing the aircraft, they made enquiries as to whom it belonged. On finding out, they approached Cotton for a flight and asked where he would take them. Cotton was a very clever chap and said, 'I have a dear old aunt who lives in such an area, and if you have no objections we could fly over there'. It was agreed and off they set, but what they didn't know was that dear old Sidney was pressing the tit the whole time, taking photographs.

I started at Heston, which was called all sorts of names before it became PRU, joining them from the Intelligence School at Harrow at the beginning of 1940, one of a very limited staff. Cotton then waved his magic wand. He knew everyone at Air Ministry and so he rang up 'P' staff and said that he wanted two or three good chaps to be on my intelligence staff; within a few days four chaps came from the City who turned out to be the nucleus of the Intelligence Section which built up as time went on at Benson. One of the first sorties that we did from Heston, was a long run down the Rhine at high altitude but which produced a long series of pictures. After we had taken these pictures, it took us about forty-eight hours to make them into a mosaic, which we called the 'snake'.

Cotton had been battling away at Air Ministry following Longbottom's paper which, as far as we could tell, they just didn't want to know about. So Cotton then took our mosaic to, I believe, Air Vice-Marshal Peck, with whom he had been battling away and, so I am told, unrolled it across the floor, saying, 'What about that?' This started the real interest in this sort of thing at the Air Ministry.

We were bombed out of Heston in 1940 when a land mine put us all out of business and so off we went to Benson, where PRU took over, kicking out 6 OTU to make room. One of the first problems that I was up against was the 'Room' factor. The briefing and de-briefing of pilots had to take place in the Ops Room which, as you know, was not very large, particularly with a couple of controllers there as well. After a week or two of this I said to the Station Commander, Group Captain Bussey, that we needed more room and as the Unit was expanding all the time, could we move out somewhere. As luck would have it, there was a large farmhouse on the edge of the airfield which we got hold of and were able to put all our large-scale maps over the walls, so the chaps could see things when they came in. This also enabled us to have the Photographic and Intelligence Sections side by side. One of the biggest attractions in all this endeavour was that you knew what was going on in the war the whole time. The joys of the job included the excellent facilities of Medmenham and the first-class people there.

The chaps that Cotton produced from the City of London grew up with me and I had a section in the end of sixteen people who all did a magnificent job of work. In the middle of 1942 we received yet another responsibility with the arrival of the first Americans; a Lightning squadron who had to be tutored a bit. Typically, American generosity was forthcoming in that when they had people like Bob Hope visiting the unit, all our people were invited. Another day an American sergeant from this unit came to see me with a present from their Commanding Officer, Jim Hall. In view of the so-called help that we had given them, he had sent over a jeep, with the star still on it. You will all remember how hard-pinched we always were for transport and I thought it a jolly nice gesture. Running around in it for a while, I came across Air Commodore Boothman, who asked where it had come from, and on being told, said, 'You can jolly well send it back, it's against all regulations.' So that was the end of the jeep.

It was a wonderful experience and I believe that we produced some excellent results, but I feel that the public at large's knowledge of the tremendous effort of PRU is still unknown to many and I am making strong efforts to get Dr Fopp to mount a static exhibition here at the Royal Air Force Museum.

Finally, Mr Chairman, we had some wonderful demands from you, particularly that low-level radar stuff and I feel very privileged to be asked to come here today to talk to you all and to know that we have some very nice memories of PRU.

Professor Jones:

Thank you, John. You mentioned another two chaps who led from the front, Jim Hall the American commander who came to tell me he was very concerned that his P-38s were suffering far higher casualties than our Spitfires. I never found the answer but I did suggest that they should buy some of our Spitfires; I don't know what happened in the end or why they lost so many in the early days; maybe it was just inexperienced pilots.

The other was John Boothman. One of my peculiar requests for a sortie was quite different from any other. I think it was over Spain. The Germans had set up a navigational station which put out a fan of beams over the Bay of Biscay for the Condors and U-boats. We knew where it was and saw it going up but the question was, what to do about it? In a previous episode, they had tried to put a burglar alarm across the Straits of Gibraltar and again PR had come into it to locate exactly where their stations were. We knew enough about it, mainly from Enigma, but I had the job of writing the brief for Samuel Hoare, our Ambassador in Madrid at that time, to indicate to Franco that we knew enough about it to view it as a most unfriendly act. It was difficult to write briefs that one was sending by signal to a non-scientific Ambassador and yet not to give away more than was absolutely necessary. We did it but it was such a tedious job that I shuddered at the thought of having to do it again about this navigational station near Lugo. Then, I thought I had rather a good idea. We had more aircraft over the Bay of Biscay at that stage than the Germans and therefore if we could use the station as a navigational aid, it would pay us to keep it in being as it put up a nice grid across the Bay. I rang the Coastal Command Chief Navigation Officer and said, 'If I could give you a network grid over the Bay of Biscay which, relied on a station

in German hands, could you make more use of it than the Germans?' The answer came back that we could, which solved that side of the problem; we didn't have to either knock it over or get it dealt with diplomatically, saving me the awful job of briefing the Ambassador. Then in order to calculate the network of the fan of beams, we needed to know exactly where the aerials were and what their disposition was. That was where PR came in, so I went down to Benson to tell the chaps exactly what we wanted and why. I was most impressed by the results. I don't know how many times the sortie was flown but John Boothman, the Air Commodore in command himself, did a sortie. It was only later that I found out what was happening; a Spit would take the photographs, go on to Gibraltar, load up with a case or two of Sherry and then return to Benson! We were able to use the information from these photographs to great effect, so much so that the system the Germans used was adopted after the war and, despite a lot of opposition from Robert Watson Watt who had a rival system, the German system remained right up to the early Seventies.

We now come to questions and discussion.

Ian Meredith:

Until recently I was Estate Manager, Danesfield House at Medmenham, which, as a matter of interest, is going to be opened as an hotel so if anybody wishes to renew their acquaintance with it, I would suggest either a second mortgage or a personal loan as it isn't going to be cheap. Coming to a serious note, long ago a unit called Tiger Force, which I had the honour to command, made great use of photographic intelligence in deciding the best dropping zones and the most efficient way of creating holy hell wherever we were asked to do it. To all those concerned, the PR fliers, the photographic experts, the interpreters and others, may I say that I know from my own unit and others that your efforts saved a great many lives, for which we all thank you very much indeed.

Cecil James:

When we were planning this particular seminar, there was a hope that we could get Professor Sir Harry Hinsley to attend. I am sure you will all know that Sir Harry was at Bletchley Park for virtually the whole of the war and subsequently became the official historian for our intelligence effort during the war. Unfortunately he recently retired from being Master of his College, which means that he is far busier than he ever was before

and so he has not been able to come; however, he did give me a little note. I asked him if he could give us an overview from his vantage point as the official historian on the importance of PR. I received a very short note that I would like to read to you.

'It is important to distinguish between location of targets and the identification of what they were valuable for'. He went on, then to the process of selecting which of them should be attacked and with what priorities. 'Once PR resources became adequate, the combination of PR and intelligence was good at location of targets. In fact I can't think of any important target or target system that was not identified, with the important exception of the V-weapon sites which the Germans protected admirably by a combination of deception and launching techniques which made the sites extremely difficult to bomb.' I think that on this point Harry may well be referring to the V2 rather than the V1 sites because, through PR, we had great success in identifying the first type of V1 site, which were never used; they were ones with far greater launching capacity than the much smaller sites that were actually used. Harry continued: 'On the second point of identification and the allocation of priorities, the process called for more than the application of good intelligence; it called for strategic and operational assessment with the relative importance of targets and the feasibility of eliminating them. Often the answers were far from clear; see, for example, the pre-Overlord different schools of thought about the bombing targets. I suppose the one missed opportunity came with the slow start of the oil offensive in 1943/44 and, an obvious mistake, the attempt to eliminate the indestructible U-boat pens.'

I should like to add a personal comment on the point that the Chairman made about the extraordinary contrast between the amount of PR we did over Germany and the very small amount of PR that the Germans did over this country. I think this may well be just a matter of priorities. The Germans did an awful lot of PR from 1941 onwards but it was directed much more to the East than the West. Some of you may remember the delightful chap who was at the Battle of Britain seminar at the Staff College (*Herr* Schlichting), who turned out to be a Ju 88 pilot operating over this country in a reconnaissance role, from June 1940 to sometime in 1943. He reckoned that he had photographed about 75% of the United Kingdom so there was PR over this country, though I don't think it was

quite as well directed as our PR over Germany.

I still have a feeling that perhaps we haven't brought out clearly in the seminar the machinery for ordering priorities. Why is Flight Lieutenant Ball over Germany at 35,000 feet on a day in March 1943? What is the process that has got him into that position? There has been something said about it but the bureaucratic solution, and I speak as an ex-Air Ministry civil servant, would have been one where you had a sub-committee of sorts of the Chiefs of Staff. It does seem as if by some inspired amateurism we got away from that kind of bureaucratic way of deciding priorities. R V Jones, an assistant Director of Intelligence, can trot down to Benson and ask them to do something and they jolly well do it, without reference to anybody else. I don't know if there is anything that our Chairman would like to add regarding the assessment of priorities?

Professor Jones:

It was formalised by ADI Photos in 1941 when Peter Stewart took over. It was his job to decide between competing priorities at the operational level but, as you say, there was a great deal of informality. I could say, in summing up, that there was a great deal of support from the top which was one of the reasons for success, particularly with us. CAS, Sir Charles Portal, told me that if ever I saw anything of importance that I thought he ought to know, I was to go straight to him at once. I had full authority from him to do this, although naturally I didn't abuse it and only used it rarely when it really was very important. There was real interest at his level, certainly more at this high level in the Royal Air Force than in the Navy or Army, and beyond this to the Prime Minister, when necessary, in an emergency; this gave the impetus to get things done. It was Winston who had learnt in the First World War that the most dreadful mistake you could make was to have a too-strong hierarchy with too rigid links. He remembered on the U-boat war in World War One, which he felt was a classic case, where the admirals were against the convoy system but the junior officers, the chaps fighting at the sharp end, were convinced of the case for convoys; after Winston and Lloyd George had talked to them, they belaboured the admirals into adopting the system. There was also the Battle of the Somme and the lesson that he drew from that was that Sir Douglas Haig was not well-served by his intelligence; the temptation to tell a chief in a great position the news that he would most like to hear is

perhaps the commonest cause of mistaken action.

Despite being behind the Germans in cameras and things, brilliant individualists like Sidney Cotton, with support from the very top, gave credence to Winston Churchill's saying, 'The carefully inculcated doctrine that an Admiral's opinion is better than a Captain's, a Captain's is better than a Commander's, does not hold good when new conditions of warfare are to be faced.' He would always look at photographs, read Enigma signals, etc. to at least sample what was going on at the sharp end; that was the sort of support and interest that we had from the top which, I am sure, is one of the reasons why things, in the end, went so well, coupled with the fact that we had these brilliant individualists like Sidney Cotton and others.

This was of singular importance when we were so far behind the Germans in cameras and the like; what is more, we were still behind the Germans at the end of the war. Here I must be careful not to get onto a hobby horse but the Chief Photographer in the Foreign Office got together with me and thought it would be a very good thing if we could put the British camera industry back on its feet. The idea was that, as we had the Leica works in our hands, we could get all the Leica drawings and so forth, and give them to a British firm to duplicate. This was done but within three years the British firm had failed completely; it could not turn out that class of workmanship at the price the Germans could. What it really came to was that the German workman was prepared to take greater care than his British counterpart. Yet despite the advantages that the Germans had, in the end, fortunately, we came out on the right side, with help from the other side of the Atlantic.

Ken Batchelor:

I think the experts would agree that poor visibility and cloud cover all too frequently hampered PR. In Bomber Command the location of targets was difficult if there was cloud cover or if industrial haze gave bad visibility, but with the advent of H2S things were slightly improved in the sense that you could see through cloud; on PPI you could get quite good resolution of a photograph providing there was a feature like an estuary or a river. I seem to remember that from a later development of the H2S, which was a Mark 9 with two scanners, there was a photograph of Le Havre harbour taken through cloud on which it was possible to identify

every ship in the harbour. With the advent of GH in Bomber Command, which was very much more accurate than Oboe and other similar things, it became better, and I have photographs taken through 10/10th cloud and black oil smoke over oil targets. Could I have a comment on PR radar photography possibilities, please.

Professor Jones:

I remember the American 8th Air Force magazine with a picture on its front page of the docks at New York taken on a 3cm H2X, which was a revelation. One of my junior staff saw this and was shocked, not only by the performance – which we could have expected – but by the fact that it was on the front page of a magazine which almost certainly would fall into German hands. I remember that he rang up Air Commodore Chamberlain, Director of Signals at that time, and I have never seen one of my young men so set back by the Air Commodore's response. He took it very calmly and the young man said, 'Aren't you going to do something about this?' The Air Commodore replied, 'I expect the Germans have plenty of photographs of New York harbour.' We never ever knew whether he meant it or not! Thinking of photographs now taken by radar of Venus, which cannot be taken by visible light because the cloud thickness round Venus is very heavy indeed, the start of this was in 1943/44. It is now possible to do this sort of radar photography to an amazingly high degree of resolution.

Gordon Campbell:

No 684 Squadron, Far East Recce Force. I understand that after the war all the Far East reconnaissance photographs went to Keele University; they now seem to have disappeared entirely. Has anybody any idea what happened to those photographs?

Professor Jones:

Does anyone know? Oh, they are there.

Anon:

I understand they are at Keele, looked after by a Mrs Walters; as far as I know, they are still there.

Professor Jones:

Even so, they are not very easy to get.

Anon:

I understand that Keele deny all knowledge of them.

Chris Brockbank:

I co-operate with the University of Keele, and the Far Eastern cover is not there. There are five and a half million original prints of pictures taken in the last war which have all been put onto 35mm microfilm and if anybody needs pictures, Keele will be very pleased to supply copies. They have a leaflet for the Air Photo Library which is available from Mrs Sheila Walton who will, I am sure, be only too pleased to help anybody who needs information.

Reginald Biggs:

May I make a couple of further observations about what has been said. Firstly, I would like to refer to the 'snake', the mosaic that was prepared at Heston in 1940. This was one of Cotton's public relations exercises. At that time I was at 32 MU in South Wales as a Mechanical Engineering Draughtsman before being posted into Heston. After the mosaic was made, I had to make a transparent acetate cover for the 'snake' because it was to be presented to those above. The several copies that I had to trace were for things like shipping, industrial areas and the like, with each being annotated. I prepared four or five of these for presentation.

The second point that I would like to comment on is night photography. The Royal Air Force really didn't develop night photography for many technical reasons. There were no such things as line overlaps in night photography and there were so many other activities besides the flash, such as searchlights, *Flak* and other aircraft dropping flares, that made returns for interpretation not particularly good.

There were ladies in interpretation such as 'Bunny' Gregson, Macknight and Vic Oliver's wife, Sarah Churchill, and I thought that Wing Commander Stephenson, whom I knew a long time ago at Medmenham, might perhaps have emphasised their role, although he did mention the proportion of them at Heston, Wembley and Medmenham.

One final experience: after five years in PR by October 1945, I was about to be posted home from Italy, where I had served with 326 Wing and MEPRW , when a sudden posting to Habbaniya, Iraq, arrived. It had

been decided at governmental level that before 682 Squadron came home they should photograph all the oil wells in Iraq and Iran; this turned out to be a ten-week stint.

David Oxlee:

I understand perfectly what makes a good photographer; it is somebody with the patience to put up with the photo interpreters! However, I would like to ask the panel for their views on what makes a good photographic interpreter.

Professor Jones:

One of the great difficulties with interpretation is that although you can learn to interpret objects with which you are familiar, when there is something there that you don't understand, it is a different matter. You have no yardstick but once you have found the first example of an object and identified it, subsequent ones, every interpreter will agree, are much easier. For example, the first radar station that we photographed successfully, and for which the pilot officer was thanked all the way up to the Prime Minister, had one of the best interpreters on the job – Squadron Leader Claude Wavell. He later came to me with some photographs saying he didn't know what they were but there were two curious round objects about twenty-five feet across in a field near Cherbourg; he felt they might be 'cow bins'. I looked and then asked for the nearest village, which I was told was Eau de Ville, which I knew from Enigma was the site of a German radar station, actually the first *Freya* station. It led on to one of the photographs on display here today, one of the great photographs of the war taken by Flying Officer Manifold. Now that is a good interpreter, in my view: someone who doesn't know exactly what he is looking for but nevertheless fixes onto a strange something that could turn out to be important. .

Another one of Claude Wavell's concerned the security before D-Day of our communications and navigational aids like GEE, which might have to operate in a hostile electronic environment, as it would be put nowadays; in other words – jamming. The question was, 'Where were the German jammers and what did they look like?' We had one stroke of luck that in 1940 on a hill between Calais and Cherbourg we came across a bit of a battle going on in Enigma between the commanding officer of the beam station and some of his rivals in the German signals organisation

who wanted to put up a jamming station on that same hill. We duly watched and found the activity and this was the one German jammer that we knew about. During the subsequent years, Claude Wavell scanned and scanned and found another five or six. He also said, 'There is something else here; it isn't one of these but it looks as if the same chaps have built it. Have a look at it, will you.' So when it came to the actual time to knock out the jammers, the electronic evidence seemed to indicate that there were twenty-three because all the DFs crossed in so many places that plans were made by counter measures to try and attack twenty-three jammers. I said, '(A) you won't be able to do it and (B) they don't exist. I know of five and there is possibly a sixth.' As enough effort for twenty-three had been laid on, we said, 'Do the five, and this one for luck, and see what happens.' When the night of D-Day occurred – 5/6th June – they were attacked and the five were knocked out. I was at AF headquarters next morning and saw the same group captain, who just did not believe me that there weren't twenty-three. He seemed much happier now and when I asked how the invasion was going, he said, 'I don't really know but there is a marked increasing in saluting this morning.' The point that I want to make about good interpreting is that this extra station which was attacked because Claude Wavell thought it was something in the same line, in the event turned out to be their main signals headquarters, perhaps even more important to knock out than the jammers. The CinC's report said that countless lives had been saved on D-Day because of these attacks. That, I say again, is what makes a good interpreter.

Mrs Diana Cussons:

I would add, 'Curiosity in the unusual'. If you saw anything that wasn't there on previous cover or if something you didn't understand aroused your curiosity, you went for help. Quite often you found out more than you expected.

Professor Jones:

And that is a very difficult thing to do by computer!! Sir Bernard Lovell has said that if Cambridge had computerised all their records, pulsars would never have been discovered because they would have been thrown out as part of the dross. It was only because they had a very good girl observer there who said this must be worth looking at, that pulsars were discovered.

Reg Lewis:

What was the process of filtering information once you had seen something unusual. Where did it go?

Professor Jones:

It would have gone to the various specialists in the Ministries. For example, anything that looked as if it could be radio or radar would have been sent up to me.

At this point the Chairman is supposed to sum up. I would have liked to have seen some answers to the question, 'Why were we so slow in getting forward-facing oblique cameras into our aircraft, when it was a crying need virtually from the start?' I am also sorry that we haven't had time to talk more about the great reconnaissance pilots like Tony Hill and Thomas Stephenson and their achievements, although we have talked of some. There are a number here who have been too modest to mention their own achievements, and I am sorry about that.

Quite rightly we have concentrated on the British side, though some comments have been made about the German effort. The surprise is not only about the comparative lack of reconnaissance over London; although they did have the Ju 86P and they did make flights over Britain, they didn't seem to have much over central London. Indeed they failed to have any cover before the 10th September 1944, as a result of which they attributed all the damage that they had done in the May 1941 raids at the latter end of the Blitz to V-weapons! Of course the flying bomb boys were only too keen to claim that damage and they got away with the claim because there was nothing to show otherwise; there were no photographs of the May 1941 raids which would have shown the damage.

We talked very little about the contribution of our allies; I would, if I may, just mention the Poles, and I think you will like this story. When Peter Stewart was commanding Medmenham, he introduced me to one or two Polish officers, one of whom was the real wag of the party and had caused Peter a certain amount of trouble. On the occasion of a visit by the then Duke of Kent, they came to this Polish officer, who was asked through an interpreter, 'Flight Lieutenant, what are you doing?' The reply was, 'Please, sir, you must ask my Commanding Officer.' After the Duke had gone, Peter went back to the Polish officer and said, 'You were

absolutely right, but next time, if you find me bringing round a senior Air Force officer in uniform, you can tell him exactly what you are doing.' The next visitor was Sir Charles Portal, Chief of the Air Staff, and of course the same thing happened. In answer to the question, the Polish Flight Lieutenant said, 'I am making the secret waste.'

What lessons then have we learnt, or re-learnt; what has been brought out into the light? Air Marshal Ball mentioned the fact that the individual pilot had liberty to plan his own sortie very much as he thought it ought to be carried out. Also, within the organisation people like Peter Stewart and Geoffrey Tuttle, once they had got to know you, were only too glad for you to talk to the pilot; many of our successes were due to the pilot knowing exactly what we wanted and why we wanted it. Off Peenemunde, people like Gordon Hughes were tilting their Spits just that bit more to see if they could get an oblique from high-level; people like Tony Hill knew exactly why we wanted the photographs of radar installations. There were times when we were criticised for that on the grounds of security; you were not supposed to tell more than was absolutely necessary – I thought it was absolutely necessary. There was the risk that if a pilot was shot down, one way or another, he might be persuaded to talk, but I always took the line that if at all possible you should tell the pilot exactly what you wanted and why, and furthermore show him how his work fitted in with the overall picture that you were trying to build up. The consequent enthusiasm was one of the most rewarding things that you could possibly experience. If you couldn't do that, and it was very rarely that would happen, I had a test which I would apply. Without knowing the facts would I, in the place of the pilot, take the risk involved? Provided the answer was positive, I would then ask for the sortie. I always felt a bit of a sham because I did not take the personal risk myself; these were the chaps taking the risk whilst we were benefiting from what they could do. Generally we would always say what we wanted and why we wanted it; there was an enormous amount of trust which was very well rewarded. The people like Donald Steventon, Tony Hill and David Douglas Hamilton had the run of my office even though it was supposed to be tremendously secure in MI6; they were one of the few groups who could come into the office at any time and talk because so much greater results could be produced by that kind of liaison. Here the Commanding Officers were very understanding in their acceptance of not

being wilfully bypassed and they appreciated the shortening of the chain to the very minimum; they were of course kept fully informed.

Another thing that we haven't said much about, mainly because there isn't anyone here apart from myself to speak on it, and that is how you use photographic intelligence. One has, in an intelligence attack, various sources – secret agents, cryptography, electronic (in the form of listening to stations, etc.) – and the art of intelligence as far as I was concerned was using each source to produce the kind of information that it was best suited to. Photographic intelligence, for example; does not tell you the power of a particular radio transmitter; on the other hand, a photograph of the aerials will enable you to calculate the sharpness of the beams and what can be done with them. You will have to use electronic intelligence, listening, to get the power. This is of course a very simple example but I always felt that one of the great arts of intelligence was, in the manner of a commander who had tanks, infantry and so forth, to be able to use each of these resources to the best of its ability in its most effective role. Also, I always felt it to be of the utmost importance to show the individuals making up the force exactly where they fitted in.

There is no doubt in my mind that photographic intelligence was one of the key contributions to the whole of the intelligence picture. The old saying that a picture is worth a thousand words is more than true, particularly when convincing air marshals, or even Prime Ministers. There is something about a picture which carries a conviction that no amount of cryptography will convey.

Thank you, ladies and gentlemen, and I hope you have enjoyed it as much as I have. In a way, of course, it is a sort of reunion of so many who were associated and contributed.

Air Marshal Sowrey:

Today achieves just what the Royal Air Force Historical Society sets out to do and that is to put personal reminiscences and contributions into the framework of official history. Thank you, particularly our guests, the two societies that I have already mentioned; you have seen what our society does, come and join us. Thank you too, contributors and participants, but thanks most of all to our Chairman, who has brought to us an inestimable amount of his own personal experience and the value of what he did in this particular field. Perhaps I may be allowed a Freudian

slip for today only; thank you, Professor **P** R. Jones.

Professor Jones:

May I offer a final reminiscence as evidence of my involvement in the subject. Many of us here, and particularly the interpreters, will have looked at pictures for the whole war and been able to know where a pilot, who had flown hundreds of miles, had been. In my case I got so used to looking the whole way from Den Haag to Bordeaux, covering the whole coastline, and some of us, like Claude Wavell, just knew everything by heart. In 1944 when Paris and Antwerp were being attacked by V1s and V2s, I had to go across to Paris and this time in an aircraft of the King's Flight. As was usual, we got shot at by the Royal Navy crossing the Channel, a fairly common experience at that time, and after the pilot had thrown the aircraft about he straightened out but was a bit lost. As we were crossing the coast, I said, 'Don't worry, I think I will be able to tell you where we are.' We were over Dieppe and I had looked at that area on film in black and white so often that I said, 'Dieppe – dammit, it's coloured!' – probably the most silly thing that I ever said in my life!!

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Marshal of the Royal Air Force Lord Tedder

Dr Vincent Orange, the author of a number of important RAF biographies, including those of Keith Park and 'Mary' Coningham, is now undertaking some research relating to Lord Tedder. He will be in the United Kingdom during the summer of 1992 and would like to meet any of our members who knew him. If you are able to help in this way please write to **Dr Orange, c/o AHB (RAF), Ministry of Defence, 3-5 Great Scotland Yard, London SW1A 2HW;** he will get in touch with correspondents once he arrives in this country.

THE FORGOTTEN AIR FORCE

The role of our Service in the Far Eastern war has always received much less attention from historians than its many activities in the war against Germany and Italy, to the concern of the many members of the RAF who served in that theatre. Just as the Fourteenth Army was, and still is, referred to as the 'Forgotten Army', so can our own men and women who worked alongside them reasonably consider themselves the 'Forgotten Air Force'. Sadly, even John Terraine, whose book *The Right of the Line* has added so much to our understanding of the RAF's contribution to the Second World War, was unable, for reasons of time and space, to extend its coverage beyond the European theatres of operation.

In an attempt to fill this gap, Air Commodore Henry Probert, formerly Head of the Air Historical Branch and now Chairman of our Programme Committee, is to write an account of the work of the RAF in the war against Japan, with the support of the RAF Historical Society. It will cover, among other things, the problems of the 1930s as they affected the RAF in the Far East, the sad tale of events in 1941/42 in Singapore and elsewhere, the strategic issues affecting the conduct of the Far Eastern war from then on, the air contribution to the military operations in Burma, and the RAF plans for the assault on Malaya and Singapore, and on Japan itself. While most of the material will be drawn from official records, some of which have never been properly exploited, the author hopes to include a certain amount of personal reminiscence in order to show, for example, the very difficult conditions under which people all too often had to operate. He would therefore like to hear from members who were involved and may be able to offer worthwhile recollections, and possibly photographs. They must, of course, bear in mind that it will probably not be possible to use more than a small proportion of the material that is made available, but obviously the wider the choice, the better. His address is 88 Kings Road, Henley-on-Thames, Oxon. RG9 2DQ and items sent to him will be returned if requested.

The task is likely to take some three years, and all being well the book will be published by Brasseys in 1995 to mark the 50th Anniversary of the ending of the Far Eastern war.

DOCUMENTING THE RAF – A PROBLEM IN NEED OF SOLUTION

Professor Robin Higham, Kansas State University

One of the puzzles of doing research on the RAF is finding out what documents the service itself raised. Trained historians can glean a great deal from such resources and can, once they have digested them, interview survivors quite intelligently and in a time-saving manner.

For those of us working in the periods before 1960, the surviving documents are in the Public Record Office. But there are two difficulties. We are not entirely sure what has survived and been accessioned there and we are uncertain as to the documentation the RAF raised in the first place.

The PRO has gradually developed finding aids which help, such as the hefty lists of the contents of AIR 10 Air Publications, AIR 20 Assistant Chief of the Air Staff (Technical Requirements), AIR 41 Air Historical Branch Histories, and AVIA 25 for the MAP (Ministry of Aircraft Production). There is also a mimeographed leaflet (No 16) on RAF operational records and a PRO handbook, *The Second World War: A Guide to Documents in the Public Record Office* (1972) produced in conjunction with the opening of the 1939-45 records and the introduction of the 30-Year Rule.

The main difficulty with many of these is that they were produced when the archival mindset was on operational history (AIR 50). So the Form 540 *(see* AIR 27 and AIR 29) logging in unit personnel and status and flying or other activity, weather, and the appendices have been kept. Material, often voluminous on testing aircraft, is there but not a variety of now important other records. For instance, as near as I have been able to determine, those parts of the Form 540 which covered maintenance and logistics have been stripped away (and destroyed?). It is possible from returns made to the Air Ministry to know the daily state as regards aircraft serviceable, serviceable within twenty-four hours, and beyond the capacity of the unit to repair. But the actual status of aircraft on a squadron, in flights, spares held, and that sort of thing, is at present a mystery. This is one place where we need the help of former engineering and maintenance officers. We need to know what documentation they kept and to whom they submitted copies. To whom and how did they signal reports and needs?

Historians know that signals often went out in multiple copies (top secret signals in the Middle East in 1940 went to forty-two addresses), so a rule of thumb is always to call for the most unlikely files. There are to be found the copies not destroyed.

Currently the files of AM S.5, Statistical Office in 1939-1940, have disappeared. This makes it hard to know how many pilots the RAF had in 1939-1940. But it is possible to get at this from what is probably a reliable source.

Looking for material in the RAF in the 1934-1941 period in the archives of the *Service Historique de l'Armée de l'Air* (the SHAA) at Chateau de Vincennes outside Paris, I found two letters of 10 June 1940 from G Bateman, Assistant Foreign Liaison Officer, AM to the French Air Attaché in London, who had passed them along to the *Deuxieme Bureau* of the *Armée de l'Air* in Paris reporting the enclosed figures on RAF pilot production, September 1939 through March 1940. These do not tally with those in the undated (immediate post-war?) Air Historical Branch History, *Manning: Plans and Policy* (n.d. secret) in AIR 41/65. Nor can I corroborate them from presently available sources.

In the same SHAA files (2B/082) was an even more interesting document: the mobilisation orders for No 226 Squadron of the Advanced Air Striking Force of RAF Bomber Command, which was to be sent to France upon the outbreak of war. What made this a 'find' was that it detailed those forms which the unit was to take with it upon going abroad.

One immediate question is, is the following list complete? The *Air Ministry War Book* does not help.

King's Regulations (Air) AP 112 Rations

AP 830

AP 1096 Mobilisation Regulations (including Rations)

AP 1270 List of Stationery

AP 1301 War Manual

AP 1407 Funds for Messes and Institutes

AP 1410 Funds for Messes and Institutes

AP 1413 Active Service Accounting Instructions

AP 1510

AP 1548

AP 1616 War Equipment Schedule ( )

AP 1625 War Equipment Schedule

AP 1643 War Equipment Schedule ( )

AP 1671 Instructions for a Short Sea Voyage (including for officers i/c of a train)

Form 48 Medical History envelopes

Form 64 Airmen's Service and Paybook

Form 149 Monthly Report of Airframes and Engines Written off in the previous (calendar) month (sent to AM. S5)

Form 167 or

Form 182 Central Trade Test Board

Form 276 Will

Form 280 Certificate of Service

Form 514 Statement of Qualifications for Registration as a RAF Voter (see AP 1444 re proxies)

Form 540 Unit Log

Form 591 Receipt for Personnel Documents

Form 637 MT Driver's ID Card in lieu of Licence

Form 783 Draft Mobilisation Note

Form 864 Identity Disc Envelope

Form 1580 Record Sheet (Active Service) (to be prepared from individual Form 280s)

Form 1623 Daily Arrival and Departure of Airframes and Engines

Form 2066 Embarkation Roll (10 copies)

Mobilisation Regulations

Maps two per aircraft sufficient to enable them to reach the new Continental base (By 1945 as a Dakota co-pilot I had

some twenty sheets for northern Europe and the UK)

Form G Daily Aircraft and Crew State Report

Confidential Documents:

CD 80 Guide to the Collection and Collation of Air Intelligence

CD 119 Manual of Air Tactics

Secret Documents:

SD 47 RAF ACTION Code for Signals

SD 107 Mobilisation Instructions – Western plan

SD 110 Aircraft and Squadron Letters and Markings

SD 123 Notes on the Italian Air Force

SD 128 Notes on the German Air Force

SD 132 Handbook on the French Air Force

Manual of Military Intelligence (Pamphlet No. 2)

All other documents (which were? – And here's where we need the help of some old Admin. types, please) were to be left at the station (base).

The mobilisation document is also helpful in that it provides information as to the issues of tool kits and small arms and a list of officers kit, together with an idea of how many vehicles it took to move an RAF squadron minus most of its personnel, who proceeded by rail. Aircrew took their kit in the aircraft including four blankets and two waterproof sheets per airman. Steel helmets were provided only for 50% of the personnel.

Now, some of the vital materials which we can suggest as not listed in the above fall not only into the maintenance area – such as spares, petrol, oil, lubricants, temporary hangarage, field supplies of all sorts – but also into the medical information.

The pre-war SD 98 dealt with scales of wastage for various levels of conflict and did provide usable estimates, but it is evident that the documentation listed here does not permit us to check those estimates except insofar as losses of personnel and aircraft are concerned. Unit records of expenditure of fuel and ammunition would allow us to measure

efficiency as expenditure of ammunition would show training, skill and experience, and possibly other variables. Fuel consumption would be a measure of activity, including air tests.

I am well aware that ration states may not be accurate, having been in a Mess which had a strength of twenty-eight but only fourteen bodies. (The Mess Secretary was being held on something like sixty-one charges when I left!) But over time and in a number of squadrons they, like medical records, could provide other concepts.

BOOKS

HIGH COMMANDERS OF THE ROYAL MR FORCE
by Air Commodore Henry Probert

HMSO; £15.95 **ISBN 0-11-772635-4**

There has long been a need for authoritative accounts, however brief, of the heads of the Royal Air Force from its inception to the present day. A few of the Chiefs of the Air Staff – notably Trenchard, John Salmond and Portal – have been the subject of full-length biographies; and a few more – Sykes, Tedder, Slessor – have left a substantial slice of autobiography. But for many the public has had to rely for its knowledge on a mere entry in *Who's Who.* Now Air Commodore Probert has admirably remedied this deficiency.

In a most thoughtful Introduction, Air Commodore Probert makes it clear how he chose his list of subjects: all the Chiefs of the Air Staff, plus two commanders (Douglas and Harris) who were made Marshals and one (Dowding) who was ennobled, but who never became heads of the Service. He also explains that he was able to interview nearly half his subjects, and that he has inevitably eschewed any attempt at critical appraisal, as opposed to purely factual details, of the Chiefs still living.

Amongst the interesting observations in the Introduction are that there seems to have been no standard career pattern among those who became CAS; that at times luck, in the form of unexpected death or accident, played its part in determining who should rise to the very top; that sometimes the heir has been obvious, at other times not; and that the effectiveness of the Chiefs has always depended on team work, on the loyal support of the senior officers and civil servants and the political chiefs with whom they had to work. The differences resulting from working within the structure of the Ministry of Defence, as opposed to the old Air Ministry, are also acutely noted.

Who appoints the Chief of the Air Staff? Should he ever resign? How far should he attempt to influence his successors? These are some of the interesting questions discussed in the Introduction, which concludes with a well-deserved tribute to a true father of the Royal Air Force, who, because he became neither CAS nor a Marshal nor a peer, does not feature in the book – Lt. General Sir David Henderson.

There is no space here to consider in detail the studies which follow. All are marked by scrupulous fairness and in each case skilful compression enables us to appreciate the subject's main achievements and contribution to the Service. Inevitably the earlier sections of the book are the more absorbing, because of the greater richness of the source material available and the greater freedom of comment. The later studies, however, have their own special degree of interest and are particularly useful in reminding us of the problems which have confronted the more recent Chiefs.

The volume, which is handsomely reproduced by the Stationery Office, has a bibliography and a most valuable appendix summarizing the record of service of each of the twenty-two officers studies. The illustrations number no fewer than eighty-four; most of them are excellent, and many unfamiliar. Both for reading and as a work of reference, the book is one which students of RAF history will certainly wish to acquire.

DENIS RICHARDS

ENGLAND AND THE AEROPLANE –
an Essay on a Militant and Technological Nation
David Egerton

Macmillan; Hardcover: £35.00. **ISBN 0-333-550226**
Paperback: £14.99. **ISBN 0-333-569210**

PLANNING IN WARTIME – AIRCRAFT PRODUCTION
IN BRITAIN, GERMANY AND THE USA
Sir Alec Cairncross.

Macmillan; Hardcover: **ISBN 0-333-53840-4**

Both these volumes seek to address issues in an area of British aviation history, the industrial and political, which has been badly neglected, and which is, in consequence, little understood. Too much strategic and operational history is still written without any consideration of the very great influence which these factors had, and any work, such as these, which seeks to address such areas is greatly to be welcomed. Both books, however, come out at less than 200 pages and are really in the nature of extended essays. Dr David Egerton sets out to challenge the views of historians such as Corelli Barnett that England *(sic* – for some reason he

excludes the British Celts!) was a 'welfarist' nation uninterested in technology. Sir Alec Cairncross is more narrowly concerned with the workings of the planning process in industrial production in war.

In Dr Egerton's eyes England throughout the Twentieth Century has been a warlike nation and its commitment to the aeroplane has been an examplar of a wider commitment of armed force, science and technology. This reviewer concluded, however, that the thesis remained unproven. Dr Egerton is quick to challenge accepted wisdom, starting off tendentiously by stating that, although numerically inferior to foreign powers in 1914, England was actually a strong aerial nation. Thus he believes that the 63 front line aircraft of the RFC were a large force in relation to the strength of the British Army. Which is all very well, but ignores the relative numerical weakness (50 rather motley aircraft) of the RNAS, which was the air arm of the world's strongest navy.

He similarly overstates the case when he argues that the Right was deeply influential in air power politics in the inter-war years. There is little evidence that the rather noisy exponents of right-wing politics had any greater practical effect than the rather more sober but equally 'air-minded' figures of the Left, such as Lord Thompson. Other than an innate conservatism (with a small 'c'), most RAF officers displayed little interest in politics.

Industrialists such as Handley-Page were inevitably of the right, and were naturally suspicious of the powerful pacifist wing of the Labour Party, but the centre, always tending to speak more softly, almost certainly carried more weight than either of the extremes. Nevertheless, the author is at his best when considering the relationship between the aircraft industry and the State. Anyone seeking a brief exposition on the various amalgamations and occasional bewildering changes of ownership within the industry will be hard-pressed to find a more lucid explanation than is given here. Whilst he is right to argue that the RAF has traditionally been reluctant to become involved in the manufacture of aircraft, Dr Egerton perhaps underestimates the degree to which the Service has been successfully able to influence design through the specification system, which has been a very effective two-way street. However, his conclusion that 'there is no failure of the British aircraft industry between the wars which needs to be explained' is an admirably argued corrective to the

more pessimistic interpretations which have come to be too readily accepted in recent times. The analysis of post-war policies, and in particular Harold Wilson's attempts to divert R and D resources from military to civil use, are also thoughtfully argued. Dr Egerton has produced a challenging book, which will provoke the reader, usually intelligently, but occasionally thoughtlessly, as when we are asked to accept simplistic nonsense such as the contention that strategic bombing 'did not work between 1940 and 1943, and pointlessly destroyed people and buildings thereafter' as if all major forms of warfare do not.

Sir Alec Cairncross attempts a comparison of aircraft production in three of the major combatant powers during the Second World War. He approaches the wartime manufacture of aircraft in Britain from the perspective of one who was deeply involved as a bureaucrat in the Ministry of Aircraft Production. There is so little written by those who were part of one of the largest exercises in bureaucratic planning and production ever attempted that his book is welcome for that alone. His personal perspective, however, is both the book's strength and its weakness. Although he has conducted some research into the primary records at the Public Record Office, by and large he uses them to bolster his personal views, whether pro or anti, rather than as an objective historian. Thus other historians using his book may feel unsure whether statements made are based on research or memory, or an amalgam of both.

There are valuable insights into the internal workings and tensions within MAP, but sometimes they are overstated, so that the reader is left to ponder how British industry managed to produce the creditable quantity and quality of aircraft which it did. The author also writes as if his strictures apply to the Ministry from its inception to the end of the war, and there is too little analysis of what preceded the Beaverbrook era, ie the foundation on which all later expansion rested, and not enough attention is paid to the changes wrought in MAP with the arrival of Stafford Cripps and Sir Wilfrid Freeman in late 1942.

In writing of German and American production the author is forced to rely on secondary sources bolstered by British reports on foreign industries in the Public Record Office. Whilst this means the reader is much surer of the origin of much of the material, it is much less

stimulating to read. The German chapter relies heavily on the researches of Dr Richard Overy, which may be unfamiliar to the general reader, and this succinct restatement is of value for that very reason. The American chapters draw heavily on the excellent if rather turgid American official histories, and again the synthesis of those heavyweight volumes is very useful, but it does not break any new ground. Nor does Sir Alec's 'research' produce anything which would contradict Dr Egerton's attack on the 'declinists', rather the opposite. Nevertheless, as with Dr Egerton, any book which helps to fill in the industrial background to the strategic decisions is greatly to be welcomed. It is sad though to reflect how little has been written of MAP by former members of its staff, civilian and military alike.

SEBASTIAN COX

AIR POWER AND COLONIAL CONTROL –
the Royal Air Force 1919-1939
David E Omissi.

Manchester University Press; £35.00 ISBN 0-7190-2960-0.

A fair amount has been written concerning the RAF's air control operations between the wars, but nothing approaching the quality of this work. Dr Omissi divides his book into two parts. The first four chapters deal largely with the origins and subsequent expansion of air control, and the practical limits to that expansion. Although an excellent survey, these chapters contain little that is new.

The second and larger part of the book examines different aspects of the problem, and these five chapters contain much new and thoughtful analysis. The author starts Part II with a chapter on the geographical environment of air policing, both in terms of the aircraft's ability to extend the reach of government, and the limitations which the physical world still imposed. The following three chapters, devoted to the indigenous response to air power, the technical dimension, and the role of force in Imperial government, contain a most perceptive analysis which goes far beyond the more familiar parameters of politics and operations.

The author takes other historians to task for their 'lack of scholarly attention to indigenous reaction ... [which] are better explained by the preoccupations of historians than by an absence of primary evidence'. He

shows how accurate this stricture is by using operational records to illustrate the changing effect of air power during the period, and the striking ability of some tribal peoples to adapt and seek to ameliorate its effects by such simple expedients as moving or working their fields by night and not by day. They also developed rudimentary early warning signals, dug shelters and dug-outs or used caves, and successfully deployed deception techniques such as displaying captured ground-to-air recognition panels, as well as more direct methods of retaliation such as concentrated rifle fire.

On technology the author argues persuasively that the RAF's sustained and heavy commitment to Imperial policing did not seriously distort its doctrine in favour of the bomber, as is sometimes argued. Nor does he believe that it hampered the development of bomber aircraft for use in Europe, which is almost certainly true, though it is equally true to say that it did nothing to encourage such development. Furthermore, he does not mention army co-operation aircraft for use in Europe, and here air policing's effect on the development of aircraft such as the Lysander is more problematical.

The most controversial part of the book is the chapter on Imperial politics and the role of force. Dr Omissi claims that his analysis is limited to the political and operational, rather than the philosophical perspectives. Nevertheless, his own ethical doubts over the exercise of air power in this role continually, if perhaps unconsciously, emerge in the narrative, and occasionally lead to less rigorous analysis than we see in the rest of the work. Thus, he attempts to lay down a yardstick against which the potential scale of force available can be measured, but then devalues his analysis by using an essentially European heavy bomber, the Vickers Vimy, never used in policing, and comparing it with the fairly light 18-pounder artillery piece, rather than the howitzers so frequently deployed by the Army in colonial operations.

Moreover, the accusation in the book that the euphemism 'moral effect' was solely related to casualties, and was wont to change in relation to operational possibilities or political expediency, is surely simplistic. The shift in emphasis, from merely inflicting sufficient casualties to induce a change of heart to more subtle pressures, also reflected the fact that the Service grew more accustomed and familiar with local conditions.

The author seems to forget that the majority of the RAF officers in the early 1920s had learnt their trade in the Great War, where the infliction of maximum casualties on an organised enemy was their major preoccupation and aim. To ascribe the recognition that less sanguinary methods may be more effective for policing purely to bowing to outside political pressures and existing operational limitations, seems unnecessarily cynical. The author himself points to a growing recognition that the destruction of livestock, terraces, etc could have unlooked-for long-term economic effects, and the increased awareness that social and political intelligence was vital to a more precisely focused campaign. These developments were surely contemporaneous with, and not just reactions to, the political and ethical debates.

Similarly, the author's view that the principles of enforcing collective responsibility on recalcitrant tribes was somehow an ethical argument thought up by the Air Force, 'premised upon a particular view of tribal society, [and] used to explain away certain military limitations of air power' is to ignore the application of power collectively against communities in Europe over the centuries, whether by blockade or siege.

These criticisms do not alter the fact that this is a fine book, highly recommended, though the author's diligent scholarship might have been better served by a publisher willing to extend the print run, reduce the price, and advertise it more widely. If academic publishers are to demand £35.00 for 250 pages, it is surely not unreasonable to expect that they employ a decent editor so that errors such as focussed *(sic* – more than once), auxiliary *(sic),* as well as several other simple typographical errors, are removed from the text.

SEBASTIAN COX

WESTLAND AIRCRAFT SINCE 1915
by Derek N James.

Putnams; £35.00 **ISBN 0-85177-847-X**

HAWKER AIRCRAFT SINCE 1920
by Francis K Mason.

Putnams; £35.00 **ISBN 0-85177-839-9**

AVRO AIRCRAFT SINCE 1908
by A J Jackson.

Putnams; £30.00 **ISBN 0-85177-834-8**

Three more volumes in the well-known series by one of Britain's best-known aeronautical publishers. The first of the three, Derek James's volume on Westland aircraft, is particularly welcome, as no previous authoritative work has appeared solely on Westlands. Those seeking the full inside story on the 'Westland Affair' will be disappointed, but James's claim to have provided a succinct summary is a fair one, and he makes the valid point that the battle over Westland was 'a publicly-contested financial reconstruction – and not a take-over'. The volumes on Hawkers and Avros are updated and revised editions of works first published in the 1960s. The Avro volume contains additional material not published in the first edition, and Francis K Mason takes the Hawker story on to the recent generations of the Harrier, and, perhaps with a rather elastic view of what constitutes Hawkers (ie anything originating in Kingston), includes the BAe Hawk. All three volumes are well produced, although some of the photographs could have been clearer – the one of King George VI visiting Yeovil in the Westland volume succeeds in making him look like a Soviet general.

SEBASTIAN COX

JAPANESE AIRCRAFT 1910-1941
by Robert Mikesh and Shorzoe Abe.

Putnams; £30.00 **ISBN 0-85177-840-2**

AIRCRAFT OF THE SPANISH CIVIL WAR
1936-1939
by Gerald Howson.

Putnams; £35.00 **ISBN 0-85177-842-9**

Two valuable additions to the Putnam series on areas poorly covered in the present literature. Gerald Howson's volume is particularly welcome since it not only details all the aircraft involved in the Spanish Civil War, but also the valuable appendices listing variously: the clandestine importation of aircraft by both sides; aircraft bought but never delivered; and 'Problematical Aircraft', ie those reported to have been flown in the conflict, but which the author's very detailed research shows did not do so. There is also a full listing of the types and numbers of aircraft employed on each side.

Mikesh and Abe's book on pre-Second World War Japanese aircraft is a welcome companion to Rene Francillon's volume on the wartime period. The authors have some interesting observations on areas where Japanese designers were and were not influenced by developments in the West, and the activities of missions such as that led by Colonel the Master of Sempill in the early 1920s. The bulk of the book, however, is devoted to the normal Putnam format of a type by type description of the products of the Japanese aircraft industry.

SEBASTIAN COX

COMMITTEE MEMBER PROFILE

GROUP CAPTAIN A R THOMPSON MBE MPhil BA FBIM MIPM RAF

Group Captain Andrew Thompson joined the Secretarial Branch of the Royal Air Force as a Graduate Entrant in September 1971, having read History at Bristol University and after 3 years working in industry. After training at the Royal Air Force College Cranwell, he was posted as OC Accounts Flt, first to RAF Hullavington in July 1972, and then to RAF Gan in September 1973. He returned to the UK in July 1974 as OC GD Flt at RAF Finningley, before proceeding in December 1975 to Ankara as ADC to the UK Permanent Military Deputy to CENTO. This appointment was followed in July 1977 by a short tour at RAF Mount Batten as OC PMF, before moving on promotion to RAF Brawdy as OC SSS in early 1978; at the end of this latter posting he was appointed an MBE. In November 1979, he was posted to a staff appointment in MOD, serving latterly as Staff Officer to DGT(RAF), before attending No 72 Staff Course at the Royal Air Force Staff College in 1982, where he won the Brooke-Popham Essay Prize. Staff College was followed in 1983 by a short tour as OC PMS at RAF Honington, before his appointment as OC Admin Wing at RAF Wyton in May 1984; during this period he won the 1985 Gordon-Shepherd Memorial Essay Prize. In January 1986 he was posted to the Falkland Islands as the first OC Admin Wing of the new base at RAF Mount Pleasant. He then went up to St John's College, Cambridge in October 1986 to read for a Master of Philosophy degree in International Relations, before joining the Directing Staff at Bracknell in September 1987. He was promoted to group captain in January 1989, and was posted to RAF PMC, initially as Deputy Director Personnel Management (Plans) and then from September 1989 until June 1991 as Deputy Director Personnel Ground 2. In March 1991 he was detached to HQ STC for two months to draft the Joint Commander's Report to CDS on the Gulf War and the Official Despatch for the *London Gazette*. He is now serving as Gp Capt Admin Training at HQ RAFSC. Gp Capt Thompson is married with one daughter; he is a qualified private pilot, and his interests include the study of military history and international affairs, politics, rugby, cricket and water colour painting.

FUTURE PROGRAMMES

20 March 1992 — Seminar on Land/Air Co-operation in the Mediterranean War, to be held at the RAF Staff College, Bracknell:

- 1000 Introductory remarks by the Commandant and the Chairman, Air Chief Marshal Sir Michael Armitage
- 1030 Setting the Scene: Mr John Terraine
- 1050 The Shape and Course of the Mediterranean Theatre 1940-43: Major General John Strawson
- 1110 The RAF in the Mediterranean Theatre 1940-43: Mr Humphrey Wynn
- 1135 The Evolution of Land/Air Warfare in North Africa: Air Vice-Marshal John Walker
- 1155 How the System Worked: Air Chief Marshals Sir Frederick Rosier and Sir Kenneth Cross
- 1215 The Commanders and the Command System: Dr Vincent Orange
- 1235 Questions
- 1415 Group Discussions
- 1545 Closing Address: Sir Michael Armitage

22 June 1992 — Annual General Meeting, to be held at the RAF Club, 128 Piccadilly, at 1745 hours. This will be followed by a lecture by Sir Frank Cooper on 'The Direction of Air Force Policy in the 1950s and 1960s'. Sir Frank, who is a founder member of the Society, held a number of increasingly senior appointments in the Air Ministry and the Air Force Department during these years, and was more recently Permanent Under-Secretary in the Ministry of Defence.

5 October 1992	Seminar on Flying Training, HQ Support Command, RAF Brampton. Please see the separate notice in this issue of *Proceedings*
March 1993	Seminar on the Strategic Bomber Offensive, to be held at the RAF Staff College, Bracknell. Members who served in Bomber Command during the Second World War and who are willing to speak during the discussion groups are asked to write to the Chairman of the Programmes Committee, Air Commodore H Probert, c/o AHB(RAF), Ministry of Defence, 3-5 Great Scotland Yard, London SW1A 2HW. Please write very briefly indicating the units with which you served.

AUTUMN 1992 SEMINAR

FLYING TRAINING IN THE RAF

The AOCinC RAF Support Command has kindly offered to host a Seminar on Flying Training in the Royal Air Force. The seminar will be held in the Headquarters conference room at RAF Brampton on 5 October 1992. The main emphasis will be on pilot training in the Second World War but it is intended also to look at our experience in the First World War, the inter-war and post-war periods. Preliminary thinking suggests a mixture of the chronological approach and treatment by recurrent themes of special interest such as planning of flying training, the central role of CFS, overseas training, role selection, and grading schools. Members of the Society who might wish to contribute to the seminar from their personal experience or who are willing to study and present on topics of special interest to them should telephone or write to the Committee member organising the seminar not later than the end of February 1992:-

AVM F D G Clark, 1 Vinetrees, Wendover, Bucks. HP22 6BS, Tel: 0296-624363 or 071-834-1768.

The full programme will be circulated to members in due course, together with application forms for attendance.

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