Fit For Purpose? An Analysis of Operational Training in Bomber Command 1934 - 1944

By Trevor Nash

As a new Service, the inter-war Royal Air Force had to battle for survival against the machinations of the Royal Navy and Army that wanted to disband it and retain their own air support. At the time when the Service was evolving, global financial conditions meant funds were short and political pressure to disarm was gaining traction throughout Europe. With four home squadrons in the Metropolitan Air Force, the Expansion Schemes that began in 1934 found the Service lacking in personnel, airfields and aircraft with the result that it had no firm base from which to expand. The other major factor was that instead of a doctrine to lead operational training, the policy of strategic bombing had become one of 'dogma' which meant that training objectives could not be defined or matched to operational requirements. Despite these difficulties, Bomber Command eventually developed a multi-faceted operational training process that encompassed Advanced Flying Units, Operational Training Units, Heavy Conversion Units and Lancaster Finishing Schools. As the war progressed, this organisation, combined with new and relevant syllabi, provided a training system that was 'fit for purpose' in preparing aircrew for the new four-engine heavy bombers.

Introduction

Between 1919 and 1929, Sir Hugh Trenchard fostered a totemic belief in an independent strategic approach to air power through the use of bombers to inflict physical and morale damage to the enemy's military forces, industrial infrastructure and home front.[1] The theoretical expectations of strategic bombing were encapsulated in the Western Air Plans that were developed as a targeting list for Bomber Command in 1937.[2] These plans called for attacks on a variety of targets including airfields, roads, railways, canals, battleships, industrial targets and forests but as this paper will show, expectations were not met by the provision of trained crews to undertake these operations. In essence, there was a training gap between expectation and capability. This paper will address that training gap and examine whether the operational training being undertaken by Bomber Command was fit for purpose.

Operational training may be considered as the preparation required to undertake operations and as such, has a direct bearing on operational capability and effectiveness. It differs from *ab initio* and pre-operational training that are designed to provide a platform on which operational skills can be built. The types of operation that are to be undertaken therefore dictate the scope and complexity of the training required to achieve operational effectiveness.[3]

The RAF entered the Second World War with a doctrine based upon 50 months of Army cooperation work on the Western Front in the First World War and nine years of air control operations against villagers and tribesmen in the Middle East.[4] Air power historian Neville Jones argued that these operations 'bred a complacency amongst the planners' which led to a failure to identify the key skills needed to undertake strategic bombing.[5] In short, there was a mismatch between operational doctrine and operational training. The result was that the RAF's inter-war doctrine became 'dogma' which only began to evolve into a truly workable doctrine as the Second World War progressed.[6] When Sir Arthur Harris became Air Officer Commanding-in-Chief (AOC-in-C) Bomber Command in February 1942, many lessons had already been assimilated that, when combined with the introduction of four-engine heavy bombers, meant that strategic bombing had become far more effective than hitherto.[7] As this paper will show, this was a slow process that was shaped by a number of factors.

The arrival of four-engine bombers in 1941 drove the need for improved training to cater for specialist aircrew functions and to operate more technologically capable and complex aircraft.[8] This period also saw an increase in the use of synthetic training equipment. The key questions that need to be answered when looking at the training process are what were the factors that shaped training, whether improvements to training were evolutionary or revolutionary and fundamentally, whether that training was 'fit for purpose' to meet the needs of the new and more complex bombers? These questions must be set within the context of political and economic factors; national strategies, organisation and personalities as well as Service ethos, to assess their relative impact on operational training. As we shall see, the training to accommodate complex and sophisticated, four-engine, multi-crew aircraft was initially lacking.[9]

As the training implications required to teach individual skills and multi-crew cooperation were recognised, operational training improved accordingly. In addition, the key factors of crew wastage and aircraft production have also been considered in an analysis that assesses the need to match trained manpower with available aircraft.[10] This training planning issue is made more difficult when the coordination between different agencies such as the Air Ministry, Bomber Command, Flying Training Command and the Ministry of Aircraft Production (MAP) are taken into account. These complexities are magnified still further when considering the resources required to undertake operational training for a rapidly expanding bomber force with elements such as airfields, ranges, training aircraft, trained instructors and synthetic training equipment, all being in short supply.[11] In examining operational training within Bomber Command, this paper will primarily use the experience of General Duties (GD) branch officers.

Background

Much has been written about the inter-war period and its impact on the RAF. In terms of political and economic factors, these altered markedly throughout 1919-1938 and reflected both national and international pressures. Britain's foreign policy was also changing as emphasis shifted to protecting its Empire and avoiding 'Continental Commitment' whilst disarmament, the Great Depression and antipathy towards the RAF from the other two services resulted in a general lack of support and funding.[12] The 1923 Locarno Treaty reinforced the standing of the Ten Years Rule that was originally established by the Finance Committee of the War Cabinet in 1919.[13] This predicted 'that the British Empire will not be engaged in any great war during the next ten years' and this therefore seemed appropriate and relevant to the nation's current political and foreign policy objectives.[14] This economic argument is not supported by all historians. Ferris, for example, argues that economic determinism was subordinate to more intangible considerations such as imperial policy and cultural issues.[15] A feeling for the RAF's general standing during the inter-war period was echoed by Lord Thomson in 1926 when he talked of the RAF being the 'Cinderella of the Services' and its reputation being 'blackened' by the 'jealousies' of 'the other two Services.'[16] The RAF's approach to training prior to the Second World War was retarded by 'political neglect and financial restriction' but also by other factors, notably its structure and ethos.[17]

When investment did begin to flow into the RAF in response to Expansion Scheme 'A' following approval by the Cabinet in July 1934, the Treasury remained in a strong position to dictate policy. With Germany now recognised as the potential foe and the Ten Years Rule abandoned in 1933, RAF strategic doctrine should have implied the need to bomb that country using long-range bombers.[18] Doctrine should have driven procurement policy but 22 out of its 39 bomber squadrons were designated Light Bomber Squadrons and equipped with the Hawker Hart; a purely financial decision that was considered as 'panic buying' to dress the 'shop window'.[19] In terms of the cost savings accrued by selecting the Hart over the more capable and longer-range Virginia, a squadron of 12 Harts cost £245,000 to procure and an annual figure of £83,000 to support and maintain. The figures for 12 Virginias were £375,000 and £139,000 respectively.[20]

There was also Treasury interference when it came to training and with additional aircraft being procured, the RAF's eyes were opened for the first time to the enormity of the task ahead.[21] In 1934, 300 pilots a year were being trained; by the end of 1941, the total number of pilots trained had risen to 22,000 in addition to 18,000 specialist aircrew. Air Commodore Arthur Tedder was appointed as the RAF's Director of Training in 1934 and oversaw the initial expansion. Tedder wanted pilots to be operationally trained when they reached their squadrons but this demanded extra training and the creation of new Flying Training Schools (FTS).[22] The Treasury's response was that due to cost constraints, flying training could not be longer than 12 months and that no new FTSs should be built as they felt the expansion was a short-term requirement.[23] The result was that some basic training and all operational training took place in squadrons thereby diluting operational capability and increasing the accident rates involving expensive, frontline aircraft. Where Tedder did succeed was in creating a new training system where all *ab initio* training was undertaken at civilian FTSs to be followed by advanced military training at Service Flying Training Schools (SFTS). Even so, 'training was dependent upon extraneous factors beyond its [RAF] control' that resulted in a 'training policy [that] was of necessity based on imponderables and assumptions.'[24] What was not extraneous was the culture of the RAF as well as its approach to training.

The RAF may have been formed as a separate Service but its ethos and organisation were initially, at least, drawn from the other two Services. In April 1920, the editor of the *The Royal Air Force and Civil Aviation Record* reported that:

> At present [the RAF] is not much more than a conglomeration. A conglomeration with a glorious record, truly, but still a conglomeration. Army and Navy methods are seen in it side by side, and they do not fit. The pay system is obsolete and bad...Discipline needs tightening up all round. The paper work organisation, a hybrid of naval and military origin, is appalling....[and all aspects] need reforming and standardising on the right Air Service lines.[25]

This observation indicates that the RAF had major tasks to achieve outside those of developing its operational and training capabilities. The development of its own Officer Cadet training college at Cranwell and Staff College at Andover would certainly assist this process but contrary to many authors who claim these institutions provided a firm basis for RAF expansion, in reality these formative years were precarious due to a lack of resources and trained staff officers.

The RAF's planned development post-1919 was dependent upon the Short Service Commission (SSC) whereby officers would serve between four and five years – later increased to six - before passing into the reserve.[26] Officers were initially trained at a SFTS for 12 months and then undertook basic military training before posting to their operational squadrons with between 100 and 150 flying hours. SSC officers formed the bulk of the RAF which made the service 'an essentially short service force [and] its flyers...birds of passage.'[27] The problem that

this created was that the RAF was not building a staff system for the future but relying on those that had served with the RFC and Royal Naval Air Service during the First World War. This point was made by Wing Commander Maclean, in a lecture delivered to the Royal United Services Institution in 1934 when he said that unlike the Army and Royal Navy's objective approaches, the RAF was subjective due to its lack of experience.[28] The other problem was that operational squadrons never became truly operational because the bulk of their pilots were always semi-trained and inexperienced SSC officers. This was compounded by drafts for overseas squadrons being taken from Metropolitan squadrons and the disruption caused by Hendon Air Pageants. This disruption was so acute in 1933 that Maclean said, 'not one squadron completed the syllabus of training laid down for it.'[29]

This pre-1934 expansion period also highlighted the RAF's pilot-centric approach whereby the skills of the pilot were seen as paramount. The Chairman of the Maclean lecture, Air Marshal Sir Robert Brooke-Popham summed this up by saying that, 'I should like to stress the importance of maintaining skill in piloting...everything finally depends on the ability of the pilot to handle his aeroplane.'[30] Although clearly correct in respect to purely stick and rudder skills to meet CFS criteria and entertaining the crowds at Hendon, the RAF was failing to consider flying as an operational and not entertainment task. Add to this the lack of full-time professional aircrew to support the pilot and it can be seen that the RAF was perhaps storing up problems for the future as well as failing to take heed of new technologies and operational techniques.[31] The problem was exacerbated by the RAF's need to use funds to build facilities such as airfields and training centres and this had a direct impact on training to enhance operational capability. In short, the RAF was not well placed to expand and transition to a war footing from 1934 onwards.

Training in the Build-Up and Transition to War

The pre-war expansion of the RAF took place during 1934-1939 in a theoretical eight-phase process, with each phase being referred to as an Expansion Scheme.[32] The purpose of this expansion was to match the numbers of aircraft believed to be in-service with the German *Luftwaffe* with those operated by the Metropolitan Air Force.[33] To fly the new aircraft, 4,500 pilots were 'taken into the RAF' during 1935-1938 and this meant that on average, 1,500 pilots were being trained each year compared to the 300 in 1934.[34] This expansion of manpower and aircraft had major implications for training and the creation of an effective bomber force.[35] Although the mechanics of the various expansion schemes between 1934 and 1939 fall outside the scope of this paper, it should be stated that these schemes tended to roll into one another and were exemplified by the need to 'dress the shop window' with numbers of aircraft to achieve quantity over quality whilst 'training was sacrificed on the altar of [this] expansion.'[36] According to Smith, this expansion process was 'piecemeal, erratic and disconcertingly rapid' and one where numbers took priority over efficiency.[37]

Training gaps are easily spotted in hindsight but by 1936, the RAF had recognised that the training required to fly and operate a new generation of aircraft was completely different to

the skills and knowledge needed for post-First World War biplanes.[38] The new generation of bomber aircraft were typically all-metal, were equipped with flaps, powered turrets, variable pitch propellers and had retractable landing gear.[39] Improved aerodynamic design and more powerful engines led to increased speeds, greater ceilings and better load carrying capabilities, and as far as bombers were concerned, to the creation of larger aircraft which needed additional crew. These improved technologies began to be specified in the early-1930s and the new generation aircraft first flew in the mid-1930s.[40] With more capable aircraft entering service, the need to train specialist crew members to a higher standard became a serious challenge. Sir Kingsley Wood, the Secretary of State for Air, highlighted these problems in his memorandum to Cabinet in 1938.

> I must repeat that the limiting factor in our war strength by the end of next year [1939] will no longer be the supply of aircraft but the provision of crews to man them...the great problem is that of training, and, above all, of the very complex training required for bomber crews...[41]

This challenge was not totally lost on Bomber Command although its speed in addressing training gaps was often slow. Its first major steps were taken in 1936 when the CAS, Air Chief Marshal Sir Edward Ellington, defined a new crewing policy for large aircraft. This policy stated that bombers would have a crew comprising pilot, observer, wireless operator and an air gunner.[42] The problem was that apart from the pilot, these crew members were seconded from technical ground trades; flying was a secondary duty.[43]

The emergence of the 'Big Bomber' policy in 1936 marked a transformation in the Air Staff's concept of operations with a move towards 'large and powerful heavy or heavy-medium bombers' which were designed to 'provide superiority in range and bomb-load rather than equality in numbers.'[44] In effect, this policy, combined with the specification of aircraft such as the Stirling and Wellington, helped to clarify the emergence of new operational methods, particularly long-range night operations, which would drive future training requirements.[45] These training requirements included multi-engine conversion, navigation and operating within a multi-crew environment.

The RAF's flying training syllabus from 1936 was divided into three phases: phase one comprised basic flying training at a civilian FTS; phase two was the SFTS and used Service aircraft; and phase three was bombing, gunnery and further navigation training at the SFTS.[46] Phase one was conducted in a civilian environment prior to the pilot's induction into the RAF and lasted eight weeks in summer and 10 weeks in winter. This was followed by two weeks basic military training at the RAF Depot in Uxbridge. Phase two, the intermediate stage, saw the pilot undergo instrument flying training, cross-country flights and solo night landings and lasted 13 weeks in the summer and 15 weeks in the winter. Following two weeks leave, the now breveted pilot returned to the SFTS for the advanced stage of training which lasted the same amount of time as the intermediate phase and included a four-week attachment

to an 'armament training camp'. In all, the pilot's training lasted a maximum of 44 weeks or 10 months.[47] Pilots leaving this training scheme logged around 150 hours and would have learned their skills on the Avro Tutor and variants of the Hawker Hind; aircraft types that were well behind the technology curve of the time.[48]

As pilots emerged from this new training scheme and were sent to their Service squadrons to conduct conversion to type and operational flying training, another change was made to the composition of bomber crews in 1937 when the CAS, Air Chief Marshal Sir Cyril Newall, stated that the bomber should now contain two pilots.[49] The junior pilot would be responsible for navigation.[50] Unable to expand training resources, the flying training course was subsequently reduced to six months to accommodate the need for extra pilots and it was during this period that discussions were held to provide an extra three-month course for pilots destined for bomber and maritime roles that concentrated on navigation and night flying.[51] One of the reasons for this change can be seen in the RAF's Flying Training Manual of the time which stated:

> Flying uninterruptedly for very long periods, even under good conditions, imposes considerable physical and nervous strain upon a pilot, and, without his being conscious of it, his judgement in flying is apt to become impaired.[52]

This 'physical and nervous strain' was probably due to the pilot being responsible for piloting the aircraft, its navigation and bombing, a point that was only being recognised in January 1936 with the opening of the first Air Observer School.[53] The observer school taught gunnery and bombing during an eight-week course but there was a reluctance to take navigation away from the pilot and this only became policy in May 1939 when direct-entry sergeant observers were introduced.[54] To be appointed as sergeants after qualifying as observers, the navigation training initially received by these men was confined to dead reckoning and map reading but later included a 10 week specialist navigation course on a Service Air Observers Course.[55] The AOC-in-C Bomber Command, Air Chief Marshal Sir Edgar Ludlow Hewitt, referred to these sergeants as 'counterfeit NCOs' and 'half-baked sergeant observers'.[56] In a letter to the Under Secretary of State for Air written in May 1939, the AOC-in-C pointed out that:

> The idea that is getting about from Air Ministry sources that the air observer is to be regarded as the navigator of the aircraft is already undermining the principle, which has long been fully accepted and established in the command, that efficient navigation can only be realised in (sic) the Captain of the Aircraft himself [who] is fully capable of navigating his aircraft.[57]

Although Ludlow-Hewitt showed orthodoxy towards the RAF's 'pilot-centric' approach to aircrew, the question of specialist aircrew to undertake the discrete function of navigation was gaining traction. It was becoming increasingly clear to the RAF that the ability of crews to navigate to distant targets in all weathers was extremely limited. In his annual training report

for 1938, Ludlow-Hewitt stated, with no sense of irony, that 'phenomenally slow progress' had been made in navigation training due to 'reactionary tendencies' and 'ignorance' on the part of senior RAF officers.[58] Ludlow-Hewitt believed that navigation should be undertaken by the pilot. This 'phenomenally slow progress' was reflected in the Staff Officer Notes made for Ludlow-Hewitt when he was the RAF's Inspector General.[59] The notes refer to a visit to RAF Abingdon, the home of 6 (Operational Training) Group in November 1940. The anonymous staff officer recorded that observers were the 'weakest link of the crew' being 'not fully trained and... especially weak in map reading.' This problem was exacerbated by poor navigation training and 'no practical navigation' being 'on the syllabus of the pilots at the OTU'. Although the policy of making the observer 'fully responsible for navigation' (albeit under the direction of the captain) was decided in May 1939, as can be seen in the notes from RAF Abingdon, there was still a training shortfall and the results were clear in Bomber Command's initial operations over targets such as Wilhelmshaven.[60] The first raid was mounted on the night of 3/4 September 1939 by six Hampdens of 89 Squadron, all of which failed to find the target.[61]

The operational training shortfalls within Bomber Command during the transition to war not only concerned a lack of navigation training but also instrument training, which in 1939, led to a 'rise in the number of fatal accidents'.[62] The conflict between operations and training resources is highlighted in the correspondence between Portal as the new AOC-in-C Bomber Command and the RAF Inspector General, Ludlow-Hewitt. In April 1940, Portal wrote to Ludlow-Hewitt prior to attending a CAS Conference, at which operational squadron and Operational Training Unit (OTU) resources were to be discussed.[63] In the letter, Portal recognised Ludlow-Hewitt's efforts in establishing the Group Pool Squadrons [forerunners of the OTUs] in 1939, but said that the current 55 hour flying course 'means the absorption of 1,548 heavy bombers in...the OTUs' and that 'we should find some means of reducing the amount of flying required in those units.'[64] Portal argued that OTU training could be reduced to 30 hours for pilots with twin-engine training experience or 35 hours for those just trained on single-engine aircraft if the following provisos were met: better pilot selection; that the SFTS syllabus 'must be thoroughly mastered' with added 'cloud flying;' more capable flying instructors were required; and finally, greater use of synthetic training must be achieved, 'regardless of expense.'

The use of synthetic training by the RAF began in 1937 with the procurement of 51 Link trainers and on their receipt, the order for a further 150.[65] This training device enabled pilots to practice instrument flying although Air Ministry policy was that synthetic training should be used to enhance training and not replace flying hours.[66] From 1939, Bomber Command made some major investments in synthetic training and established a Crew Training School (CTS) at RAF Finningley to act as an experimental and development centre for future synthetic training applications. As well as the individual Link trainer, the CTS also had a Link trainer coupled with an aircraft fuselage mock-up to allow full crew training and this was referred to as 'dry-swim' training.[67] The CTS concept led to the development of Airmanship Halls which later developed into Ground Training Centres that housed a variety of different simulators including

the Grope and Silloth crew training devices.[68] In an effort to coordinate the development and use of synthetic training devices, the RAF formed the 'Simulation of Air Training on the Ground Committee' in March 1940 which was later renamed, the Synthetic Training Committee.[69] By November 1942, the RAF was using 197 discrete types of synthetic trainers. The Service may have been playing catch-up in terms of conventional training but its use of synthetic training was both innovative and far-sighted.

Until 1939, Bomber Command's operational training was undertaken in front line squadrons but this presented a number of problems. To achieve the throughput of pilots, training courses had been halved to meet the 'two pilot requirement' and therefore pilots were arriving at their squadrons with even less experience than they had in 1935. Secondly, operational bomber squadrons were exactly that and were not equipped with trained instructors or the resources to make up the shortfall of SFTS syllabi.[70] Even the instructor pilots had major shortcomings. The Macdonald report of February 1941 showed that after conducting a course on the Link trainer, 95 per cent of the instructors were not noticeably better at instrument flying than the average pupil.[71] In 1939, over 70 per cent of the squadrons in Bomber Command had 'either been formed or re-armed [with new aircraft] within the last year.'[72] Ludlow-Hewitt argued that 'over expansion' had meant that 'operational training had not kept pace' with the arrival of new aircraft or changes to Bomber Command's organisation.[73] The problem here was that inexperienced aircrew were posted to squadrons and this resulted in an increase in accident rates. This point was made by Air Marshal Sir William Mitchell when he was chairman of a conference on pilot training in 1938. 'What we have to compete with is the inexperience of pilots turned out in ten months and put into squadrons where they fly these high-speed machines...I think the cause of these accidents...is purely inexperience.'[74] According to the AHB narrative, 'Squadrons became diluted, during autumn 1941, with half-trained men, and became incapable of successful or sustained operations.'[75] This period is when the numbers of Stirling and Halifax operations were slowly increasing and so clearly, at this stage of the war, Bomber Command training was not fit for purpose.

Ironically, this dilution in mid-1941 was due to aircraft output promised by the Ministry of Aircraft Production failing to meet delivery forecasts and this created a surplus of aircrew, especially pilots. For example, in terms of heavy bombers, the first quarter of 1941 saw production of seven Stirlings, six Halifaxes and 12 Manchesters.[76]

Closing Training Gaps

With the promise of increasingly capable aircraft during the later stages of the Expansion Scheme process, the RAF developed more relevant training syllabi.[77] These syllabi included greater emphasis on night flying and navigation training. In addition, there was a gradual move towards the creation of specialist aircrew trades which replaced the use of part-time ground crew trades; the Air Observer aircrew trade was the first to be created followed by that of Air Gunner and then Wireless Operator/Air Gunner.[78] In essence, the RAF began to understand the enormity of preparing aircrew to operate complex aircraft in war and in so

doing, started to create a professional aircrew cohort. As discussed above, the problem was that the operational training was undertaken in operational squadrons and this resulted in the reduction of operational efficiency and training often being delivered by untrained and sometimes unwilling instructors.[79] In addition, although poor skills in night and 'cloud flying' had been recognised and syllabi modified accordingly, skill levels still remained low.[80] For example, between 1937 and 1939, 478 aircraft made forced landings because the pilot became lost.[81] These shortcomings were recognised by Ludlow-Hewitt, in his inspection report on taking over Bomber Command in 1937 that was sent to the Secretary of State for Air, Viscount Swinton. Ludlow-Hewitt stated that Bomber Command had a 'lack of experienced personnel' and that it was 'entirely unprepared for war, [and] unable to operate except in fair weather'.[82]

With the creation of the Command structure in July 1936, each Command could provide a more focussed approach on operational training for specific roles.[83] Bomber Command created a one star position responsible for operational training known as the Air Officer Training (AOT) and Groups were staffed with a Group Captain Training post.[84] Thus, the problems specifically associated with Bomber Command: long-range navigation, instrument flying and the coordination of a large crew within a multi-engine aircraft could be addressed within a single command. The responsibility of closing the gap between the aircrew arriving from the SFTS and the operational squadron still fell upon the operational squadrons with each group providing a Group Training Syllabus.[85] AOC Groups were given, 'full responsibility for the efficiency of the Commands, and the largest measure of discretion as to the methods and routine of [the] training adopted.'[86] The task of providing this training devolved to station and squadron commanders. Although this training process sounded logical, the training burden still remained with operational squadrons and created the previously mentioned dilution to operational capability. In a letter to the Secretary of State for Air in January 1937, the AOC-in-C Bomber Command, ACM Sir John Steele stated that the delivery of operational training was 'conflicting' with three factors: the desire to lay down a long-term training policy; the combined shortage of experienced personnel and the arrival of modern equipment; and finally, the need to maintain readiness for mobilisation.[87] In a more forceful letter written in September 1937 just prior to leaving Bomber Command, Steele expressed concern:

> ...at the delay in the provision of organisation and equipment which are necessary, both on the ground and in the air, before operational training and long-distance flying by night and day conditions of bad visibility can be carried out to a satisfactory stage of development.[88]

Ludlow-Hewitt, Steele's replacement, identified the two major challenges affecting Bomber Command's readiness for war were a lack of reserves, both aircraft and crews, and poorly trained crews. He argued that the Bomber Command Groups that were so far responsible for operational training, 'shamefully neglected' elements such as blind flying.[89] According to Ludlow-Hewitt, operational training needed to be removed from operational groups to allow the latter to concentrate on operational tasks but to achieve this, aircraft had to be taken

from operational squadrons with which to train. Formed into Group Pool Squadrons, these units were initially kept within operational groups but in September 1939, were 'concentrated' into the former 6 (Auxiliary) Group.[90] The creation of Group Pool Squadrons may be considered as a seminal moment in the professionalization of Bomber Command training and their importance was highlighted by Ludlow-Hewitt in his memorandum to AOC Groups in March 1939:

> *"...you are to be quite clear that the permanent instructional personnel, both air and ground, on the establishment of the Group Pool Squadrons, is sacrosanct, and under no circumstances is it available to you for making good deficiencies in first line squadrons. The principle must be observed since on it depends the continued output of trained operational crews".*[91]

The problem was that towards the end of 1939, the Group Pool Squadrons were becoming unable to cope with the numbers of aircrew coming from the SFTS and specialist aircrew schools.[92] Ludlow-Hewitt was unwilling to reduce the six-week course length and exchange 'a reduction in efficiency in return for greater output' so therefore more Group Pool Squadrons had to be created.[93] Although the Air Ministry recognised that the Group Pool Squadrons were a 'bottle-neck', its solution was to reduce the length of the course and not increase their number.[94] The replacement of Ludlow-Hewitt by Portal as AOC-in-C Bomber Command saw the OTU (the term OTU replaced Group Pool Squadrons from April 1940[95]) course length reduced.[96] Despite the reduction, Portal wrote in May 1940 that 'our squadrons cannot possibly maintain a sustained air campaign unless there exists a powerful organisation behind them for the provision of trained crews.' He continued and talked of the 'paramount importance' of the OTU organisation with the need to 'build it up' at 'all costs'.[97] Five days later, it was agreed to form a second OTU organisation, No.7 Group.[98]

The scale of the operational training task was now clearly recognised by the staffs at the Air Ministry and Bomber Command but this task was to become magnified by the introduction of four-engine heavy bombers. OTU aircraft such as the Wellington, Whitley and Hampden, represented operational types but with the arrival of aircraft such as the Stirling, Halifax and (twin-engine) Manchester, additional training would be required.[99] On 30 October 1940, the AOC-in-C, Sir Richard Peirse, Portal's replacement, wrote to the Secretary of State for Air and stated that special conversion to type training was required for the new heavy bombers and enquired about the need to speed up the training of the 'new flight engineers'.[100] This conversion to heavy bombers added another layer of complexity to the training equation. As the Stirling and Halifax aircraft began to arrive in squadrons from August and November 1940 respectively, the first four squadron aircraft were allocated to a Heavy Conversion Flight (HCF) and this flight was used to convert the remainder of the squadron.[101] This approach marked a retrograde step as it placed training back in the remit of operational squadrons. As production of the heavy bombers began to increase and more squadrons began re-equipment, it was decided to abandon the HCFs in favour of Heavy Conversion Units (HCU), each equipped with 16 aircraft.[102]

Initially, each Group had its own HCU but in June 1942, HCUs were concentrated in 92 Group, formerly 7 Group.[103] This new nomenclature for training groups saw 6 Group become 91 Group whilst June marked the formation of 93 Group.

The final element to be added to the training structure specifically for the four-engine bomber force was peculiar to the Lancaster. When the aircraft began to enter service in early 1942, Lancasters were initially sent to HCUs.[104] Subsequently, the aircraft was considered too valuable to be allocated to an HCU.[105] Now, pilots destined for the newly formed Lancaster squadrons would complete HCU training on the Halifax or Stirling and then receive 10 hours flying at one of three Lancaster Finishing Schools (LFS) that were formed in the winter of 1943.[106] LFSs were equipped with 18 aircraft but by March 1944 it became clear to Harris that this number was inadequate and that it should be increased.[107] As Lancaster production increased throughout the war and the Stirling was withdrawn, Lancasters were again sent to HCUs and the three LFSs disbanded.[108]

Turning to the question of the professionalization of aircrew, Bomber Command had already made major changes to its training structure and it now turned its attention to crew roles and composition. Central to this discussion was the 'pilot omnipotency' issue discussed above. During the first half of 1941, Bomber Command's policy was to have two pilots, the second pilot having additional training in navigation and bomb aiming.[109] With the expansion of Bomber Command, the onus was to improve training efficiency still further by maximising training resources to get properly trained aircrew to operational squadrons in the shortest possible time. One method of increasing aircrew throughput was to halve the number of pilots within operational squadrons. In October 1941, AOC 6 Group, Air Commodore MacNeece Foster, chaired a conference with his OTU 'Chief Instructors' where it was agreed that the best bomber manning solution was 'one pilot plus "George" over 2 pilots at present (sic).'[110] Forwarded to Groups, AOC 6 Group's suggestion was largely supported. The only dissention came from 3 Group flying Stirlings as the AOC said that the aircraft could not be flown by a single pilot as the second pilot operated controls at take-off and landing, a point later disproved by MacNeece Foster when he flew the Stirling for himself.[111] During a meeting at the Air Ministry on 29 March 1942 and chaired by Portal, it was agreed that heavy bombers should be crewed by 'one pilot plus George', one WOp/AG, specialist dorsal and tail gunners, a specialist navigator, a Flight Engineer and a specialist Bomb Aimer.[112] Although the new crewing policy would result in an 'embarrassing accumulation of pilots' at the Bournemouth holding centre, Portal said that the recommendations should be sent to the Air Council, forthwith.[113]

In parallel with this process, the Air Member for Training, Air Marshal A.G.R. Garrod, submitted a paper to the Air Council in December 1941 which considered how the overall training process could be improved.[114] Part of this paper included a review of the number of aircraft written-off per 1,000 flying hours at the EFTS, SFTS and OTU phases from 1 January to 1 September 1941: these being 2.5, 5 and 10 respectively. According to Garrod, this showed that skill levels were not increasing commensurate with flying more complex types of aircraft.[115] Although much

of Garrod's improved training programme, later known as the 'New Deal', do not come under the heading of operational training, what was achieved was to raise the standard of aircrew arriving at the OTU, in particular, through an eight-week, 60 hour Advanced Flying Unit (AFU) phase after SFTS training for those pilots destined for Bomber Command. The pupils that arrived at the OTU would have five times the previous night flying experience, improved navigation and instrument flying skills and be able to conduct beam approaches.[116]

In theory at least, improvements to Bomber Command's training structure, crewing and flight training syllabi meant that 1942 could reasonably be described as 'the turning point in the operational development of Bomber Command' but problems still persisted.[117] When Air Chief Marshal Sir Arthur Harris became AOC-in-C Bomber Command at February 1942, he had 250 serviceable bombers.[118] According to Probert, this was from a total operational fleet of 594 aircraft; at the same time there were 410 aircraft in OTUs.[119] Harris was clearly frustrated with this imbalance and had previously, 'complained that the shaft of all our training organisations... was very thick and the actual spearhead of operational effort was very small.'[120] Harris' point is debatable as it was not the shortage of crews retarding expansion but the lack of bombers being produced to fit the expansion.[121] The operational training 'shaft' had a number of problems associated with it that called for such a high number of aircraft, namely serviceability and crew wastage. Stirling-equipped HCUs were causing particularly serious concerns and were adding to the OTU bottle-neck. Accidents at Stirling HCUs per 10,000 flying hours were 48.5 compared to 21 for Halifax HCUs.[122] As Harris was taking over at Bomber Command, 6 Group was complaining of a shortage of aircraft in its OTUs that was being 'aggravated by the position of spares.'[123] In August 1941 for example, the OTUs in 6 Group were 200 aircraft below establishment and its AOC complained of poor instructors, a lack of equipment and the need to lengthen the OTU course because of poor weather.[124] As far as wastage was concerned, the training pipeline had to generate more aircrew than the number of operational aircraft logically demanded. This was highlighted in February 1941 when 5 Group called for increased crew output from the OTUs because during the four months from September to December 1940, 267 pilots joined Group squadrons from its two OTUs. Of these, 237 were killed, posted missing or 'became medically unfit' to fly.[125] As a result, the Group requested the formation of another OTU.

The implementation of the 'New Deal' and Bomber Command's crewing policy certainly alleviated the training problem, but the other factor in Bomber Command's increasing efficiency was the improvement in delivery from MAP. The first month that over 100 heavy bombers were produced occurred in March 1942.[126] Annually, in the period 1941 to 1944, heavy bomber total production was 498, 1976, 4615 and 5507 respectively.[127] More importantly perhaps, Halifax and Lancaster production gradually outstripped that of the less capable and more unserviceable Manchester and Stirling aircraft.[128] This meant training could be focussed on two instead of four types and in a Darwinian process, the best heavy bombers survived thereby reducing loss rates.

As the war progressed, the training system evolved and gradually became fit for purpose in respect to preparing aircrew to operate four-engine bombers. This was not an easy or

straightforward process as of the 55,358 airmen killed in Bomber Command, 8,090 were killed on non-operational flying, significantly on training.[129] In his *Despatch on War Operations*, Harris said that training was complicated by changing tactics, new technologies and aircraft and the 'large-scale expansion'.[130] Although a challenge, Bomber Command training did become more efficient as the war progressed as measured by OTU accident rates and output. For the period 1942 to 1945, OTU accident rates per 10,000 hours flown reduced each year to: 44, 23, 15 and 8.[131] In terms of crew output from the HCUs, a spotlight on the three-month period from March to May 1944 shows that target output was 1,215, 1,787 and 2,357 crews per month; actual output was 1,305, 1,826 and 2,418 respectively.[132]

Conclusion

The RAF in the inter-war years not only had to survive in a period of economic austerity and political uncertainty, it also had to come to terms with its very existence and the development of its own structure, ethos and culture. From the first expansion scheme in 1934, operational capability and its relationship with operational training began to be taken more seriously. New training syllabi were developed, the availability of resources increased and new types of training aircraft and synthetic training equipment were developed. As new types of modern operational aircraft were ordered to replace the older biplane types, new technologies became apparent that would alter training syllabi still further. Although Tedder had managed to improve the training syllabi, the RAF still relied on a 'pilot-centric' training process, believing that the skills involved in mounting air operations lay solely with the pilot. Other aircrew were seconded from ground trades which led to a lack of professionalism in the air and also denuded groundcrew capability. When multi-crew bombers such as the Heyford and Harrow were introduced in the mid-1930s, the CAS decided to add a second pilot to act as the navigator instead of providing extra navigational training for the air observer. This decision doubled the pilot training burden and was not challenged until October 1941 when MacNeece Foster proposed a new crew structure.

This expansion brought new equipment, the deployment to new airfields and a shortage of experienced personnel. Expansion was the goal, with efficiency in training and the preparation of a force that was fit for purpose coming a very poor second. However, considering the aforementioned lack of resources, it is difficult to see how else the problem could have been addressed. The key factor that drove improved training was the formation of the RAF's Command structure in 1936 and the appointment of an AOC-in-C Bomber Command who was ultimately responsible for operational training. As well as the formation of Bomber Command, 1936 saw the release of specifications for what became the Stirling and Halifax as well as the first flights of the Hampden and Wellington. The arrival of complex, multi-crew bombers into squadron service heralded yet another change in operational training that would ultimately make the preparation of crews fit for purpose. The formation of Group Pool Squadrons was the first step in preparing aircrew to fly four-engine bombers and remove the training burden from operational squadrons. As operational aircraft became more complex and capable, additional phases were added to the training process including the addition of the AFU, HCU and LFS courses.

The massive expansion of the RAF's bomber force between 1934 to 1944 in respect to numbers, personnel and aircraft performance, often saw operational training lagging operational capability. The impetus of the Second World War, and, in particular, the clarification of Bomber Command's *modus operandi* of night, long distance bombing, made it easier to train to meet a clear operational doctrine. Training in Bomber Command was a gradual evolution rather than a revolution and as such, operational training eventually became increasingly 'fit for purpose' as the war developed. The training gap had been closed.

Notes

[1] Air Staff Memorandum No.43, The War Aim of the Royal Air Force (C.D.64) accessed at **www.airpowerstudies.co.uk/1928-AirStaffMemo_No.43Text.pdf**, on 22 March 2013.
[2] N. Frankland & C. Webster, *The Strategic Air Offensive Against Germany 1939-1945, Vol. IV* (London: HMSO, 1961), W.A Plans Annex.
[3] See JSP 822 (HMSO, 2012) for a description of the context between training and operational capability. As an example of doctrine driving training, consider that if strategic bombing requires long-range flights in bad weather at night over enemy territory, crews should be well trained in skills such as instrument flying and navigation.
[4] T. Davis Biddle, *Rhetoric and Reality in Air Warfare* (Princeton: Princeton University Press, 2002) pp.81-83.
[5] N. Jones, *The Beginnings of Strategic Air Power – A History of the British Bombing Force 1923-1939* (London: Cass, 2002) pp.xx-xxi.
[6] J. Terraine, 'Theory and Practice of the Air War' in H.Boog (ed) *The Conduct of the Air War in the Second World War* (New York: Berg, 1992) p.474.
[7] As the paper will show, by early 1942, Bomber Command's doctrine had become clearer but what was holding it back was a lack of aircraft and operationally trained crews.
[8] O. Thetford, *Aircraft of the Royal Air Force Since 1918* (London: Putnam, 1976) provides an excellent historical overview of the RAF's bomber aircraft and their capabilities.
[9] See for example Ludlow-Hewitt's 1938 report on Bomber Command training in N. Jones, *The Beginnings of Strategic*..., p.147.
[10] One element of this crew wastage and Harris' particular bête noir was posting trained crews to Coastal and Middle East Commands. Sir A. Harris, *Bomber Offensive* (London: Greenhill Books, 1990) p.99 and Harris' interview with T.Mason at the RAF Staff College Bracknell in 1977.
[11] AHB LHP, Ludlow-Hewitt's *Draft Operational Training Plan*, dated January 1939 highlights shortages of instructors, aerodromes and spares.
[12] S. Robertson, *The Development of RAF*..., p. xv.
[13] S. Robertson, *The Development of RAF*..., pp.29-30. Robertson's comments on the Ten Years Rule make the point that despite being ridiculed by some historians, future 'events...could not be foreseen.'
[14] TNA PRO, CAB/24/196. CID Minutes, *The Basis of Service Estimates*, 2 July 1928.
[15] J.Ferris, 'The Greatest Power on Earth: Great Britain in the 1920s in *The International History Review*, XIII,4, November 1991, pp. 661-880, p.726-8.
[16] Hansard, House of Lords Debate on Air Policy, 10 March 1926, Vol. 63, cc527-545.

[17] TNA PRO, AIR 10/5551, Flying Training Volume 1, Policy and Planning, AP3233, p.11.
[18] TNA PRO, AIR41/39, p.60.
[19] TNA PRO, AIR 41/39, p.80 discusses the selection of the Hart and concludes quantity and not quality of aircraft was the key factor.
[20] Ibid. pp.80-81.
[21] Ibid, provides numerous examples of the Treasury shaping equipment procurement and defence posture. The document highlighted 'comparatively slow progress' on offensive development due to economic factors.
[22] TNA PRO, AIR 41/4 *Aircrew Training 1934-1942*, pp.2-29.
[23] TNA PRO, AIR41/4, p.29 talks of the financial need to keep the course duration 12 months and use the 'bare minimum of schools'.
[24] TNA PRO, AIR 10/5551, p.1.
[25] J.W.R. Taylor, *C.F.S. Birthplace of Air Power* (London: Putnam,1958) p.93. Taylor also cites Churchill's speech in the House of Commons of March 1920 in which he said the Army and Royal Navy were supportive of the RAF's existence. Taylor says Churchill was 'deceived'.
[26] TNA PRO, AIR 41/8, p.114.
[27] Ibid.
[28] L. Maclean, 'The Royal Air Force Training Year at Home' in *The Royal United Services Institution Journal*, No. 80, February/November 1935, pp.50-68. Wing Commander Maclean was a staff officer at Air Defence of Great Britain.
[29] Ibid.
[30] ibid.
[31] S. Robertson, *The Development of RAF...*, pp.151-152.
[32] TNA PRO, AIR 41/8, p.33.
[33] See for example TNA PRO, CAB/23/90A, the Cabinet Minutes of 8 December 1937, Item 7, *Comparison of the Strength of Great Britain with that of Certain other Nations as at 1st January 1938* and 'the maintenance of parity between the Air Force of the United Kingdom and that of Germany.' The Metropolitan Air Force was the name given to the RAF forces stationed in Britain.
[34] TNA PRO, AIR 41/8, pp. 116-117.
[35] Appendix 7 'Comparison of Expansion Schemes of Aircraft Strength, 1934-39' in Webster, C and Frankland, N. *The Strategic Air Offensive...Vol. IV* gives a comprehensive view of the squadron and aircraft numbers involved.
[36] TNA PRO, AIR41/4, p.62. See also AVM M. Robinson, 'Training the Bomber Force for World War Two' in the *RAF Historical Society Journal*, No. 20, 1999. pp.8-15.
[37] M. Smith, 'Sir Edgar Ludlow-Hewitt and the Expansion of Bomber Command, 1939-40' in the *Royal United Services Institute for Defence Studies Journal*, 126:1 (March 1981) pp.52-56.
[38] AHB LHP, Ludlow-Hewitt's *Readiness for War Report* dated 10 March 1939.
[39] A.M. Sir C.L.N. Newall, 'The Expansion of the Royal Air Force' (lecture) in the *Royal United Services Institution Journal*, No.81, February/November 1936, pp.347-354.
[40] O. Thetford, *Aircraft of the Royal Air Force...*, The Whitley was first specified in July 1934 (B.3/34) and the Stirling in July 1936 (B.12/36).
[41] TNA PRO, CAB/24/279. *Relative Air Strengths and Proposals for the Improvement of this Country's*

Position, Memorandum by the Secretary of State for Air dated 25 October 1938.
[42] TNA PRO, AIR 10/5551, p. 19.
[43] TNA PRO, AIR41/4, pp.37-38. The AHB monograph says that these secondary trade aircrew, 'did not reach full efficiency in their flying duties.'
[44] TNA PRO, AIR 41/39, pp.120-125.
[45] TNA PRO, AIR41/39, pp.120-126. Doubts about the light bomber began to emerge in 1934 and the CAS memorandum of 8 November 1935 which stated that the 'short range and small load' of such aircraft made them of limited value in a war against Germany. In response O.R.2 pointed out the threat to bombers of modern fighters when engaged on daylight operations.
[46] AVM L.A. Pattinson, 'The Training of a Royal Air Force Pilot' (lecture) in the *Royal United Services Institution Journal*, No.83 February/November 1938, pp.11-21. AVM Pattinson was AOC 23 (Training) Group.
[47] Ibid. pp.11-21.
[48] AHB, *Notes on the History of Royal Air Force Training 1939-1944* (London: HMSO, 1945) p.25. In 1937, the average hours flown by a pilot joining his operational squadron was 146.
[49] TNA PRO, AIR41/8, pp.29-30.
[50] C.G. Jefford, *Observers and Navigators and Other non-Pilot Aircrew in the RFC, RNAS and RAF* (Shrewsbury: Airlife, 2001), p.131,
[51] TNA PRO, AIR41/8, pp.29-30.
[52] NAL, AP129. *RAF Flying Training Manual Part 1 – Landplanes* (Revised 1937). Chapter 4, Long-Distance Flying, para. 71.
[53] TNA PRO, AIR10/5551, p.19.
[54] TNA PRO, AIR 2/4467 Letter to RAF Commands from Principal Assistant Secretary to the Permanent Under Secretary of State for Air dated 22 May 1939.
[55] TNA PRO, AIR10/5551, p.25.
[56] TNA PRO, AIR2/2968 letter from Ludlow-Hewitt to AMP, AVM Portal dated 12 May 1939.
[57] AHB LHP, Ludlow-Hewitt letter to Under Secretary of State for Air, dated 25 May 1939.
[58] AHB LHP, *Bomber Command Annual Training Report – 1938* dated 23 January 1939.
[59] AHB LHP, *Staff Officer Notes for Visit to Abingdon, 22 November 1940*. 6 Group was home to the Group Pools and later Operational Training Units during the early years of the war.
[60] TNA PRO, AIR10/5551, p.19.
[61] P. Bishop, *Bomber Boys* (London: Harper Perennial, 2007) pp. 1-3.
[62] AHB LHP, Letter from Ludlow Hewitt, to CAS dated 3 December 1939.
[63] AHB LHP, DO letter, Portal to Ludlow-Hewitt dated 11 April 1940 concerning CAS Meeting.
[64] Ludlow-Hewitt was actually responsible for the formation of the Group Pool Squadrons that became known as OTUs from April 1940.
[65] AHB, *Notes on the History of RAF Training 1939-44* (London: HMSO, 1945) Annex W – Synthetic Training.
[66] *Ibid*.
[67] AHB LHP, *RAF Inspector General Visit Report No. 7, Finningly*, dated 26 April 1940. In the report, Ludlow-Hewitt called for the establishment of a designated officer at the Air Ministry to coordinate synthetic training.

[68] Sir A. Harris, *Despatch on War...*, p.167.
[69] AHB, *Notes on the History...*, Annex W – Synthetic Training.
[70] TNA PRO, AIR41/4, p.282.
[71] TNA PRO, AIR41/4, p.323.
[72] AHB LHP, *Readiness for War Report*, AOC-in-C to Secretary of State for Air dated 10 March 1939.
[73] Ibid.
[74] AVM L.A. Pattinson, 'The Training of a Royal...', AVM Pattinson was AOC 23 (Training) Group. Mitchell's comments are very interesting as he describes a lack of instruments hampering 'bad weather flying'.
[75] TNA PRO, AIR41/41. *The RAF in Bomber Offensive Against Germany: Vol. III Area Bombing and Makeshift Force June 1941-February 1942*, p.24.
[76] NAL, J.V. Connolly Collection, *Ministry of Aircraft Production Statistical Review 1939-1945*, published January 1946.
[77] TNA PRO, AIR41/8, pp.71-72 describes 'The winter of 1938 [as the] dividing line between the old order and the new' with the RAF in 1934 being a 'force of wooden bi-planes' and in 1939, 'a force of metal monoplanes'.
[78] TNA PRO, AIR10/5551, pp.24-25.
[79] AHB LHP, Bomber Command Annual Training Report 1938 dated 23 January 1939.
[80] TNA PRO, AIR2/4168, Paper from DWTT to ACAS dated 12 April 1940 points out the poor standard of FTS graduates with only 'a small proportion of pilots...trained on twin-engined aircraft' and pilots with 'an average of two hours (night) solo.'
[81] R. Wakelam, *The Science of Bombing* (Toronto: University of Toronto Press, 2009) p.15. Wakelam also points out that the Air Ministry did not establish an Air Navigation Office until 1938.
[82] AHB LHP, Inspection Report from AOC-in-C Bomber Command to Lord Swinton, Secretary of State for Air dated 10 November 1937. Ludlow-Hewitt also complains about the lack of W/T and navigation equipment.
[83] J. Terraine, The Right of the Line (Ware: Cumberland, 1999) p.23. Training Command was created in May 1936. Discussion on the formation of the new command structure started in 1935. TNA PRO, AIR2/8875 *Organisation of Home Commands Consequent on Expansion Scheme C*, Minute from CAS to DCAS, dated 5 June 1935.
[84] See for example, TNA PRO AIR 14/2156 and the 'Forecast on Expansion of Bomber Command to Target Force "A" By The End of 1941' paper written by Air Commodore A. Lees, AOT, Bomber Command. Group Captain Training positions are discussed by R. Wakelam in *The Science of Bombing*, p.18.
[85] TNA PRO, AIR 14/45, Bomber Command Training instructions dated 25 November 1936 from HQ Bomber Command to Air Ministry and the four Bomber Group SASOs.
[86] Ibid.
[87] TNA PRO, AIR 2/2058, letter AOC-in-C to Secretary of State for Air, dated 27 January 1937. The shortage of experienced personnel and the arrival of modern equipment were considered as one factor by Steele.
[88] TNA PRO, AIR 2/2058, letter from AOC-in-C to Secretary of State for Air dated 1 September 1937.
[89] AHB LHP, Ludlow-Hewitt War Diary, Sunday 10 December 1939.

[90] TNA PRO, AIR 2/4168, loose minute from Air Commodore R.P. Willock, D.S.D. to H.Q. Bomber Command.
[91] TNA PRO, AIR 2/4168, memorandum from AOC-in-C Bomber Command to AOC Bomber Command Groups dated 16 March 1939.
[92] TNA PRO, AIR 2/4168, letter from AOC-in-C Bomber Command to Secretary of State for Air, dated 6 October 1939.
[93] Ibid.
[94] TNA PRO, AIR 2/4168, letter from Sholto Douglas (ACAS) to AOC-in-C Bomber Command dated 3 October 1939. This reduction by two weeks would have meant crews flying 33-35 hours instead of 55-60 hours.
[95] TNA PRO, AIR 41/4, p.238.
[96] TNA PRO, AIR 2/4168, Note of Conference Held in CAS's Room, 19 April 1940. As a *quid pro quo*, Portal asked for improved pilot selection, better FTS instructors, an improved FTS syllabus and the increased use of synthetic training equipment.
[97] TNA PRO, AIR 2/4169, letter from AOC-in-C to Under Secretary of State for Air, dated 11 May 1940.
[98] TNA PRO, AIR 2/4169, memorandum from HQ Bomber Command to Operational Groups dated 16 May 1940. The new OTU organisation was referred to as 7 Group.
[99] TNA PRO, AIR 2/4169, letter from Air Commodore Capel, Director of Operational Training at the Air Ministry to the new AOC-in-C Air Marshal Sir Richard Peirse, dated 11 October 1940. Capel states that to maintain an operational squadron of 16 aircraft required 24 heavy bombers in the OTU. He asked Portal to consider how this additional heavy training should be delivered.
[100] TNA PRO, AIR 2/4169, letter AOC-in-C to Secretary of State for Air dated 30 October 1940.
[101] TNA PRO, AIR 10/5551, p.170.
[102] TNA PRO, AIR 10/5551, p.171.
[103] TNA PRO, AIR 14/1136, 'HCU and LFS Expansion', see for example, memorandum from Director of Operations to Group AOCs on the formation of additional HCUs, dated 24 March 1943.
[104] W.R. Chorley, *Bomber Command Losses* Vol.8 (Hinckley: Midland Publishing, 2003) p.176.
[105] R. Overy, *Bomber Command 1939-1945* (London: Harper Collins, 1997) p.143.
[106] K. Delve, *Bomber Command 1936-1968* (Barnsley: Pen & Sword, 2005) p.190.
[107] TNA PRO, AIR 2/7965, letter from AOC-in-C to Under Secretary of State for Air, dated 24 March 1943.
[108] W.R. Chorley, *Bomber Command Losses*, p.176.
[109] This policy even applied to the single-cockpit Hampden. See TNA PRO, AIR 14/2156, letter AOC-in-C, Air Marshal Peirse to Under Secretary of State for Air, dated 30 January 1941.
[110] TNA PRO, AIR 14/10 'Aircraft Crews – Policy', memorandum AOC 6 Group to AOC-in-C Bomber Command, dated 31 October 1941. 'George' was the name given to the aircraft's auto-pilot system.
[111] Ibid. Memorandum, AOC 3 Group to AOC-in-C dated 2 February 1942.
[112] TNA PRO, AIR 14/1020, 'Note Of A Meeting Held In The Air Council Room at 11 am. On Sunday, The 29th March, 1942', undated.
[113] Ibid.

[114] TNA PRO, AIR 10/5551, pp.161-163.
[115] Ibid.
[116] TNA PRO, AIR10/5551, pp.161-163.
[117] C. Webster & N. Frankland, *The Strategic Air Offensive*...Vol. III, p.300.
[118] D. Richards & Hilary St George, *The Royal Air Force Vol. 2*, (London: HMSO, 1953) p.121.
[119] H. Probert, *Bomber Harris* (London: Greenhill Books, 2006) p.114.
[120] TNA PRO, AIR 14/10, Harris quoted by MacNeece Foster in a memorandum, AOC 6 Group to AOC-Cin-C dated 13 January 1942.
[121] TNA PRO, AIR 41/42, *The RAF in the Bomber Offensive, Vol.IV, A Period of Expansion and Experiment March 1942-January 1943*, p.38.
[122] TNA PRO, AIR 2/7965, loose minute from Wg Comd G.N. Anison, AM O.7 (2) to AM T.01. Anison says 'that the Stirling is the most difficult of the heavy aircraft to fly.'
[123] TNA PRO AIR 14/490, letter AOC 6 Group to HQ Bomber Command dated 25 February 1942.
[124] TNA PRO AIR 14/2156, 'Minute of Training Conference Held at Headquarters Bomber Command on August 26th, 1941'.
[125] TNA PRO, AIR 14/2156, letter from SASO 5 Group to AOC-in-C Bomber Command, dated 6 February 1941.
[126] NAL, JV Connolly Collection, *MAP Statistical Review 1939-1945, Table 1*, dated January 1946.
[127] Ibid.
[128] NAL, JV Connolly Collection, *MAP Statistical Review 1939-1945, Table 3*, dated January 1946.
[129] C.Webster & N. Frankland, *The Strategic Air...Vol. III*, p.287.
[130] S. Cox (ed) Sir Arthur Harris, *Dispatch on War Operations* (London: Cass, 2001) p.163.
[131] Ibid. p.168.
[132] TNA PRO, AIR 2/7965, Monthly HCU Summaries from AOT Bomber Command to Groups and AM, various dates 1944.