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Invented and Predicted Futures: Britain and the Challenge of Air Defence

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Dr David Jordan is a co-director of the Freeman Air & Space Institute. He joined the Department of Defence Studies, King's College London in 2000, based at the Defence Academy. He has been variously the Air Warfare Historian to the Higher Command & Staff Course, the Academic Director for the RAF Division and for the air and space power elements of the Advanced Command & Staff Course. He is a Fellow of the Royal Aeronautical Society, the Royal Historical Society and the Royal Society of Arts.

Abstract

As noted in Freeman Air & Space Institute paper *Britain's Air Defences: Inventing the Future?*, the air defence of the United Kingdom is all-too often seen through the prism of the Battle of Britain in 1940. The popular narrative that success in this vital battle was the result solely of the efforts of Air Chief Marshal Sir Hugh Dowding as Air Officer Commanding-in-Chief of RAF Fighter Command obscures the fact that success was built upon a long period of development. Drawing upon a basic interpretation of the notion that 'inventing' the future represents a better approach than simply attempting to predict it, the two papers examine the ways in which the United Kingdom has sought to shape future air defences, with varying degrees of success. This supporting paper provides additional historical context, contrasting the successful efforts of the 1920s and 1930s with the flawed approach adopted in the late 1950s and early 1960s which undermined Britain's air defence capabilities thanks to erroneous and optimistic premises about change and the future, and notes how the long-term effects of this were profoundly deleterious. It concludes with a consideration of how the contrasting periods might inform defence planning today.

Invented and Predicted Futures: Britain and the Challenge of Air Defence

On 20 January 1920, Number 203 Squadron of the Royal Air Force (RAF) disbanded. This was hardly a remarkable development at first sight. The RAF had, since the end of the Great War, undergone dramatic reductions in strength. Yet 203 Squadron's departure was significant, as it meant the nation had no air defence.[1] In the context of the time, this step was not as drastic as it might have appeared, since it was impossible to immediately identify a threat to the airspace above the United Kingdom. The only bomber force which lay in range of Great Britain was that belonging to France, Britain's wartime ally. The notion that the French government would suddenly launch a surprise air attack on Britain was preposterous. Indeed, the only threat was completely unknown to the British government. This lay in the possibility of an air raid against London by what would now be termed 'non-state actors', in the form of Irish republican forces. In 1922, Michael Collins, making contingency plans for the failure of negotiations with the British government, considered launching a surprise attack using surplus bombers flown by men who had learned to fly with the RAF.[2] Within months, a press 'scare' proclaimed that France was a threat, and the slow regeneration of the air defences began.

After the Second World War, while history did not repeat itself, it can justifiably be said to have demonstrated the validity of Mark Twain's alleged observation that it rhymed.[3] The end of the war removed any obvious threat and any imperative to maintain strong air defences. A strategic shock, in the form of the Cold War, prompted the formation of the North Atlantic Treaty Organisation (NATO) and a revitalisation of the UK's air defences. Before the 1950s were over there had been another strategic shock. The debacle of the 1956 Suez crisis demonstrated the limitations of Britain's power, and saw the government embark upon a wide-ranging defence review. This review fundamentally altered the nature of the UK's air defence, with the threat presented by Soviet ballistic missiles armed with nuclear warheads being thought to render air defence largely irrelevant because of the impracticalities of intercepting these weapons. The fighter aircraft was proclaimed to be on the verge of supersession by guided weapons.

Within months, it began to dawn on the government which had made these alterations that key aspects of their analysis might be wrong. The threat was not simply from ballistic missiles, and the guided weapons in which so much expectation reposed were unlikely to realise the capabilities predicted of them for many years to come. A revision of plans took place against a backdrop of a bureaucratic battle over the size of the fighter force required, with the Air Ministry pushing for anything up to 20 Squadrons, while the Ministry of Defence and the Treasury advocated just four. By 1967, as NATO moved from a policy of 'massive retaliation' to 'flexible response', the importance of conventional defence became clear again. Although the RAF's air defence forces did not return to their former size or status, a degree of stability returned until the Cold War came to an end, although by the end of the 1970s, there was profound concern at the mis-match between the potential threat and the UK's ability to face it. The profound strategic shift of the end of the Cold War brought a perceived threat to an end and led to pursuit of an elusive 'peace dividend'. While there was little apparent aerial threat to the United Kingdom itself, the growing propensity for the British government to become involved in 'expeditionary operations' presented a new air defence challenge, this time in the protection of deployed forces.

The start of the 21st Century brought with it another strategic shock – global extremist terrorism, and the attacks on the United States (US) on 11th September 2001. The form of a growing resurgence of Russia as a participant in international affairs was prompted by the election of President Vladimir Putin and his efforts to revitalise Russia's military power. For the United Kingdom, this meant a return to intercepting and identifying Russian long-range aircraft as they embarked upon long-range flights similar in nature to those seen during the Cold War.[4] As Russia's return to the centre of the international stage became more apparent, the potential challenges presented by that nation to air defence returned as a concern. The 2010s saw even greater reason to worry. Ballistic missile technology proliferated, notably in Iran and North Korea, while non-state actors obtained and made use of technology in ways which seemed previously unthinkable for what had once been seen as terrorist or insurgent groups. Remotely piloted air systems (RPAS, more commonly referred to as 'drones') and missile technology entered the hands of these groups, making them an air defence threat to be considered alongside the possible challenge presented by state actors. If this were not enough, the decade drew to a close with developments in hypersonic weapons by Russia and the People's Republic of China which may in due course present profound challenges to the defence of Britain's airspace.

This paper examines the way in which changes to the strategic environment have affected the air defence of the United Kingdom over the past 100 years. It does so through utilising a basic interpretation of the premise articulated by Dennis Gabor, and later Alan Kay, which holds that the future cannot be predicted accurately, but can be 'invented' through actions taken to try to shape it. This approach suggests that in the field of air defence, there are profoundly useful indicators of how to successfully 'invent' (or at least make effective efforts to shape) the future, and also where pitfalls might lie.[5] It also highlights how attempts to shape a future based upon overly-optimistic premises so as to deliver cost-savings have had deleterious effects.

The early years of air defence are analysed through the technical, financial and conceptual issues which arose, illustrating that despite an array of challenges the Air Staff and successive governments 'invented' an air defence future which was to pay off handsomely in 1940 during the Battle of Britain. The paper then explores the profound challenges which emerged in the 1950s and 1960s as British strategy was realigned in the midst of the reduction of Britain's empire and the realisation of the nation's retreat from superpower status. Here, a bid to invent a future based upon deterrence and cutting edge technology not only failed to deliver, but set in chain developments which hindered the effective delivery of air defence capabilities, further exacerbated at the end of the Cold War by optimistic predictions of a stable, largely peaceful world which did not transpire.

Building the Future: Air Defence, 1912–1918

The potential threat of enemy air attack had been one of the key considerations in the formation of the Royal Flying Corps (RFC) in 1912. Originally a joint organisation, with naval and military wings, the RFC split in two when the Royal Navy decided to form its own air service, the Royal Naval Air Service (RNAS) in 1914.[6] The RNAS held initial responsibility for the air defence of the United Kingdom, but the Admiralty came to regret this assignment, spending much of 1915 attempting to persuade the War Office that the task would be better performed by the RFC. While the bureaucratic debate over which service should have the duty of dealing with incoming enemy air raids dragged on, the Germans had begun a bombing campaign, using a mixture of aircraft and airships. By far the greatest initial impact was achieved by airships. Even if their destructive effect was relatively limited, the psychological factors were, for a brief period, notable.

In early 1915, the 'Zeppelin menace' was a source of considerable concern.[7] Early warning that airships were approaching, to allow defending aircraft to be airborne and thus able to reduce the time required to climb to the heights at which zeppelins routinely operated was essential. Fortunately, German signals security was often poor, and intercepted wireless traffic, as well as sightings by ships in the Channel and the North Sea, often gave some clue that a raid was imminent, even if it was difficult to ascertain where the airships might be heading. Nevertheless, the low performance and light armament of defending aircraft meant that the airships seemed largely invulnerable during their early operations in 1915 and 1916. Only one success was recorded in 1915, when, in the early morning of 7 June, the LZ37 was brought down by Flight Sub-Lieutenant 'Rex' Warneford over Ostend. Warneford had benefitted from early warning of the airship's passage, allowing him to reach the same altitude as the airship, which he had engaged by diving upon it and releasing light bombs which had set the Zeppelin ablaze. The award of the Victoria Cross to Warneford illustrated the perceived difficulties and dangers of his achievement.[8]

While anti-aircraft guns damaged some airships, there were no further successes until September 1916, when Lieutenant William Leefe Robinson brought down the SL11. Leefe Robinson took 50 minutes to get into a position to attack the airship, but, when he did, a small but significant technological development in the form of incendiary ammunition enabled him to rake the airship with machine gun fire and set it alight. Like Warneford, Leefe Robinson benefitted from early warning which allowed him to be waiting for any airship which happened to enter his patrol area. His success marked a turning point for the defences, which destroyed five more airships in the next three months.[9]

These victories came about through a combination of elements. Improved weapons technology, better warning systems and the use of anti-aircraft guns created a new paradigm for air defence operations. It was clear that if early warning through intelligence could be transmitted to defences, the chance of success was dramatically increased. The challenge lay in creating a network to bring these elements together. As London was the most obvious target for German air attacks, Admiral Sir Percy Scott, a gunnery expert, was given responsibility for establishing the coordination of the capital's defences.[10] This marked the tentative steps towards an air defence network, but it did not protect London from attacks by German bombers in 1917. The 'Gotha raids' caused political consternation and led to the inquiries by General Jan Smuts which led to the formation of the Royal Air Force. This overshadowed the creation of the London Air Defence Area (LADA) on 8 August 1917, commanded by Major-General E. B. Ashmore.[11] Ashmore had spent more than 20 years in the Royal Artillery before joining the RFC, and possessed knowledge of the key elements used in the defence of London. This was coupled with awareness from the Western Front of the vital importance of timely information delivered through what we would now call a networked solution.[12]

Although primitive, LADA was effective. Coordination of the defences improved, making daylight raids much more dangerous for the bombers.[13] The Germans moved to night attacks, but, although this reduced losses, they were still significant. The defences now had a network to guide them, and much better aircraft than before. Rather than the motley collection of aircraft that had been available between 1914 and mid-1917, the latest fighter aircraft were available.[14] By 1918, Ashmore had a reasonably effective reporting and control system, although it reached its high point just as the German bomber effort was redirected against the Allied armies in France.

Ashmore instituted the installation of the first wireless telephony sets in aircraft to allow control of the defending fighters.[15] This technology was not available to all aircraft before the war ended, but was another key part in the networking of air defences, and a further illustration of the importance of up-to-date technology to their efficacy. While LADA's capabilities should not be overstated, John Ferris's conclusion that it 'smashed daylight Gotha attacks', and contributed to the Germans suffering 'staggering losses to combat and accidents' is an appropriate summary.[16]

Resetting Air Defence: Preparing for An Unlikely War, 1922–1939

The end of the First World War brought with it a massive reduction in the strength of the Royal Air Force, and in the air defence system. It also saw a period in which the RAF's very existence was threatened, leading to the Chief of the Air Staff (CAS), Sir Hugh Trenchard, embarking on a campaign to save the service from disbandment and reabsorption into the Army and Royal Navy. To achieve this, Trenchard promoted the air force's role in aerial bombardment.[17] In reality, while bombing was the enthusiastically-declared doctrine of the RAF, its primary task was supporting operations in the British Empire and the Mandated Territories. Trenchard aggressively promoted the concept of 'substitution' under which aircraft would replace regular British Army battalions in the policing of the colonies rather than making them a subordinate element.[18] Air defence did not receive the same vigorous support for two reasons. First, Trenchard feared that it might detract from his message of the devastating effect of bombardment, and second, he did not truly believe in it. He continued to expound the virtues of the offensive over the defensive, just as he had from when he had taken command of the RFC in France in the summer of 1915.[19] Yet he had a number of senior subordinates who thought his views too dogmatic.

They faced a challenge in promoting the value of air defence, as the result of there being no obvious near-term threat of air attack on Britain or its Empire. Furthermore, the need for extreme economic retrenchment was exemplified by the Committee on National Expenditure, chaired by Sir Eric Geddes. Geddes recommended significant cuts in expenditure (the so-called 'Geddes Axe') including £70 million from defence spending.[20] Although John Ferris has noted that the British public was perhaps less pacifist in outlook than has been popularly supposed, politicians were right to be cautious in thinking that there would be opposition to large-scale defence expenditure. [21]

Retrenchment saw the almost complete destruction of Ashmore's air defence system by early 1920.[22] Within a matter of months, the government concluded that this drastic reduction had gone too far, and a debate over the value of air defence began. Ashmore noted:

> In the months after the Armistice the question: "can there be another war?" had but one answer. By 1923 the Everlasting No [*sic*] had taken on a far less confident tone.[23]

The experience of air bombardment which had affected many parts of the country between 1915 and 1918 left a sense of unease about the threat of air attack in future. The government could not afford to be complacent about air defence, and despite the limitations of 1919's 'Ten Year Rule', renewed every year until 1932, spending on air defence was not adversely constrained.[24]

The greatest challenge to the reconstruction of the nation's air defences came from Trenchard, who noted the difficulties of intercepting enemy bombers. He instead argued that the threat of a large RAF bomber force, deterring a possible attack, was a far better approach than active air defence. The government, and his successors as CAS, were not prepared to go so far. By the time Fighter Command was created in 1936, Britain possessed probably the best air defence system in the world. [25]

The first steps towards this began within weeks of the disbandment of 203 Squadron mentioned above. Number 25 Squadron was reformed in April 1920, as part of a deliberate plan for the small fighter force Trenchard preferred.[26] Geo-politics reinforced the need to consider air defence when, in 1922 a press scare about the possible threat presented by France gained public attention. Disagreements over dealing with Germany under the terms of the Versailles settlements caused a decline in relations, and the size of the French air force was presented to the public as a threat to Britain.[27] The government's preparations for the Washington Arms Conference had already exposed the difference in strength between Britain and France, alarming many senior politicians concerned about the effect this might have on Britain's influence.[28]

The spurious 'French Air Menace' became the new strategic factor which revitalised air defence. The Committee for Imperial Defence established a 'Continental Air Menace Sub-Committee', which concluded that the French air force was, in theory, a serious threat.[29] The proposed solution was presented by the National and Imperial Defence Subcommittee of the Committee for Imperial Defence, more commonly known as the 'Salisbury Committee' after Lord Salisbury, its chairman.[30] The committee called for a 52 squadron-strong Home Defence Air Force, with an emphasis on bombers rather than defensive fighters, drawing upon Trenchard's preference for the offensive.[31] There would be 17 fighter and 35 bomber squadrons, many of the latter being drawn from reserve and auxiliary squadrons. This fighter force was larger than Trenchard considered necessary, but he had bowed to the views of Air Staff members such as Air Commodore T. C. R. Higgins, who had commanded the RAF's contribution to LADA in the last two years of the war and pointed to the efficacy of the defences.[32] Progress was slow because of financial constraints and a general improvement in the relationship between European states after the signing of the Locarno treaties which reduced the perceived risk.[33] Nevertheless, the defences and warning systems – including the formation of the Observer Corps – were gradually built up.[34]

Careful attention was paid to the development of the control and reporting systems, and the RAF took care to build close relationships with the scientific community, so as to be able to draw on the latest technological developments. The construction of huge sound mirrors to provide aural warning of approaching aircraft was undertaken. These were seen as being vital to the defence effort, and by the time of the 1934 air defence exercises they were able to detect all the raids heading towards them.[35] The challenge lay in the variability of the early warning times from the sound mirrors, but technology was once again harnessed to address this challenge, with the development of Radio Direction Finding and high-performance fighter aircraft in the form of the Hawker Hurricane and Supermarine Spitfire.[36] At the outbreak of the Second World War, the UK possessed an effective, if still-evolving, integrated air defence system (IADS) which enabled victory in the Battle of Britain. Further developments to enable night interception thwarted the 'Little Blitz' of 1944, and the integrated network, using radar, anti-aircraft guns and fighters, helped to dramatically reduce the effect of the flying bomb offensive launched as part of Hitler's reprisal weapon programme against Britain. That latter offensive, though, hinted at a new challenge in the form of the ballistic missile.[37] It would be this new challenge that made a major contribution to the next major shift in the Air Defence of the United Kingdom in the 1950s.

Building Air Defence in the Nuclear Age

Britain's experiences in developing the world's first true IADS over a period of almost 20 years pointed towards a number of key issues. The first was the importance of building an effective network, first for providing early warning and then to coordinate the defensive response. This was followed by the need to ensure that the enemy's attacking aircraft did not enjoy technological overmatch against the defending fighters, an approach which had led to the development of high-performance fighters at the cutting edge of technology of the time. It was also clear that the use of high technology was costly and would present challenges in terms of deciding where to allocate funding most effectively.

This had demonstrated two clear philosophical and doctrinal schools of thought. The first held that active air defence – that is to say the provision of a fully networked capability – was superior; the second that defence was best achieved through deterring conflict in the first place. The question of what happened if deterrence failed was not fully addressed in this construct. Just as in the immediate aftermath of the First World War, the UK's air defences after 1945 suffered serious reductions in strength, in the face of the financial austerity caused by the Second World War. The situation was further complicated by some notable strategic changes. Whereas France had been a rather implausible adversary in 1922, the deterioration in relations with the Soviet Union meant that there was a credible threat to the UK. Furthermore, the development of nuclear weapons presented a significant defence challenge, as the destructive capacity of the atomic bomb meant that it would be essential in a future war to engage enemy bombers long before they could attack the UK. While this was not an immediate problem, the detonation of the first Soviet atom bomb in 1949 changed the defence calculus significantly. Finally, the Second World War brought about the end of Britain's position as a great power, although it took some time for British political leaders to recognise this. The rise of the United States to prominence at Britain's expense was perhaps best exemplified in the continued stationing of American forces in the UK at the end of the war. As Ken Young has observed, the 'protection of the American nuclear umbrella [was] accepted with gratitude, if little grace.'[38]

The presence of the American forces created a problem, in that the rapid shutting down of much of Britain's air defences in the aftermath of the Second World War was a source of considerable concern to the Americans, who were not slow to highlight their doubts as to the effectiveness of the protection which their forces based in the UK enjoyed. They were right to be worried, since unbeknown to them investigations in 1946 into the possible scale of air attack against the UK five and ten years hence had produced gloomy results. By 1956 it was estimated that the projected strength of the defences would be insufficient to prevent somewhere in the region of 80% of an attacking force from reaching its targets, using a mixture of manned aircraft and flying bombs.[39] This unpleasant assessment was mitigated by the imposition of yet another assumption that, fortunately, there was no threat to the UK for the next ten years. Fighter Command was to concentrate upon research and development, and to make sure that it would be able to accommodate the return of fighter squadrons then based in Germany if circumstances dictated.[40]

By 1949, little improvement had occurred, and a serious of doom-laden assessments of the UK's air defences were circulating in Whitehall. The Berlin blockade had demonstrated the potential threat from the USSR, and it was clearly understood that Fighter Command and the supporting air defence network were insufficient to meet the task before them. It was also obvious that there was little hope of the necessary money being found to rectify this situation.[41] Realisation that the air defence network in effect shut down for the weekend and bank holidays dawned very quickly on the Americans, who were astonished at the apparent lack of concern.[42] In reality, there was great concern, which only intensified after the detonation of the first Soviet atomic bomb in August 1949, followed by the outbreak of the Korean War the following June.[43] Britain's decision to support the United Nations intervention led to concerns that there might be a widening of the war, and even an air attack on the UK.[44] The Attlee government felt compelled to embark upon a programme of rearmament, which included the strengthening of air defences.[45]

The re-election of Winston Churchill as Prime Minister in the 1951 General Election saw a renewed focus upon rearmament, and the introduction of 'super-priority' programmes, including the new Hawker Hunter and Supermarine Swift fighters, to reduce the time it took to bring key items of equipment into service more quickly.[46] These programmes did not deliver aircraft in time for the Korean War, and the RAF was forced to obtain the American F-86 Sabre as an interim measure.[47] The RAF had coveted the Sabre for some time, but the procurement of the aircraft under mutual defence aid plans meant that some diplomatic sleight of hand was required to commit two of the squadrons to the air defence of the United Kingdom. The presence of Royal Canadian Air Force Sabres, along with a mixture of US Air Force units equipped with F-84s and F-86s helped to alleviate some of the air defence burdens the RAF faced. The superb performance of the Hawker Hunter helped further mitigate the disastrous failure of the Supermarine Swift as a fighter aircraft when that pair of British aircraft entered service from late 1953. The inadequacies of the air defences still concerned the Americans, who in early 1956 offered to provide a wing of F-86D all-weather fighters to the RAF.[48] Although the F-86D was the most advanced version of the Sabre, the offer was turned down on the grounds that there was little hope of integrating them into the RAF without causing serious difficulties in finding the additional personnel to operate them.[49]

Suez and Sandys: Future Creation Gone Wrong

Ongoing American dissatisfaction with Britain's air defences was as nothing compared to their reaction to the ill-judged Suez Campaign in November 1956. Sir Anthony Eden, Churchill's heir apparent as leader of the Conservative Party had finally replaced him as Premier in April 1955, but his response to the nationalisation of the Suez Canal brought about his downfall. The Anglo-French plan to seize control of the canal zone demonstrated the limitations of the two powers, and President Eisenhower's irate response to the adventure caused a run on the Pound. Britain and France were forced into an ignominious withdrawal. Although Eden's long-standing ill-health was given as the reason for his resignation in January 1957, the loss of trust between London and Washington, and Eden and his backbenchers, necessitated the change.[50] Eden was replaced by Harold Macmillan, a former Minister of Defence and Chancellor of the Exchequer. Macmillan had a clear vision of where he wished to take Britain, and central to this was a reduction in the size of the defence budget. His appointment of Duncan Sandys as the Minister of Defence was bad news for all three services, sparking a radical reappraisal of Britain's air defence. Macmillan had been sceptical about the value of air defence in an era of ballistic missiles for some years, viewing Fighter Command as being a particular target for savings.[51]

Sandys arrived at the Ministry of Defence knowing that he had the express support of Macmillan to reduce the defence budget and force through change.[52] Sandys' wartime political career had seen him appointed by Churchill (his father-in-law) to take charge of the initial investigation into the existence of German V-Weapons, and his familiarity with the difficulties of defending against missiles meant that he concurred with Macmillan's perceptions of the value of active air defence.[53] He thus set about his review with a clear brief as to what he was to achieve, and a willingness to make radical reforms. There can be little doubt that he did so with his 1957 Defence White Paper.[54] For the air defences of the United Kingdom, the effects were profound.

Introducing his review to the House of Commons, Sandys made clear that Britain's defences would be focused upon the deterrent. It was no longer possible to provide for the effective air defence of the whole country:

> It must be frankly recognised that fighters cannot give the country as a whole any effective protection against the catastrophic consequences of nuclear attack. [55]

Sandys had given clear warning of his intentions in a House of Commons debate a month previously, informing MPs:

> When the Russians are in a position to bombard this country accurately and on a massive scale with nuclear rockets, we shall have to consider whether it is worth while retaining fighter aircraft at all. But until we are sure that the Russians are, in fact, so far advanced, it would be irresponsible to neglect such means as are available to protect our deterrent power, this power which may play such a big part in the prevention of war.[56]

Thus, air defence policy changed from that of protecting the nation to that of protecting the deterrent, in the form of the RAF's V-bomber force and, in due course, ballistic missiles such as the American Thor and the British-built Blue Streak.[57] As observed, 'we must concentrate our defence effort, not on preparations for war, but on measures to prevent it—not on planning for victory, but on the protection of peace.'[58]

The implications for the RAF were significant. Sandys' plan called for a dramatic reduction in the strength of the RAF. All 20 of the Royal Auxiliary Air Force's squadrons disbanded, along with two regular fighter squadrons. By March 1959, a further 13 squadrons were to disappear. This left the RAF with 20 squadrons of Gloster Javelins and Hawker Hunters, a reduction of more than 300 aircraft in three years.[59] Sandys, with his long-standing interest in missile technology saw a further opportunity for reductions once various Surface to Air Guided Weapons (SAGW) projects came to fruition.[60]

The Air Ministry disagreed with the proposed structure, noting that there would need to be fighter squadrons in Cyprus, Aden, Singapore and Hong Kong. The proposed disbandment of all nine fighter squadrons in Germany would require Fighter Command to provide reinforcements in time of war, which militated against Sandys' plans. Unfortunately for the RAF, this consideration was one Sandys proved adept at overlooking as he pursued an air-defence plan which protected the nuclear deterrent rather than the country as a whole.

The fighter force would be supported by the Bloodhound SAGW, with the interim Mark 1 version entering service in 1958, in proximity to the stations housing Bomber Command's V-bomber force and the Thor IRBM.[61] The advanced Mark 2 Bloodhound would follow in the mid-1960s, along with a nuclear-armed Mark 3 version. Sandys believed that a large SAGW force would provide a credible means of protecting the deterrent in due course.[62]

The Air Staff estimated that these forces would be sufficient to meet the Soviet threat until 1960, but that after that the threat level would increase. The Soviets were known to have a number of bomber types in development, and while it was thought that they would rely upon stand-off missiles from the mid-1960s, it was assumed that the bomber types would be used to attack 'fringe targets' such as radar sites, and to conduct jamming of the radar network. The latter was an enormous concern, since this would undermine the control and reporting system vital to defence of Bomber Command's airfields.[63]

This did not move Sandys from his view that the proposed size of the fighter force was too large, but growing realisation that the SAGW force would not be capable of defending against the anticipated nature of a Soviet attack led to a modification of his views. Macmillan was also concerned by wider political issues. The Prime Minister was attempting to juggle the various aspects of Britain's global role with economic reality, and these helped to save some air defence capability. Fighters were clearly of value in supporting overseas interventions, and it thus made sense to retain a reasonably credible force. As David French has observed, part of the reasoning behind the 1957 White Paper was to allow Britain to continue to mount expeditionary operations.[64]

Also, the concern that Britain's credibility with the Americans would be reduced remained, and this helped the Air Ministry to at least maintain the case for a combined fighter and missile force. This was particularly relevant when, at the end of 1957, the Americans made a request to locate part of their Ballistic Missile Early Warning System (BMEWS) in the United Kingdom.[65] Although the BMEWS only gave limited warning of missile attack to the UK, its symbolism of the close cooperation between the US and UK was valuable. The presence of some form of early warning prompted the Treasury to argue that even smaller air defence forces were now possible, since the V-bombers could be scrambled to avoid destruction. The Air Ministry found itself fighting an ongoing and rather circular battle throughout 1958 and 1959 to prevent financial constraints from destroying Fighter Command completely, using the argument that credible defences were required to maintain American cooperation as part of their case.[66]

Macmillan realised that the reaction to such wide-ranging cuts to air defence, so soon after the 1957 review, were likely to be unfavourable, and thus sought to avoid making any decisions until after the 1959 General Election, which he won.[67] Sandys was moved to the Ministry of Aviation and replaced by Harold Watkinson, but this made little appreciable difference to the case made against air defence. Watkinson agreed that no firm decisions should be made until a number of examinations of defence policy had been conducted, but it was already clear that Fighter Command would be smaller than the 20 squadron force the RAF had fought for, and the Air Staff now argued that 12 squadrons would probably suffice, aware that Watkinson was thinking in terms of a force of no more than eight squadrons of fighters.

When the various reports were complete, that by the Joint Planning Staff gave weight to the Air Ministry's position. It suggested, without necessarily appreciating Macmillan's aim of being able to conduct expeditionary operations, that choosing air defence as the major target for economy was illogical, and that arbitrary cutbacks could cause an imbalance in the nation's defences. The idea that aircraft would cease to be a threat in the near term was rejected, and were anticipated to remain a threat, even if the Soviets were, in theory, able to attack Britain with ballistic missiles alone. The importance of being able to gain early warning of an attack was highlighted, as well as possessing forces:

> ...to enable the United Kingdom to play an appropriate part in the NATO integrated air defence system of which the United Kingdom is one of the regions. The known ability to do all this will undoubtedly influence potential enemies and reassure our own people.
>
> The knowledge that the United Kingdom has an air defence system which is able to provide effective early warning and tracking should by itself deter Russia from using aircraft against her; the comparatively large amount of warning available from such a system would permit the United Kingdom – and, in fact, the United States – to launch their nuclear strike forces. [68]

In the face of this, Watkinson agreed that he would accept a fighter force of up to 12 squadrons, supported by a reduced number of SAGW launch sites, although he gave clear warning that he felt that a fighter force of more than nine squadrons was probably excessive.[69]

Ultimately, a decision to settle on 10 fighter squadrons was made in 1962, but a number of the units were to be deployed overseas. The two Lightning F2 Squadrons at RAF Leconfield were deployed to RAF Germany in 1962 when it became obvious that a small fighter force there was necessary, while the decision to base two squadrons of Vulcan bombers in Cyprus saw the commitment of another Lightning squadron to RAF Akrotiri.

Finally, the retirement of the Gloster Javelin from the Far East Air Force saw another Lighting squadron sent to Singapore, leaving Britain's air defences at the end of the 1960s in the hands of six Lightning squadrons (including the operational conversion unit) and, from late 1969, a single F-4 Phantom squadron at RAF Leuchars.[70] The Bloodhound Mk2 force reached a peak strength in the late 1960s, but of the six squadrons which operated the missile, only two formed in the United Kingdom, and one of these went to Cyprus in 1967 for protection of the two Vulcan squadrons.

Although the debates of 1957-1960 had ascertained the scope and purpose of air defence, the strategic changes brought about by the transfer of the nuclear deterrent to the Royal Navy's Polaris force meant that the new conception of what air defence was for had been changed in character once more by the late 1960s, but the principle of forming part of the overall deterrent mechanism lingered. The incoherent and contested building of a future air defence construct in the late 1950s meant that by the late 1970s, the air defences of the UK were a source of great concern. Sandys had aimed – almost literally – for the stars but had brought about adversity.

‘Uncomfortably Thin’: The Consequences of Sandys

In 1969, the RAF handed over strategic nuclear deterrence to the Royal Navy, and at a stroke the link Sandys had established between air defence being part of the credibility of the deterrent force was removed. The decision to cancel the CVA-01 aircraft carrier programme meant that the RAF was given responsibility for the air defence of the Royal Navy which placed a further operational commitment upon a force which was arguably too small to meet the tasks which would be required of it in the event of a major war. Fighter and Bomber Commands had merged in 1968 into Strike Command, and the fighter and missile force had remained at a constant level. The RAF Lightning force was reduced, with the multi-role Phantoms that had previously served in the strike and attack roles in RAF Germany replacing the majority of the Lightnings in the air defence role by the mid-1970s. By 1977, the fighter force in the UK stood at two Lightning squadrons and five of Phantoms, along with the Phantom Operational Conversion Unit, which would be added to the front line in time of war. The Turkish invasion of Cyprus had seen the withdrawal to the UK of the squadron permanently based there (and its re-equipment with Phantoms), while the removal of British forces from Singapore led to the disbandment of the fighter squadron there in 1971. A single Bloodhound SAGW squadron provided missile defence in the UK. Short range air defence was provided by the RAF Regiment with 40mm guns and the Tigercat missile, although a new missile, the Rapier, was under development. Two further Lightning squadrons were based in RAF Germany, along with another Bloodhound squadron and the RAF Regiment’s point defence weapons.[71] From 1972, a squadron of Shackleton maritime patrol aircraft modified for the Airborne Early Warning (AEW) role was added to the UK’s defences, ostensibly as a short-term measure while a dedicated AEW type was selected.

A 1977 Joint Intelligence Committee (JIC) report ‘The Soviet Capability to Attack the United Kingdom Base’ prompted Prime Minister James Callaghan to enquire whether the ‘other side of the picture’, that of Britain’s ability to defend itself had been considered.[72] The response from Fred Mulley, the Secretary of State for Defence, was gloomy. He noted that the defence of the UK was now rooted in the collective defence provided by NATO, and that, alone, Britain could not match the Soviet threat the JIC had outlined. The main cause had been insufficient funding for many years, and the small number of fighters only had sufficient air-to-air missiles for an estimated three days. The defences, Mulley concluded, were ‘uncomfortably thin’.[73] Just under 100 fighters would be facing over 200 Soviet bombers were a conventional attack to be launched. Callaghan’s request for consideration of whether air-to-air missile stocks could be increased led to a response from Mulley in which he dolefully observed ‘our air defence posture is plainly weaker than I should like.’[74] Mulley observed that the situation would improve over time. The Air Defence Version of the new multi-role combat aircraft, the Tornado, would enter service in 1985 with better missiles, and an AEW version of the Nimrod maritime patrol aircraft would reach the RAF in 1982, which would dramatically increase capability, if not solve the conundrum over aircraft numbers.[75] Suggestions from the Foreign Secretary, David Owen, to change the balance in Tornado orders in favour of a larger number of the fighter variant over the strike version, so as to increase the fighter force, were rejected, more on the grounds that this would cause production delays than because of any philosophical preference for attack aircraft.[76] The Callaghan government, while endeavouring to increase missile stocks, particularly for the Bloodhound launchers, found itself consumed by political difficulties. The minority government, whose apparent impotence in the face of trade union militancy in the winter of 1978 cost it popularity, was defeated in the 1979 election, bringing the Conservative Party, led by Margaret Thatcher, to power.

The Conservatives had been critical of the state of defence in general during the election campaign, but on taking office discovered that the state of the economy militated against taking any dramatic steps to improve matters. A plan to create a third Lightning squadron foundered, and by 1980, the cost overruns in the defence budget meant that the Secretary of State, John Nott, introduced his infamous defence review which inflicted serious cuts upon the Royal Navy. The re-equipment of the RAF with the Tornado helped prevent significant cuts to that service, but there was no room in which to increase the size of the air defence forces.[77] Indeed, the failure of the Nimrod AEW programme meant that the Shackleton had to soldier on, and the premature halving of the size of the Shackleton squadron (in anticipation that the Nimrod would soon enter service) added to the pressures on the force. The 1982 Falklands War was followed by the despatch of Number 23 Squadron's Phantoms to Port Stanley, creating a standing air defence commitment which endures to this day. The departure of the Phantom squadron led to the procurement of 15 ex-US Navy F-4 Phantoms to form a replacement squadron; it was further decided to run on some Phantom squadrons after the Tornado entered service. The Phantoms in the Falklands were reduced in number and 23 Squadron renumbered as 1435 Flight, allowing the re-formation of the squadron in the UK with Tornado F3s. This did not mark the beginning of a resurgence in air defence strength. By 1990, the RAF's air defence forces in the UK stood at a single Bloodhound missile squadron, seven Tornado F3 and two Phantom squadrons. 1435 Flight continued to operate Phantoms in the Falklands, as did the two fighter squadrons in RAF Germany.[78]

The Nimrod AEW programme was finally cancelled in 1986, and the Boeing E-3 Sentry, already proven in the role, was ordered instead. By 1990, the threat to the UK's air defences had changed dramatically thanks to yet another strategic shift, unthinkable when Callaghan had agonised over air defence 12 years previously. The Soviet leader, Mikhail Gorbachev, sought rapprochement with the west, and in a series of agreements between the USSR and the United States the Cold War was brought to an end, best exemplified when Germany reunified on 3 October 1990.[79]

1990 to the present day

The thawing of relations between the USSR and the west brought about a wave of optimism that a new era of peace and coexistence would ensue. As part of this major change, many NATO nations embarked upon pursuit of what was known as 'the peace dividend'. In the UK, this manifested itself in the 'Options for Change' defence review, which saw the start of what would become the significant diminution of the UK's air defence capabilities.[80] The Bloodhound missile was withdrawn from service in 1991, ostensibly to be replaced by a different Surface to Air Missile (SAM) in due course.[81] Nearly 30 years later, it seems safe to suggest that this represents the longest unrealised procurement in British military history. The UK thus fell back upon air defences based upon a fighter force, supported by AEW aircraft and point defence missiles, coordinated through a control and reporting system employing a range of radar sites around the United Kingdom as well as drawing information 'handed off' from NATO allies regarding the passage of Russian aircraft.

Even as 'Options for Change' was under way, there was a worrying sign that optimism about the stability of the Post-Cold War world might be misplaced. Saddam Hussein's invasion of Kuwait and the subsequent 1991 Gulf War suggested that in a unipolar world, there might be greater risk of instability than predicted. This proved to be alarmingly true. Yet despite this, the RAF's air defence forces found themselves reduced still further but being tasked with a wide range of duties. The intransigent Saddam Hussein was to be constrained by No-Fly Zones over Iraq, with the Tornado F3 force forming part of the British contribution. There was no question that the standing commitment to the air defence of the Falklands would remain a requirement, while the international response to the outbreak of the Yugoslav Civil War required the RAF to provide support to Operation Deny Flight, designed to prevent the warring parties from making use of their air power, particularly as part of 'ethnic cleansing' operations designed to drive communities from their homes.[82] Given the need for aircraft with an interception capability to fulfil this duty, it was inevitable that Tornado F3s would be committed to support Operation Deny Flight, in addition to maintaining their non-discretionary tasking of the UK's Quick Reaction Alert (Intercept) duties.

By the end of the 1990s, two more Tornado F3 squadrons had been disbanded, largely on cost-saving grounds. If Fred Mulley had worried about the air defences of the UK being 'spread uncomfortably thin' in 1978, it seems reasonable to suggest that he would have been even more concerned by the size of a force upon which considerable demands were being placed, even in the absence of an obvious air threat to the United Kingdom. Assumptions that the end of the Cold War would lead to a much more stable world were, therefore, misplaced, but this did not prevent a further diminution in air defence forces. The two remaining Phantom squadrons had disbanded in 1992, leaving the UK's air defences resting in the hands of five Tornado squadrons and an AEW force of seven Boeing E-3 Sentries.[83]

The election of Tony Blair's Labour government in 1997 led to a new defence review. The Labour Party, while in opposition, had been most critical of the Major administration for its failure to balance resources and commitments. As part of its manifesto commitment, the party promised the initiation of a defence review if elected to power. The Strategic Defence Review was presented to parliament in 1998. Despite the notion that commitments and resources were out of balance, the news was not good for the Tornado F3 force, which saw another squadron being disbanded. The notion that this would be offset by the deployment of elements of the Operational Conversion Unit if additional numbers were required was unhelpful, since this suggested that there would be a risk to the training pipeline as instructors and possible aircraft were deployed, leaving those converting to the type with less opportunity to fly and to complete their conversion.[84] There was little sign that the Blair government would modify its view that the UK should be a 'force for good', suggesting that there was a danger of further commitments of British air power to operations, but without any sign that the balance between resources and commitments would remain in balance.[85] Rather akin to the 1920s, though, there was little in the way of an obvious threat to British airspace, and the strength of the air defence force seemed appropriate.

Another Failed Prediction?

The perception that the air defences established in the 1990s were sufficient to meet the nation's needs came under challenge very quickly. On 11th September 2001, the terrorist attacks on the United States focused attention upon defence of British air space. While the possibility of shooting down hijacked airliners was an uncomfortable prospect to contemplate, there was perhaps a greater difficulty in ensuring that there was sufficient capability within the UK's air defence forces to deal with not only actual threats but instances where airliners would require escorting as the result of a possible threat to the aircraft itself or some other issue which made it necessary to launch QRA aircraft to ensure that the aircraft would not present a danger to those on the ground.

Furthermore, relations between Russia and the west had become more fraught. While there had been tensions during Boris Yeltsin's presidency of the Russian Federation (most notably during the Kosovo campaign in 1999), the election of Vladimir Putin as his replacement saw a revanchist spirit within the Russian leadership, anxious to reassert the nation's position as a leading world power. As part of Putin's demonstration of Russia's return to international prominence, Long Range Aviation (LRA) was provided with increased funding and engineering support, enabling it to resume regular flights in 2007.[86]

These operations, while not as extensive as those carried out during the Cold War, have presented a notable challenge to NATO nations, and have prompted a notable increase in QRA launches by the RAF, as well as the need to maintain a robust reporting and control system capable of addressing the challenge presented by the Russian aircraft. The coordination between NATO allies shadowing the LRA flights has echoes of the Cold War period, and the use of RAF aircraft for shadowing purposes has clear linkages with the debate during Sandys' and Watkinson's tenures as Minister of Defence over the need to be able to shadow and escort reconnaissance aircraft, or those carrying out training flights for their bombing role.

Although the Tornado F3 force retired in 2011 and was replaced by the Eurofighter Typhoon, the Typhoon's multi-role capabilities means that there is a risk of the force being subjected to overstretch. As well as the standing air defence commitments in the UK and the Falklands, the Typhoon's multi-role capability has seen it deployed on operations over Libya in 2011, and the ongoing Operation Shader against the Islamic State group since 2014. In addition, the NATO air policing mission has led to deployments to the Baltic States and Romania. Project Centurion, providing the Typhoon with capabilities allowing it to replace the Tornado GR4 in the attack role, has turned the Typhoon into the mainstay of the RAF's combat force. While the number of squadrons – eight, including the operational conversion unit and the joint Anglo-Qatari squadron – at first sight appears to be consistent with the force levels employed for UK air defence (and a slight increase on the mid-1990s), this ignores the fact that as well as the Tornado F3, the type has, in effect, replaced the SEPECAT Jaguar, the Tornado GR4 and the Harrier GR9. While the arrival of the F-35B Lightning into UK service will help reduce some of the burdens, questions must arise as to whether there is a risk that Fred Mulley's analogy of the RAF being spread 'uncomfortably thin' will be repeated. Although procurement of more Typhoons seems highly unlikely, judicious management and structural changes within the extant force construct to alter unit establishment numbers might permit the formation of an eighth front line squadron to help alleviate some of the burdens, even if not increasing the overall combat mass of the force in terms of the number of airframes.

The challenge is further complicated by a number of other critical factors. While the last occasion on which British troops deployed on operations were attacked by hostile aircraft was during the Falklands War in 1982, the threat of attack from the air has always been present for those forces on operations. The range of threats has increased in recent years as non-state actors have gained access to technology which allows them to utilise a form of air power of their own, while nation states have improved both their aircraft capabilities and their stocks of ballistic missiles.[87] The growing threat from hypersonic weapons where the high speed of the weapon and the plasma sheath generated by the weapon's velocity make it difficult to track and intercept the missile for much of its flight, has been accompanied by a proliferation of cruise missiles and remotely piloted air systems which can be used to target British troops overseas and, potentially, the UK itself.

Relatively resource-poor adversaries are now able to obtain drone and cruise missile technologies which present potential dangers which require technological overmatch to defeat. Whether the vision of Trenchard, and then Sandys, that the only effective defence against what we would now term 'high end', technologically advanced threat was offence, either threatened or executed is the correct response requires consideration. Sir John Slessor's observation from the 1930s seems to be apposite:

> Purely passive self-protection, that is to say waiting for an enemy's attack and then attempting to repel it, has never been the British conception of national defence, and is peculiarly ineffective in the three-dimensional battlefields of the air.[88]

As a deterrent-only posture seems unlikely to work against non-state actors, or states operating in the 'grey zone', it suggests that a blended approach to defence, mixing offensive and defensive capabilities to counter hostile air activities, will be necessary.[89] This is almost certain to require the ability to engage aircraft and missiles at long range, and in the case of certain missile systems, during their boost phase.[90] It will also require the necessary systems for early warning and reporting.[91] As the first nation in the world to have to respond to an attack by ballistic missiles and to have built an effective IADS, there is at least some heritage to fall back upon, but whether the will exists to translate this into a modern defensive response is unclear.

Conclusion: Created Futures Good And Bad

The history of Britain's air defences demonstrates a number of critical issues for decision-makers to ponder. It seems clear that air defences need to be tailored to meet a range of prospective threats. Successive governments chose to maintain the nation's air defences during the 1920s and early 1930s, even though the financial situation facing the UK might have given rise to the temptation to reduce air defence when there was no immediately obvious threat of air attack. Within little more than a single parliamentary election cycle, Britain went from peace to facing daily air raids; the preparations undertaken in peacetime when few serious commentators would have regarded the Blitz as anything more than speculative fiction meant that Britain was able to withstand the assault. Blending new and established technologies in a balanced manner brought about success.

Conversely, in the late 1950s, the Macmillan government focused upon a relatively narrow threat to the United Kingdom, using technological advancements in the offensive power of the most likely enemy as a rationale for almost abandoning air defence in anything other than token form and placing reliance upon the nuclear deterrent. While the changed strategic rationale after Suez, coupled with a need to reduce Britain's defence spending, had to be considered, the Sandys review went too far. In the desire to jump forward a generation, from the manned aircraft to the guided missile, the challenges of making such a leap – both technological and financial – were optimistically overlooked, and the fixation upon guided missiles helped to hollow out Britain's air defences. This began the steady reduction of air defence capability which so alarmed Jim Callaghan nearly 20 years later. The withdrawal from overseas main operating bases meant that deployed forces required deployed air defence capability, thus reducing the forces available for the defence of the UK. It also became painfully clear to the Macmillan government that dramatic reductions in capability called Britain's credibility with its allies, and particularly the United States, into question.

There is a danger that in attempting to balance financial constraints with capability, extant capabilities may be labelled as irrelevant and thus 'safe' to cut in favour of new ones which may, in reality, take time to become effective, but at least appear to be forward looking when described in the media.

This in turn creates a risk that defence policy makers might following the path laid by Duncan Sandys, focusing upon a narrow aspect of national security challenges rather than taking the more challenging approach of carefully analysing a balance of capabilities. Sandys, unlike the governments of the 1920s and 1930s, chose to predict the future, drawing his conclusions upon plausible developments which he chose to treat as certainties.

The United Kingdom can no longer claim to be as powerful or as important a nation as it was during the 1920s and 1930s, and is thus unable to develop and maintain a full range of capabilities. It does not seem unreasonable, though, to contend that the air defence of the United Kingdom, and of forces deployed overseas, is a capability which cannot be neglected. Being able to offer meaningful air defence as one of a range of meaningful capabilities seems unlikely to bring about a diminution in the influence the UK might enjoy in a coalition construct.

The danger of following the high-impact, headline-grabbing approach of Duncan Sandys and throwing all effort and funding into new technologies while begrudging all but the most limited investment in extant – yet still vital – capabilities is all too obvious. While they were less spectacular in their popular impact as Sandys, those who chose to invent a future for Britain's air defences perhaps offer the better example for those contemplating air defence, and indeed defence generally today. Their efforts to blend cutting edge technology with extant capabilities, balancing revolutionary ideas with evolutionary capability development provided the means for the United Kingdom to defend itself effectively during the Second World War. Although that war concluded 75 years ago this year, the example of inventing a future to allow proactive responses to enormous and varied challenges, rather than remaining reactive and constrained remains as relevant today as it did then.

Endnotes

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4 Putin was first elected President in March 2000. Four Presidential terms and one term as Prime Minister have given Russian policy a level of continuity not seen since the height of the Cold War and the days of Leonid Brezhnev.
5 Denis Gabor, *Inventing the Future* (London: Secker & Warburg, 1963) and *InfoWorld*, 4:16, p. 6, reporting the remarks of the computer scientist Alan Kay. Multiple iterations of Kay's can be found online.
6 S. W. Roskill, *Documents Relating to the Naval Air Service: 1908–1918 Volume I* (London: Navy Records Society, 1969), p. vii.
7 All German airships became known by the popular name 'Zeppelin', although the German Army made use of airships made by the Schütte-Lanz concern.
8 *The London Gazette*, 11 June 1915, p. 5635.
9 Leefe Robinson, like Warneford, was awarded a Victoria Cross. The subsequent victories against airships saw the pilots involved awarded the Distinguished Service Order, perhaps recognising that while the challenge and danger of attacking airships remained, it was not as great as it had been only a matter of weeks previously.
10 Sir Percy Scott, 'As a British Admiral Saw It', *The North American Review*, 210:7, pp. 63-68.
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13 John Ferris, 'Fighter Defence Before Fighter Command: The Rise of Strategic Air Defence in Great Britain, 1917-1934', *Journal of Military History,* 63:4, p. 853.
14 Christopher Cole and E. F. Cheesman, *The Air Defence of Great Britain 1914-1918* (Oxford: Bodley Head, 1984), *passim*. Cole and Cheesman describe the multitude of different aircraft types employed in great detail.
15 idem, pp. 420-421.
16 Ferris, 'Fighter Defence Before Fighter Command', p. 854.
17 See, *inter alia*, Tami Davis Biddle, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas about Strategic Bombing, 1914-1945* (Princeton: Princeton University Press, 2009), pp. 69-127; Phillip S. Meilinger, 'Trenchard and Morale Bombing: The Evolution of Royal Air Force Doctrine Before World War Two', *Journal of Military History*, 60:2, pp. 243-270.
18 Richard D. Newton, *The RAF and Tribal Control* (University of Kansas Press, 2019); David Omissi, *Air Power and Colonial Control* (Manchester: MUP, 1990).
19 See, for example, Trenchard Papers, RAF Museum, MFC 73, 'Future Policy in the Air', 22 September 1916.
20 See Andrew McDonald, 'The Geddes Committee and the Formulation of Public Expenditure Policy, 1921-1922', *The Historical Journal*, 32:3, pp. 643-694.
21 See John Ferris, 'Treasury Control, the Ten-Year Rule and British Service Politics, 1919-1924', *The Historical Journal*, 30:4, pp. 859-883, and '"The Greatest Power on Earth": Great Britain in the 1920s' *International History Review*, 13:4, pp. 726-750.
22 David Zimmerman, 'Information and the Air Defence Revolution 1917-1940', *Journal of Strategic Studies*, 27:2, pp. 373-374.
23 Ashmore, *Air Defence*, p. 131.
24 See John Ferris, *The Evolution of British Strategic Policy 1919-1926* (London: Palgrave, 1988) for a full examination of this issue; Neil Young, 'British Home Air Defence Planning in the 1920s', *Journal of Strategic Studies*, 11:4, p. 492; N. C. Fleming, 'Cabinet Government, British Imperial Security and the World Disarmament Conference, 1932-1934', *War in History*, Vol 18:1, p. 72.
25 John Ferris, 'Achieving Air Ascendancy: Challenge and Response in British Strategic Air Defence, 1915-40', in Sebastian Cox and Peter Gray (eds), *Air Power History: Turning Points from Kitty Hawk to Kosovo* (London: Frank Cass, 2002), p. 34. See also John Ferris, 'Fighter Defence before Fighter Command: the Rise of Strategic Air Defence in Britain 1917-1934', *Journal of Military History*, 63:4, pp. 845-84.
26 Jefford, *Op Cit,* p. 36. Rather bizarrely, after its disbandment in January, 203 Squadron was reformed on the same aircraft it had given up, the Sopwith Camel. Although it had a secondary role of air defence, its prime duty was to cooperate with the Royal Navy; idem, p. 70; John D. R. Rawlings, *Fighter Squadrons of the RAF and their Aircraft* (London: TBS, 1969), p. 149.
27 See, *inter alia,* Brett Holman, 'The Next War in the Air: Civilian Fears of Strategic Bombardment in Britain 1908-1941' (University of Melbourne, unpublished PhD thesis, 2009), p. 232; *Daily Mail*, 22 June 1922; Brigadier-General P. R. C. Groves, 'Our Future in the Air', *The Times*, 22 March 1922, cited in Holman, *Op Cit,* p. 56, also *Our Future in the Air: A Survey of the Vital Question of British Air Power* (London: Hutchinson, 1922). Groves had retired from the RAF as an Air Commodore in 1922 but wrote using his pre-RAF rank.
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29 Young, 'British Home Air Defence Planning', p. 494.
30 Neville Jones, *The Beginnings of Strategic Air Power: A History of the British Bomber Force, 1923-1939* (Abingdon: Frank Cass, 1987), pp. 27-32.
31 *Parliamentary Debates (Hansard)*, House of Lords Debates 26 June 1923, Vol. 54, Columns 570-572.
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40 Bob Clarke, *Britain's Cold War* (Stroud: History Press, 2009), p. 79. The squadrons based in Germany formed part of the occupation force, but it was assumed that they would be forced to leave their bases in the face of a Soviet invasion.
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42 Young, *American Bomb*, p. 157.
43 Matin Zuberi, 'Stalin and the Bomb', *Strategic Analysis,* 23:7, pp. 1146-1148.
44 Geoffrey Warner, 'Anglo-American Relations and the Cold War in 1950', *Diplomacy and Statecraft*, 22:1, p. 47.
45 Clarke, *Britain's Cold War*, pp. 80-81.

46 Till Geiger, *Britain and the Economic Problem of the Cold War: The Political Economy and the Economic Impact of the British Defence Effort, 1945-1955* (Aldershot: Ashgate, 2004), p. 166; pp. 237-272.

47 Duncan Curtis, *The Canadair Sabre in RAF Service* (Stroud: Sutton Publishing, 2005), pp. 6-17.

48 TNA, Air 41/86, 'The RAF in the Postwar Years: Defence Policy and the Royal Air Force, 1956-63', p. 63.

49 The F-86D was a very different aircraft to the version the RAF did operate and from which it was derived; it was sufficiently different to be given the designation of F-95 by the USAF, but upon the realisation that it would be easier to persuade Congress to fund a development of the successful F-86 rather than what appeared to be a brand new aircraft, the designation was changed. The RAF was also mildly sceptical about the efficacy of the F-86D's all-rocket armament as an effective air-to-air weapon.

50 See Kenneth Kyle, *Suez* (London: Weidenfeld & Nicolson, 1991); D. R. Thorpe, *Eden: The Life and Times of Anthony Eden, First Earl of Avon, 1897-1977* (London: Pimlico, 2004).

51 Simon J. Ball, 'Macmillan and British Defence Policy', in Richard Aldous & Sabine Lee (eds), *Harold Macmillan and Britain's World Role* (Basingstoke: Palgrave, 1996), pp. 68-69.

52 Martin Navias, 'Vested Interests and Vanished Dreams: Duncan Sandys, the Chiefs of Staff and the 1957 White Paper', in Paul Smith (ed), *Government and the Armed Forces in Britain 1856-1990* (London: Hambledon Press, 1996), pp. 217-218.

53 Sandys' performance in this role was not without controversy – see RV Jones, *Most Secret War* (np: Fonthill, 2009), p. 335 and Adrian Fort, *Prof: The Life and Times of Frederick Lindemann* (London: Jonathan Cape, 2003), pp. 287-288.

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57 John Boyes, *Thor Ballistic Missile: The United States and the United Kingdom in Partnership* (np: Fonthill, 2015) and the same author's *Project Emily: Thor IRBM and the RAF* (Stroud: The History Press, 2008) and *Blue Streak: Britain's Medium Range Ballistic Missile* (np: Fonthill, 2019).

58 *Hansard,* 13 February 1957, Vol. 564 Column 1315.

59 TNA, Air 41/86, 'Defence Policy', p. 134.

60 SAGW are better known today as Surface to Air Missiles (SAM), but the terminology employed in the contemporary files is employed here to avoid possible confusion.

61 The Thor had been obtained from the United States under a dual-key arrangement. See Boyes, *Thor Ballistic Missile*.

62 TNA, Air 41/86, 'Defence Policy', p. 135.

63 Ibid.

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65 Graham Spinardi, 'Golf Balls on the Moor: Building the Fylingdales Ballistic Missile Early Warning System', *Contemporary British History*, 21.1, p. 89.

66 TNA, Air 8/2478, 'Air Defence: Note by the Air Ministry', 29 September 1959.

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69 Ibid.

70 The Royal Navy's Phantom headquarters unit could also be added to a wartime order of battle, although the front line RN Phantom squadron was assumed to be aboard HMS *Ark Royal* and unavailable.

71 The two Lightning squadrons were re-equipped with Phantoms in 1976-77.

72 TNA, PREM 16/1563, Prime Minister to Mr Vile (Cabinet Office), 2 November 1977.

73 TNA, PREM 16/1563, Mulley to Prime Minister, 16 January 1978.

74 TNA, PREM 16/1563, Mulley to Prime Minister, 23 March 1978.

75 Ibid. The Nimrod AEW3 turned into possibly the largest procurement disaster in the RAF's history and never entered service, while the Tornado air defence variant (the Tornado F2 and F3) entered service two years later than planned. The RAF had never wanted the Nimrod AEW3, and eventually ended up with the Boeing E-3D Sentry some 15 years after making clear that this was the aircraft it required. A desire to buy a British aircraft had led to the selection of the Nimrod AEW3, over-riding all other concerns.

76 TNA, PREM 16/1563, Owen to Prime Minister, 27 July 1978; Sir John Hunt (Cabinet Secretary) to Prime Minister, 1 August 1978.

77 See Andrew Dorman, Michael Kandiah & Gillian Staerck (eds), Institute of Contemporary British History Witness Seminar: 'The Nott Review' (London: ICBH, 2002).

78 1435 Flight re-equipped with Tornado F3s in 1992, and with the Typhoon in 2009.

79 Robert Service, *The End of the Cold War 1985-1991* (London: Pan, 2016); David Armstrong & Erik Goldstein (eds), *The End of the Cold War* (London: Frank Cass, 1990). Historians dispute the exact end date of the Cold War, although the symbolism of the reuniting of Germany offers a reasonable demarcation point.

80 *Statement on the Defence Estimates, 1991: Britain's Defence for the 1990s* Cmnd 1559 (London: HMSO, 1991).

81 *Hansard*, 2 May 1991, Vol. 190 Column 455. The term 'SAGW' had fallen from favour some years previously. The Bloodhound squadron in RAF Germany was withdrawn to the UK in 1983, disbanding in 1989. The squadron was replaced by a new Tornado F3 squadron which bore the same 'numberplate' (25 Squadron) as the former missile unit.

82 David Jordan, 'Air Power and Intervention: The Royal Air Force Experience in The Former Yugoslavia, 1992-95' and Luke Botting, 'Air Power in and Age of Armed Humanitarian Intervention', *RAF Air Power Review*, 21:3, pp. 40-59 and pp. 14-39.

83 The E-3s entered service with Number 8 Squadron in 1991. Between 1996 and 2009, the fleet was shared between Numbers 8 and 23 Squadrons, before reverting to a single-squadron force. Although the number of squadrons increased, overall force size did not.

84 *Strategic Defence Review* (Cmnd. 3999), Paragraph 38. The deleterious effect this might have on training new Tornado crews was glossed over.

85 *Hansard,* 6 June 1997, Vol. 296 Column 5.

86 James Bosbotinis, 'Russian Long Range Aviation and Conventional Strike' https://www.defenceiq.com/air-forces-military-aircraft/articles/russian-long-range-aviation-and-conventional-strat (accessed 15 May 2020); Keith Crane, Olga Oliker & Brian Nichiporuk, *Trends in Russia's Armed Forces: An Overview of Budgets and Capabilities* (Santa Monica: RAND, 2019), pp. 35-36.

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