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The place of air power doctrine in post-war British defence planning, and its influence on the genesis and development of the theory of nuclear deterrence, 1945-1952.

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**THE PLACE OF AIR POWER DOCTRINE IN POST-WAR BRITISH DEFENCE PLANNING, AND
ITS INFLUENCE ON THE GENESIS AND DEVELOPMENT OF THE THEORY OF NUCLEAR
DETERRENCE, 1945-1952**

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PhD Thesis 1985

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ABSTRACT

This thesis is about the origins of nuclear deterrence. It argues that British air power doctrine as it developed between 1945 and 1952 was crucial to the formulation of western strategic thought about nuclear weapons, playing a role of far greater significance than is recognized in the established literature. The numerous available studies of the evolution of nuclear strategy and its political context take as their premise that deterrence depends on the capability to destroy the opponents' cities. The essential mechanism of deterrence thus involves reliance on the military offensive. It is widely accepted that this requirement to destroy cities arises from the innate, non-historical logic of nuclear weapons. But one of the main conclusions which emerges from the analysis in this thesis is that the primacy of the offensive was already a historical reality before nuclear weapons were first used, at Hiroshima. Furthermore, British military thinking had increasingly emphasized the devastation of cities long before it was realistically possible to claim that there was no defence against the missile. However clearly individuals such as Bernard Brodie and P.M.S. Blackett may have seen the implications of the missile age in the 1940s, the development of such ideas in fact was bound up with the largely pragmatic reality of the RAF's struggle to come to terms with post-war circumstances.

The argument in the thesis has three parts. (1) The essential tenets of British air power doctrine, as it developed 1939-1952, are examined, illustrating their interaction with British strategy as a whole and with the composition of the British armed forces. (2) The history of the air war in Europe is analysed to show how certain principles were applied in combat, and emerged as the key ideas of deterrent air power. (3) Examination of the post-war scientific effort, British demobilization, the Air Staff's management of its priorities, and the British international situation after 1945, shows the historical context within which the basis of nuclear deterrence theory evolved.

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Chapter 1

INTRODUCTION

1. The subject.

This thesis is about the progress of a strategic idea and the development of a military theory. The idea concerns the employment of air power and the theory is that of nuclear deterrence. After nearly a century of manned flight, and in a climate where military air power is universally regarded as the dominant factor in war, it is easy to overlook what a hostile environment existed for British air power advocates during the early years of the Air Force, and how desperate was their struggle to oblige others to take air power seriously. The terms 'air minded' and 'air enthusiast' come from an age when the future of air forces was in flux, and most commanders regarded air power as an adjunct to sea or land power.

What made an officer air minded was his belief that air power had an independent role to play in future wars, and that air power (as a third factor) could intervene decisively in a military situation rather than simply enhancing the traditional operations of fleets and armies. These were subversive attitudes, and they were fiercely resisted. The outcome of the dispute was shaped by the types of argument on which the Royal Air Force (RAF) based its case. The early history of the RAF was dominated by two themes: the desire for an independent air force; and the primacy of the bomber and the strategic bombing offensive. Thus, in the period roughly 1920 - summer 1942, the RAF fought and won a defensive battle, first for survival as a force, and then for the survival of its cardinal doctrines. These two struggles were inextricably linked.

In 1921 the War Office launched a campaign for the abolition of the RAF and the Air Ministry, proposing that air requirements be met independently by the two older services. The navy supported the War Office in this attack, but the Admiralty's real intention was to secure the return of the Fleet Air Arm to Admiralty control. After a protracted struggle, this was achieved in the later 1930s. This defeat for the RAF influenced the post-1945 relations between the RAF and Admiralty, at the time it was the theoretical concept of the 'unity of the air' that was forfeited. In reality this concept owed its existence to the claims made by the Air Staff for an independent air force - hence what was in

practice surrendered was the RAF's claim to control all air activity. Thereafter, the airman's case was necessarily based on the argument for an independent strategic bombing capability that only an 'air minded' service could conduct. For if the Admiralty was to control the air over the sea, it could be said that the air defence of Great Britain could be just as well performed by an Army flying service. Once the notion of the 'unity of the air' was negated the existence of independent air power came to depend on its having a special role - hence the supreme importance of the bomber. There is, of course, nothing inherently correct in this approach to air power, but it became the heart of an air power orthodoxy which its advocates would not surrender. ✓

Gradually during the Second World War, the defensive struggle for survival became an offensive struggle of vindication. By the end of the war British air power theory had become a dominant one. The numerous air enthusiasts became the theorists and practitioners of a now established form of war. They were able to elaborate an orthodoxy into a fully developed doctrine, giving it a standing on a par with other established military tenets.

This is a vital point to understand. No longer would one talk of 'an air minded general', but of whole staffs of air power theorists, working within the senior military councils of the land. After 1945, the Air Staff did not have to guard its back against the intrigues of the other two services¹, but had only to fight the common battle against the Treasury and the other powerful peacetime ministries. No war was expected for at least five years. The Air Staff could elaborate its approach to air power and build up the next front line with a degree of security previously unknown to it. Furthermore, although it was likely that the British atom bomb could not be ready before the turn of the

1. The RAF's struggle for survival and influence against the Army and Navy in the years 1919 to 1936 is a fascinating subject. The bitterness occasioned by the claims of the new service, and the extent of campaigning to secure its disbandment, seem almost incredible. In the face of such assaults, some of the claims for air power made by the advocates become understandable even if they remain outrageous. Little wonder also, that bomber theorists seized on incidents such as the bombing of Guernica to support their case. The inter-war struggle is well covered in such works as: Uri Bialer, The Shadow of the Bomber; Sir Maurice Dean, The Royal Air Force and Two World Wars; Sir Robert Saundby, Air Bombardment - The Story of its Development; Malcolm Smith, British Air Strategy Between the Wars; Geoffrey Till, Air Power and the Royal Navy.

decade, it was this weapon which seemed to confirm the dominance of air power. Air matters were now popular, the RAF had had a very successful exposure to public attention, and air warfare technology was recognised as the key to future military preparedness. The air chiefs collaborated in the adjustment of British strategy and shaped policy in accordance with their own precepts of modern warfare.

This post-war planning process and its consequences form the essential milieu for the evolution of modern strategic thinking. I will argue that the British understanding and development of air power in the period 1945-1952 is a uniquely important source for an examination of the origins of nuclear deterrence. It was the British marshals who first faced the difficult task of planning a practical nuclear deterrent force. Three factors are crucial. First, British air power theory was, at that time, the most refined and influential of any nation's. It had been the most successful in taking unto itself an all embracing strategic role. Second, the British approach to air power emphasized the pre-eminent role of the independent bomber formation, and thus corresponded well to a strategic nuclear role. Third, because the British had been in practice the first of the great powers to be confronted by the dilemma of future defence against air attack, the central relationship between strategic defence and strategic offence was present in their thinking and practical planning from the start.

The new basis for grand strategy and military operations that was a product of this British experience had been consolidated by 1952 into a developed theory of strategic warfare. This historical relationship between air power and nuclear weapons has been recognized by other writers¹. What I wish to undertake is an analysis to show that, after the invention of nuclear weapons, the key feature of nuclear deterrence theory lay in the relationship between its defensive and offensive objectives. The origins of the strategy are to be found in the conjunction of the search for a defence against a form of attack which seemed almost invincible (because of its enormous scope for destruction),

1. For example: "Without the atom bomb the theorists of air power would have been pushed onto the defensive, hard put to justify the pounding of cities for limited rewards. With the atom bomb, air power could be said to have come of age." Lawrence Freedman, The Evolution of Nuclear Strategy, page 22. A J Pierre, Nuclear Politics and R E Walters, The Nuclear Trap, furnish equally good examples.

and the (supposedly) 'natural' assumption of the vast potential of offensive air power.

I have not tried to undertake a re-evaluation of the overall course of British strategic policy after the Second World War, although I suspect that a case could be made to show that many of the principal leaders were mistaken, misguided or simply foolish in their approaches. I am obviously not in a position to blame or accuse. Nor will I attempt to answer the momentous questions humanity faces as a result of nuclear weapons, and I have not sought prescriptions for the future course of policy. However, nuclear deterrence is a subject that invites polemic, and can easily be treated in a non-academic way. I appreciate the sentiment that it is too large a subject to be handled dispassionately. Yet I have been careful to keep my subjective anxieties about nuclear deterrence off these pages. I have not sought to write a history of deterrence, nor of strategic bombing; this is a thesis in which I make the analysis of concepts the primary undertaking, and the logical and prudential quality of the arguments which went into the making of nuclear strategy, the main question to be examined.

2. A revolution in warfare?

The force of my argument depends on the view that nuclear deterrence theory emerged from existing military thinking and established approaches to strategic problems. It is thus vital to tackle at once a judgement which holds that nuclear weapons and strategic bombing, separately and in conjunction with one another, initiated a revolution in warfare. There are two lines of refutation of this judgement. (A)¹ The appreciation of the enormous destructive power of nuclear weapons. It was well understood that a profoundly important military capability had been discovered. At the most extreme, this can be categorised as a quantitative revolution in the military ability to devastate large urban areas. This much was clear after Hiroshima and Nagasaki. However, during the formative years of the theory of nuclear deterrence there was

1. For (B) see page 12.

also some suggestion of the possibility of a qualitative revolution - that is to say, whether a transcending leap had in fact occurred which negated much or all of past theory. For example, there was, amongst contemporary opinion, a wave of revulsion, shock; expressions of a belief that such weapons were too powerful to be used and that, in some generalised sense, war had therefore outlawed itself.¹ These reactions led to proposals for international control of the atom, a ban on weapons development and the need for radical approaches to international disputes. This type of reaction tended to contain a cataclysmic attitude, and it is easy to infer that a period of confusion and deep uncertainty pervaded the minds of military planners. Following this line of argument it is possible to conclude that the genesis of nuclear deterrence lay in an automatic, unreflexive response to a period of hesitancy and chaos in military strategy. In short, that there was a period of groping, in an atmosphere of fear and distaste towards some 'logical use' for an unwanted but 'available' weapon. This approach gives rise to the idea that nuclear deterrence was the product of an 'intellectual leap' - the inspired and radical answer to a revolutionary and horrible intrusion upon traditional strategy. It is an idea that I hold to be incorrect.

It has also been refuted by most of the principal military men in their accounts of events. In their view the military bureaucracy was able to cope, intellectually and in terms of policy, with the advent of the new weapon. For example, Air Commodore Cozins and Air Chief Marshal Earle both told me² that the Air Staff quickly appreciated the practical military value to the RAF of nuclear weapons. In a very short space of time policy took account of the potential and implications of use, and plans were laid accordingly. Cozins maintains, I believe correctly, that the special implications of a strategy of nuclear deterrence emerged more gradually, largely consequent upon the operational planning that occurred. His view, which seems viable, is that nuclear deterrence flowed from the Chiefs of Staff asking themselves whether Britain would,

1. See for example: Admiral Dickens in the preface to his book Bombing and Strategy, the Fallacy of Total War; Bertrand Russell in his speech in the House of Lords, September 1945; and Stephen King-Hall in his National Newsletter, number 475 of 16 August 1945.

2. Conversations between Air Commodore Cozins and Mark Venables, 1st August 1984; and Air Chief Marshal Sir Alfred Earle and Mark Venables, 30th July 1984.

in fact, ever be first to launch a strategic attack with nuclear weapons. In which case, the crucial strategic quandary for Britain remained very similar to that posed by the strategic bombing situation of 1939. ✓

The record is thus one of a rational response to urgent new circumstances in which decisions were needed which would exert an influence over a span of 15 years. The type of evidence I shall cite for this interpretation hinges, for example, not simply on the decision to produce nuclear weapons, but on the coherent and viable operational requirements and specifications set down for the first British free fall atomic bomb and the bombers to carry them. The operational requirements were laid down in August 1946. It seems that the Air Force officers and the scientists involved did indeed make a steady appraisal of the situation and reached at least a reasoned conclusion as to the options they faced. Any later tendency to assume otherwise perhaps derives partially from the prominence subsequently given to the views of dissident scientists such as P.M.S. Blackett and Sir Henry Tizard¹.

I will argue that this second interpretation of the climate of higher military policy-making in the two or three years immediately after the war is, broadly speaking, a more accurate one. There are notable examples of technological muddling (such as over supersonic air frames and the requirements for supersonic flight, and a willingness to neglect rocket research) but these should not be allowed to mask the fact of a dedication of purpose. The case for positing a cold blooded approach to the military value of nuclear weapons after Hiroshima and Nagasaki is further strengthened by two facts. (1) Those who were then in charge of grand strategy were not only accustomed to dealing in massive destruction, it was central to their experience. They had presided over the devastation of Germany, and the point is well made that the two atomic bombs were comparable in effect to the raids on Hamburg and Dresden. The fundamental achievement of atomic bombs seemed, in reality,

1. Expressed in such instances as: Atomic Energy: An Immediate Policy for Great Britain, memorandum by P.M.S. Blackett, for the Chiefs of Staff Committee - COS(45)0(651), 10th November 1945 (PRO-CAB 80/98); reproduced in Margaret Gowing, Independence and Deterrence Volume I, pp 194-206. P.M.S Blackett, Military and Political Consequences of Atomic Energy. Sir Henry Tizard, Memorandum (undated) and memorandum, 4th November 1949, discussed at Chiefs of Staff Committee, COS(49) 159th and 188th meetings. Referred to in Margaret Gowing, Independence and Deterrence Volume I, pp 229-231.

to be 'nothing more' than a new level of concentration of force and economy of force - two of the central tenets not only of air power doctrine but also classical military doctrine. (2) Hydrogen bombs were not exploded until 1952, and it is they which represent the truly enormous accretion of explosive force in contemporary arsenals. In comparison, the atom bomb was a manageable weapon. After all, the larger global and environmental consequences of nuclear warfare were not at all appreciated. Radiation and radio-active fallout, with their lasting genetic implications, let alone the risks of 'nuclear winter' and of atmospheric ionisation, were not factors available to give pause to the military planners.

(B) This relates to the place of air power in military strategy. The revolutionary character of air power has been claimed almost from its first military application. The claims of the British advocates such as Trenchard, Portal, Harris and Slessor, rested on a specific employment of air power. Briefly, they argued for (i) the independence of air power - that is, its unique ability to by-pass all other forms of military power; (ii) the uniquely offensive nature of air power based on strategic bombing; and (iii) the decisive character of the air offensive, in the sense that the destruction of the economic and home base of a war effort is effectively limitless and that defence is futile.

The arguments for and against these claims, and in favour of alternative approaches to the use of air power, have been put in many ways, but the essential question is whether air power represents a new form of warfare (and is thus an independent factor), or whether it obeys established military tenets and is thus a novel extension of military practice.

Whether air power is a revolutionary development is a question fundamental to this thesis. My conclusion is that it is not. I suggest that its offensive primacy is an illusion. The character of air warfare is not different from the essentials of land and sea warfare, and air defence is not only viable, but is also quite capable of triumphing over the offensive, however powerfully mounted. I will also argue that the emphasis placed on gaining victory by the destruction of the enemy homeland is misplaced.

Such arguments inevitably raise the question of whether air power, in its modern manifestation of long-range nuclear rockets, is still subject to the traditional limitations of strategy? Obviously, a case can be made, based on modern rockets with nuclear warheads, to show that the revolutionary claims of the British theorists have now been vindicated, and that they were merely expressing ideas in advance of technical capability. In the first place, such a case misses the point that they were bound by, and formed their conclusions from within, the intellectual and material conditions of their time. They were committed to the offensive primacy of the bomber and approached the problem of the defence of Britain from that perspective in circumstances where, it seems to me, defence was a viable option had sufficient effort been put into it. But, in spite of the evidence, they chose the bomber option in the belief that therein lay security, and out of that choice emerged the nuclear deterrent concept of defence through offensive readiness¹.

In the second place, the choice of the offensive bomber option was made without regard for the potential of the long-range rocket, and thus the British commanders were not sufficiently sensitive to the limitations of the strategic bomber. By this I do not wish to suggest that they should have opted at once for a rocket force - but rather that it was the concept of the offensive which dominated their thinking about British security even though the potential of the rocket made the offensive approach to British security markedly less viable.

1. A good example of the line of thought to which I refer is to be found in the following comments by Marshal of the RAF Sir Arthur Tedder. "I am getting a bit nervous about this guarding the shop business. I entirely agree how essential it is to guard the shop but I am not at all sure whether we are not confusing that very sound and necessary object with the methods. The idea that Bomber Command's operations were a diversion from guarding the shop I personally do not accept at all. I suggest that Bomber Command's operations were in fact the most effective guarding the shop that was possible, by land, sea or air, because there was no question about it that they put the Hun back (though I hate to use these phrases, offensive and defensive) on the defensive and he completely lost the initiative and that guarded the shop and I think that this is a thing we want to be very careful about in the future; because in the past I know only too well in the early days of the war there was a lot people who had not thought about it very deeply and thought all we needed was fighters to guard the shop. Well, under modern conditions we know that that would be utterly unsound. In the future I think it might be suicide." From the third day's transcript of discussions during 'Exercise Thunderbolt', 11th-16th August 1947, "[inaugurating] an annual series of higher RAF study periods intended to give us the necessary firm basis for subsequent advances in regard to the principles of air offensive". Chief of the Air Staff papers, PRO - AIR 8/1536.

I do not know whether Anti-ballistic Missile Defence can work - there is a vast amount of contemporary material on that subject which I cannot incorporate into this thesis. It is not my wish to argue a technical case for air defence in the contemporary environment where the orthodoxy of the offense is so pervasive and has so conditioned military thinking and planning. What I do wish to argue is the contention that a military analysis of air power should not be overwhelmed by the ideology of offense - which has come to assume the status of an idealism¹.

Otherwise, the ability of modern strategic analysis to deal rationally with the military products of science and technology will be sharply constrained. If the view is taken that the revolutionary claims of independent air power and the revolutionary perspective given to nuclear weapons were in fact quantitative leaps in a process developing from the early years of the 19th century, then a much clearer understanding becomes available, in a dynamic sense, of why the doctrine of nuclear deterrence was evolved, what are the bases of its contractions, and what is the nature of the hold it exercises on modern strategy. To begin to understand the mistaken basis of that orthodoxy we must first appreciate its idealist quality, and secondly, analyse the quantitative revolution as part of a much longer process, both material and of ideas.

Thus the position taken, between 1945 and 1952, on the question of air offense and defence, and on the military value of urban destruction, is crucial for the entire direction of contemporary military strategy because of the negation of defence, in the traditional sense, that resulted. It is fruitless to assert that had the British devoted their efforts to air defence, other nations would have followed suit, or that the seemingly insurmountable potential of rocket offense would have been countered. But it is equally fruitless to point to the present primacy of the offense in order to show that there was no alternative outcome - to do so is to justify the intellectual origins of a strategy by the outcome which they produced. The genesis of modern strategy lies in the theory and practice of the bomber offensive over Germany, and in trends that had been developing for a century before that. By examining that genesis one is better able to understand the low status of defence today.

1. By the use of the term idealism here I mean that repeated accretions in the destructive capability of the military machine are thought of as laudable, necessary and (in a world of competing states) inevitable; and it is held that they provide a sure route to victory in war.

3. The stages of the analysis

The overall stages by which the argument will proceed are as follows:

(1) The important features of the air power controversy will be identified, along with the practical implications for the RAF during the 1930s and the early war years. I will argue that the strategic bombing offensive over Germany during the war was crucial to the intellectual strength of bomber based air power theory after the war. The outlines of that campaign will be drawn, and the aspects of greatest importance to the bomber theorists will be examined in some detail. The purpose of this stage is thus to describe the background, growth and eventual pre-eminence of a military doctrine. The initial treatment is substantially descriptive, although the attempt to draw 'lessons' from the campaign itself is obviously more analytical.

(2) The second stage of the argument will be to examine the post-war influence of the bomber theorists and their doctrine within the British military establishment. The influence covers such aspects as strategic formulation, the allocation of resources and the shape and size of the military forces, the direction of scientific effort, and the response to post-war demobilization and the start of the Cold War. The existence of a bomber-based air power theory and a group of influential advocates of the bomber in the RAF is implicit in this thesis. Inferential and circumstantial support for this is abundant and my argument constantly draws upon it. In fact the influence of the bomber is so pervasive as to suggest the notion of a 'bomber school', not in the sense of a formal association or circle, but in the shape of a profound consensus that informed the thinking of airmen.

"I think it fair to say that all mature pre-war regular Officers, whether they were dedicated fighter pilots like Kenneth Cross or specialists in Army Co-Op like myself, believed that Air Power would be the dominant factor in the coming war and the Bomber would be the primary instrument. In other words we all belonged to a 'bomber school' without making a thing about it."

Because the notion enjoys such currency, it would seem not unreasonable to regard it as a granted fact. There can be little doubt that the

1. Letter from Air Vice-Marshal Sir Lawrence Sinclair to Mark Venables, 11th July 1984.

'bomber school' was the source of an ideology and the focus of a post-war doctrine that was not merely articulate, but which dominated Air Staff thinking and materially informed policy and activity. Yet I do not mean to imply that there was an active conspiracy or that a small group of powerful officers had conducted a coup and ruled the Air Ministry in the manner of a dictatorship. What I do perceive is a dominant idea that enjoyed a forceful advocacy by a significant group of officers and a sufficiently powerful currency as to be at least passively accepted by the majority of the others. I can find no evidence for an active corps of opposition or dissent. In fact, although it is not a straightforward matter to construct a list of passionate bomber advocates, it appears quite impossible to identify more than one or two open dissidents. Even officers who were by experience or inclination fighter or tactical commanders appear not to have resisted the primacy of the bomber. The impression is one of the existence of an unquestionable dogma under the influence of which all other forms of activity occurred.

Thus I believe one cannot write accurately of a conflict in the Air Staff approach to air power. Nothing existed akin to the division in the late 19th century War Office between the Africans and the Indians, each side having its powerful supporters and commanding generals as champion figures. The endurance of Trenchard's influence, the importance of the political arguments for independent air power in the formation of early doctrine and the prestige of the strategic bombing campaign all undoubtedly served to create a profound consensus within the Air Staff.

However, there is some evidence in addition to the demonstrable power of the strategic bomber orthodoxy that this thesis examines, for the existence of a bomber school. Partially, it can be drawn from an examination of the structure and decision making paths of the Air Staff (and, to a degree, of the Ministry of Supply). My reason for elaborating these structures is not only to show how the bureaucratic process operated in reaching strategic policy and procurement decisions, but also to map out the framework within which the bomber school operated. A branch of political science¹ holds that bureaucratic structure can influence, perhaps determine, certainly elucidate, policy. In examining the structure of the Air Staff, and tracing the careers and positions of

1. See Karl W. Deutsch, The Nerves of Government.

the senior officers, I do not believe that one can conclusively determine a dominant structural influence. But it is evident that a small group of influential leaders in the most senior positions guaranteed the continuing power of the bomber orthodoxy.

There is also a certain amount of documentary evidence. For example, Air Vice-Marshal Embry made the following comment after the war -

"With the exception of the skipper, the Bomber Command has a full wartime 15 here today, and all the minor bomber barons are here too. But, in spite of being outweighed and outranked I am encouraged to get on my feet because the late AOC of 5 Group is almost off-side and is playing for me."

However thorough the search for evidence of an ideological school amongst men not widely given to extensive written theorising (in comparison to the search for evidence about technical requirements for new aircraft or the rationale for a certain research decision) it would seem that substantiation of the 'bomber school' claim will inevitably rest partially on a 'sense' of the period and the assertion of a common intellectual approach built up from anecdotal and circumstantial scraps.

An interesting parallel lies in the 'battleship school' of sea warfare which was supposed to be founded upon the influence of the naval gunners.

"To a certain extent the institutional weakness of the FAA was a natural reflection of the relative novelty of the technology that took air power to sea. Military bureaucracies tend to be conservative, as they reflect the status of established groups whose pre-eminence is based on the proven effectiveness of existing weaponry. The dominating power and prestige of the heavy-gun capital ship made the gunnery interest the strongest in the Navy of the time, and this is often held to be one of the main impediments to the growth of naval air power. "In 1938", one commentator notes, "most of the senior officers in the Navy were specialists in gunnery and didn't like aeroplanes. In their opinion aeroplanes were fit to tow targets for their ack-ack guns, and nothing more." The gunnery interest, it is said, dominated the Navy's institutions and was therefore able to deprive naval aviation of the funds needed if it was to realise its full potential and ultimately take over as the decisive weapon of the Fleet. Precisely the same situation applied well into the 1930s in the US Navy, in which ".... the clique centring around the Bureau of Ordnance known as the 'Gun Club' maintained practically a monopoly of the top posts, both in the Navy Department and at sea, to the exclusion of others including naval aviators. Using their

1. From the second day's transcript of discussions during 'Exercise Thunderbolt', 11-16 August 1947. Chief of the Air Staff papers, PRO - AIR 8/1536.

institutional strength, battleship admirals were thus able to protect their established interests against the challenges of the new technology.

Although there is plainly much to be said for this view, there is still a danger of overstating the case."¹

(3) Following the discussion of the genesis and essential tenets of nuclear deterrence, I will set out a speculative exploration of modern grand strategy and the course it took as a result of the dominance of an air power doctrine. The commonplace that the destructive nature of nuclear weapons makes their military employment unthinkably counter-productive actually obscures the rather more obvious fact that a large majority of strategists implicitly assume (almost as an article of faith) that were it not for the crudest balance of terror these weapons would be readily used. Furthermore, there is an assumption that nuclear deterrence contains a vital dynamic that other forms of deterrence do not. It would appear that contemporary strategists believe that if the 'balance' (which I suspect is supposed to be at the heart of this dynamic) is maintained then the probability of a major war breaking out should be low. There is some recognition (by strategists) that the arms race which supports this 'balance' has taken on its own momentum and is now more important than the cause which it is supposed to serve. But there is apparently little willingness to follow this with a recognition that the notion of a nuclear balance is therefore fatally compromised.

Perhaps the most profound intellectual absurdity that seeks translation into military reality is the modern concentration on the defensive role of nuclear forces. At the origins of the doctrine one of the central features was the relationship between deterrence and defence. The tracing out of this is the most extended theme of this thesis. Trapped between the suicidal course of attacking the enemy cities while his retaliatory forces remain, and attempting the large and uncertain task of destroying those retaliatory forces first (following the outbreak of hostilities), strategists have attempted to categorise 'defensive' and 'offensive' nuclear forces, and then to build strategies which would allow this distinction to hold in a war.

1. Geoffrey Till, Air Power and the Royal Navy 1914-1945. A historical survey, pages 129-130

My treatment of contemporary strategy in this third stage of analysis will not involve a history of the development of the theory since 1945. I simply wish to show the connection between the thought of the 1940s with that of the 70s and 80s, and emphasize the central themes which owe their origin to the post-war theorists.

I have organized the argument in seven chapters. Following this introduction I have devoted the second chapter to a study of the strategic bombing campaign over Germany, including some account of the pre-war preparation for the offensive, and of the perspectives that the RAF brought to that struggle. Because my argument is that the wartime events crucially shaped post-war theory, it is necessary to spend some time on the 1939-1945 period. I have approached the campaign solely with the intention of extracting from it the events and concepts which most influenced bomber doctrine. In no sense is my account a comprehensive history of the air war, nor an attempt to do justice to all facets of RAF or even Bomber Command activities.

Two points must be stressed; (i) the second chapter contains no original research. I have not sought to bring forward new material nor any previously unemployed evidence, but have relied exclusively on secondary sources. My chief one has been the four-volume official history by Sir Charles Webster and Noble Frankland. I am aware that some criticism has been levelled at this work, and although I do not wish to comment on the validity of that criticism, I have been careful to consult other works at all stages.¹

What I have sought to contribute is an original analysis of the campaign, which brings me to the second point. (ii) My treatment of the campaign is not in the manner of a critical history of the period. My critical focus is on the period 1945-1952; for the period 1936-1945 I regard events and decisions as part of a formative process. For example, one could argue that the genesis of nuclear deterrence strategy lies

1. For example: Max Hastings, Bomber Command; Martin Middlebrook, The Nuremburg Raid, The Battle of Hamburg, and The Schweinfurt-Regensburg Mission; R.J. Overy, The Air War 1939-1945; Air Marshal Sir Robert Saundby, Air Bombardment - The Story of its Development; Anthony Verrier, The Bomber Offensive.

fundamentally in the 1941 decision to use Bomber Command as a bludgeon to do the German population to death. This sort of contention would, it seems to me, entirely miss the crucial nexus of science, history and British military thinking in the period summer 1945 to summer 1948 that shaped nuclear deterrence. This does not mean that I regard the formative time of 1936-1945 as a transparent given, entirely without problems and imponderables - certainly not. Part of chapter 3 is devoted to a discussion of these issues. Rather, in chapter 2 my aim is to assess events to the extent that they formed a groundwork for future policy.

In saying that the 'proper' questions inherent in a critical analysis are not central to my treatment of the bombing campaign, it is as well at this point, to devote a little time to outlining what I consider examples of those 'proper' questions to be. These considerations are in any case germane to my later arguments.

Is the attempt to destroy the enemy's industrial structure a coherent policy of war? Is it not rather a futile expenditure of resources, or an irrational act of destruction which equally might or might not achieve the desired outcome? This question may be approached by discussing the relationship between the resources devoted to Bomber Command's offensive and those denied to the German war effort as a consequence of the offensive. For a while after the war there was an acceptance that the balance was in the favour of the British. Sir Charles Webster and Noble Frankland suggest that "on an average, 7% of the manpower effort directly absorbed by the fighting services during the war" was devoted to the strategic campaign. Some historians have suggested different costs while some of the bomber commanders have been distinctly ambivalent in their judgement.¹ Irrefutable success would have been demonstrated by

1. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, vol. 3, page 287.

A J P Taylor (English History 1914-1945) comments as follows on the figure of 7% - "It is difficult to understand what this means. Even on this favourable estimate, British bombing did more damage to Great Britain than to Germany until the autumn of 1944." (ff page 571). His own estimate is that "the damage to German war production was at most 9% and probably less. the demands of bombing on Allied war production were much greater: about 25% in Great Britain and 15% in the United States." (page 571) Geoffrey Till (Air Power and the Royal Navy 1914-1945) writes

complete civil collapse, anarchy or the death of most of the working population. The starvation of the war machine - tanks without bearings, planes without engines and transport without fuel - would have been equally conclusive. The evidence is equivocal. This leads some writers to shift the centre of the case from destruction to diversion of resources, arguing that strategic bombing caused a certain number of men and anti-aircraft guns to be deployed in Germany, using valuable ammunition, all of which could have been used elsewhere. A variation of this argument is to point to the dedication of the Luftwaffe to defensive operations over Germany.

Not only was the German air force less able to deploy offensively at the front line, it was forced to adopt a defensive attitude, supposedly fatal to the correct employment of air power, so runs the argument. This type of 'we draw the enemy onto us' argument has a circularity which entirely vitiates it unless a set of prior strategic intentions can be demonstrated, both for the initiator of the policy and the enemy.

The attempt to prove (in a sense scientifically) that the bombing offensive was efficient use of resources is characteristic of a novel approach to warfare. The Americans conducted a survey in an attempt to quantify the results of their campaign, and Air Marshal Harris regretted that the British did not undertake a similar exercise. P.M.S. Blackett¹ approaches the problem directly from this quantitative point of view. An important reason for attempting this sort of justification for the offensive lies in the fact that other arms and other strategies clearly

(1. continued from page 20) "After May 1940 over half of Britain's war production was devoted to the RAF." (page 201). Max Hastings (Bomber Command) devotes some space to a discussion of the level of resources devoted to Bomber Command, but his conclusions are not very comprehensive - "Churchill made an error of judgement in the winter of 1941-1942 by committing British industry to the enormous heavy bomber programme that came to fruition at the end of 1944. The Prime Minister could have achieved his strategic purpose with a far less extravagant outlay of resources." (page 349) Of the sceptical commanders, Air Marshal Sir Norman Bottomley may be regarded as typical: "You may ask which was the better policy, area bombardment of industrial cities or precise attack of specific targets in special target systems. I think the answer is not yet fully clear. My predecessor in Bomber Command held strong views as to the efficacy of the air bombardment of industrial areas." (Lecture to Army Staff College, no date; Bottomley Papers - AC 71/2/78.) Chapter 5 in R.J. Overly's The Air War 1939-1945 contains a valuable discussion on this issue.

1. P.M.S. Blackett, Military and Political Consequences of Atomic Energy, chapters 1-5.

played some part in achieving victory; without an evaluation, the role of air power could come to be regarded as merely one contributory factor among others.

The fact is that both sides in the war had a wider range of material and strategic options than ever before. In spite of all the opportunities for manoeuvre that contemporary mobility gave to the belligerents, a large part of Britain's war effort was devoted to an attritional struggle. Using the 'drawing the enemy on to us' argument to demonstrate the efficiency of the offensive (rather than the head count method of Joffre and Nivelle), suggests that some theorists were indeed willing to acknowledge that the campaign was an attritional one. However, it is not cogent to argue (a) that the true nature of air power is the offensive, and (b) that the offensive was a success because it forced the enemy to 'waste' military resources defending his home air space. The aim of the offensive was, and had to be, the defeat of the enemy by destroying their industry - the existence of plans such as Operation Rankin and Harris's hopes for the 1943/44 Battle of Berlin suggest that some of the bomber advocates clearly appreciated this fact. Forcing the enemy to become 'defensive minded' is a partial matter, simply the point at which he begins to surrender the offensive initiative over one's own air space. Thus, to promote this stage in the struggle to the status of proof of final victory is a lapse in the argument. It also reveals a genuine uncertainty about the value of air power as a tactical adjunct of the other arms. If air power really is a novel, independent factor in war, then the diversion of enemy air power from ground support (which was its prime use for the Germans) can be of only marginal relevance.

This leads to the questions of whether defensive air power has the potential to succeed, and whether its tactical role in support of other arms can be a crucial influence (or merely a fortuitous one depending on other circumstances - such as a shortage of light flak or suitably protected air bases). A searching analysis of wartime evidence would cover the application of air power to naval support (including naval aviation itself and air cooperation with the convoy system), and in the Far Eastern and Mediterranean theatres. There is extensive writing on the importance, for the allies, of their air superiority over France at the time of the D-day landings, and on how it was tactically employed. The destruction of the French railway system is well documented and the benefits recognized; but there remains no agreement on the absolute

value of this course as opposed to some of the others that were proposed at the time. Precisely how Allied air superiority was achieved also remains a contentious subject. It is argued that strategic air power (striking within Germany) so crippled the strength and resources of the German Air Force (and for good measure made it obsessed with defence) that it was incapable of intervening. This construction is used to show the independent value of air power correctly applied, yet I do not believe that it has been subjected to the critique it deserves. It has also been cogently argued that the weight of the tactical and fighter support deployed precluded any successful German intervention - independent of the strategic balance.

Finally, one could point to the absence of judgement on the wartime allocation of skills and technology. It is accepted that the quality of British aircraft was very high (so that the performance and capability of types such as the Lancaster, Mosquito and Spitfire consistently exceeded that of any mass produced German types), whereas the quality of British tanks was almost uniformly inferior to the Germans' and Americans'. The usual interpretation for this inferiority emphasizes doctrinal confusion about the role of tanks and the nature of tank warfare; and inadequate control over the industrial base. This is undoubtedly part of the truth, but no effort of which I am aware has been made to assess the impact of the decision to concentrate on bombers in 1941-1943 on tank design and production.

It is these sorts of questions that would have to be addressed in any critical history of air power during the war. It may seem that I am drawing a pedantic demarcation. I do not think so. By no means the last word has been said on the application of air power in World War II and that which I have sought to add is dependent on its degree of significance to the evolution of air power doctrine after 1945.

In chapter 3 I apply the classical principles of military strategy to the conduct and outcome of the bombing campaign. This approach should clarify the purely military features of the campaign, making it easier to judge the military appreciation that sophisticated air power thinkers like Air Marshals Bottomley and Slessor themselves made after the war. It also facilitates an estimation of the post-1945 air war expectations that were formed. The most valuable consequence of such an analysis, however, is the insight it gives into the air theorists' claims to be

dealing in a new concept of warfare. The air power theorists had an important influence on military policy and took their themes from the pre-war advocates and their own wartime experience. It is therefore useful to be able to deal with these concepts against a standard of campaign analysis which isolates the central claims from the peripheral. Thus the matter of air defence becomes one of substance, while those of area versus precision bombing or evasion versus formation flying are less crucial. We can take the Dardanelles Campaign of 1915 as an analogy. Any examination of classical principles would have to consider the notion of a strategic flanking movement, whereas critical analysis would address strategic choice of landing beaches and the application of land/sea cooperation.

In chapters 4 and 5 I examine the transition of the RAF from war to peace, detailing the pressures of demobilization and the responses to the growing scientific potential. In the few years after 1945 the military and political leaders were forced to lay plans for the future of the British military establishment confronted by an outlook which never promised to be especially peaceful. It is true that there was a popular wish for peace and that the new government had a well articulated policy for the transition to peace. Yet any military historian is obliged to devalue the peaceful and optimistic impulses in that society. The situation was different to the urge for peace in 1919. Amongst other things; there was no peace treaty in central Europe and thus Germany was partitioned and occupied; the economic and Imperial prospects for Britain were far worse in 1945 than they had been in 1919; and, in the USA and USSR, two substantial non-European powers stood ready to exercise a decisive influence on the shape of the 'peace' and indeed, on the future of Europe. The start of the Berlin blockade in June 1948 was an event without parallel in the early 1920s, and established an atmosphere in which strategic thinking and military preparations regained a considerable urgency. The urgency was reflected in the four priorities that we can recognize as existing in the Air Staff's approach to its own planning. (i) How the RAF was to formalize doctrinally and exercise operationally the new strategic supremacy it enjoyed within the framework of British defence thinking. (ii) How best to cadre the force and preserve some semblance of a bomber fleet-in-being such that rapid expansion would be possible. This priority also required a solution to the difficulties of maintaining a viable bomber force while a technological gap was overcome. (iii) How best to direct the scientific

effort that would be required. (iv) How best to develop a strategy which would ensure the air defence of Great Britain against long-range attack, which had become identified as the chief post-war military threat facing Britain.

The demobilization and financial retrenchment that occurred after May 1945 was not as severe as the 'flight from arms' that took place in 1919. Some reasons for this are suggested in chapters 4 and 6. The continued existence, independent or otherwise, of the RAF in 1945 was never an issue. However, the reversion to peace did impose a painful contraction on the armed forces, and obliged the RAF to make some difficult choices. These are described in chapter 4. This contraction coincided with a series of scientific innovations which promised to be of great importance for the RAF. The direction of the scientific effort (which is described in chapter 5) depended both on the resources that could be made available and the priorities in research and development set by the strategic planners. In this important period, then, limitation of resources and the lessons of the war interreacted with a range of scientific options and a conception of future requirements. The outcome was the constraint of certain distant options and enhancement of others. However, it was not only because of the pace of scientific innovation that such constraint occurred: the pressures of the Cold War and the weakness of Britain relative to the Superpowers (and in comparison to Britain's strength after 1919) also ensured that the pattern established in this period would become markedly influential for the future. The creation of the V bomber force is an example of this pattern - strategically there was a commitment to bombers while in design terms certain parameters became fixed. In dealing with this interrelationship between patterns and innovation it is impossible to define exactly what depended on conceptual orthodoxy, what was made inevitable by financial requirements and what sprang from scientific momentum or advice. But I have tried to demonstrate the dominating impulses.

In chapter 6 I give an outline of the international and domestic, military and economic pressures experienced by the British government in dealing with the requirements of peace and exacerbated by the onset of the Cold War and the weakness of Britain relative to the Superpowers. Britain's reduced ability to police the post-war empire served to enhance the problems of retaining global influence. This range of pressures, challenges and imperatives played a crucial role in shaping grand

strategic policy; they also vitally influenced the decision to produce the atom bomb. It is possible to be almost certain about the influences which made possession of nuclear weapons seem such an overriding priority. My first interest in the bomb, however, lies in the military reasons that were put forward for its use, and in the strategy of which it was to be a part. As a cardinal element in Britain's post-war military policy it is without parallel.

In fact, the issues discussed in chapters 3, 4 and 5 take on a relevance which can be judged only in the light of nuclear weapons and the intention to possess them. It would be unthinkable therefore not to deal with the decision to make the bomb: however, it is the implications discussed in chapter 7 which matter most.

The final chapter contains a discussion of the development of post-war British strategic thinking drawing on the events and decisions examined in the previous four chapters. Strategic thinking was of course concentrated on the security of Britain and the best means to prepare for a future war; it was dominated by the problem of the defence of Britain. In arriving at an understanding of British post-war military policy, an appreciation of the importance of air defence is paramount. Not only is it the key to many of the decisions made, it is also central to the genesis of nuclear deterrence¹.

The directors of British military policy understood quickly and comprehensively that the central threat to Britain's survival in any future war came from a direct attack by long range air forces. While the

1. It is important to note, at this point, a divergence in the treatment of nuclear deterrence deriving from British thinking and that deriving from American thinking. I pay almost no attention to post-war strategic theorising in the United States. I believe that early progress on nuclear deterrence owed little, in the United States, to any defensive imperatives, and much more to unreconstructed concepts of the power of the offensive. In Britain, the two themes co-existed. As I attempt to show in the final chapter both elements are integral to the overall theory (a completed outline of which began to emerge in both countries in the early 1950s). In some senses, then, a study of the British development is more instructive for a comprehensive understanding of the overall theory. Thinking and planning in the United States is not the subject of this thesis; therefore I make no apology for not dealing with it. But I do not wish to suggest that it is either primitive nor without value.

Luftwaffe's bombing efforts over Britain partially informed this understanding; and the depredations of Bomber Command and the United States Army Air Force (USAAF) further sharpened the picture, it was the 1000 V2 rockets that fell on Britain, against which there was no known defence, that really underlay this new strategic appreciation. The Chiefs of Staff and the Cabinet saw that herein lay the means to achieve the swift and sure victory through a knockout blow that had been the centrepiece of RAF planning in the 1930s. They also saw that the geographic location of the British Isles, the concentration of British society and industry, and the likely course of weapons' development made Great Britain itself vulnerable to a surprise knockout blow by strategic bombing and rocket and atomic attack.

The central dilemma, then, of post-war British strategy arose from the acceptance of an air power doctrine committed to the strategic offensive, and the appreciation of the urgency of finding a defence against such an attack aimed at Britain. But it would be incorrect to divine the existence of a debate between offensive and defensive strategies, or to deal in terms of a dispute between bomber and fighter factions as to the better approach to defence. This was absent not only in the RAF but substantially among the higher sources of military policy too - such as the Chiefs of Staff Committee and the Cabinet Defence Committee. Instead, the important issue gradually emerged as one between deterrent and defence; the question being, could a deterrent force ensure against the kind of attack that was most feared. The immediate answer to this issue was found to lie in the then current value of the bomber viewed against the future potential of the long range rocket. Judged in these terms, fighter defenses were almost irrelevant to the future security of the British Isles. The strengthening of the defensive jet fighter forces that did occur in great spurts in the later 1940s and the early 1950s was viewed as being of limited long term significance and, for the RAF, posed no real challenge to the dominant doctrine. Their role was to deal with enemy bombers in that period before the creation of the British nuclear deterrent, and in the interim while it was still massed bomber formations that posed the threat. Following this line of logic, it is easy to understand the claim that the bomber was Britain's first line of defence.

The more acute understanding of the postwar vulnerability of Britain was a product of the potentiality of atomic-armed air power per se.

Irrespective of the state of British air power doctrine, this

understanding was bound to suggest a diminished role for the Royal Navy as the traditional guardian of the shores. The defence of the approaches and of sea-borne supplies, the blockade and the quest for the decisive fleet action, even the exercise of imperial protection - all these declined in importance. However, the matter went beyond one simply of defence. The ascendancy of air power produced a shifting emphasis in British grand strategy. The case was being put for the eclipse of the Royal Navy as Britain's principal strategic force, and with it the demise of the battleship. It was being argued that the bomber fleet (the undisputed essence of air power) was the heir to the naval battle fleet as the means of projecting British power. It is not easy to be certain of the relative importance of a number of contributory influences behind these assertions. The trend was a product of war time experience (demonstrating as it seemed) the omnipotence of bomber formations capable of delivering one million tons of high explosives on Germany in 1944 alone, and certainly witnessing a sharp limitation, by air power, on the exercise of sea power - especially with the vulnerability of capital ships to air attack. It was also the outcome of the intellectual synthesis which foresaw the all pervading influence of air power in wars to come.

It is also important to acknowledge the spirit of the age, in which at every turn the power of the offensive appeared vindicated and triumphant. This attitude owed a great deal to the success of offensive air power. Movement appeared to be the key to success on any battle front. There was thus little impulse to invest in new defensive systems or technologies. The defence was perhaps somewhat discredited - the feeling being that the initiative counted for everything. Two of the Germans' greatest defensive efforts had been overcome, (indeed at great cost) - the fighter defence of German air space and the Atlantic Wall had not been able to stem the onrush of the offensive. At another time, the fact that Britain's true long term military problem was actually one of defence might have been approached from a different perspective. It is not impossible that defensive means could have been found (although it is difficult now to envisage how such a decision could have been made by any post-war government). German air defence efforts had been not only spectacular, they had come close to success. However, because the influential view was that the best defence lay in the potential might of an offensive strike, a real devotion to purely defensive measures was unthinkable. The advent of nuclear weapons greatly enhanced the

perceived validity of the prevalent lines of thought. They also held out the prospect of possession of a credible deterrent force in spite of Britain's limited resources.

In bringing together and attempting to elucidate the historical circumstances and perceptions that underlay nuclear deterrence, the place of the theory in the larger science of military strategy can be fixed satisfactorily. It also becomes possible to argue that such an approach was not inevitably contingent upon the invention or use of nuclear weapons, but can be shown to be the conscious product of the military and political leaders of the time, acting in response to their own unique experience and a set of circumstantial events. This I believe to be a valuable corrective to the determinism that is frequently accepted in arguments about the bomb.

4. The problem of method.

"The nature of everything is entirely comprehended in its development." ¹

The distinction between descriptive and critical history need not be pressed too far, for any critique depends on the marshalling of some facts and no course of events can be set down without some degree of interpretation. However, it seems to me important to recall at the outset that actions do not speak for themselves, neither do the ideas which appear to underlie actions correspond unfailingly with the outcome. John Keegan states the problem clearly.

".... the history of strategic doctrine, with some notable exceptions, of which Jay Luvaas's Military Legacy of the Civil War is a glittering example, suffers markedly from that weakness endemic to the study of ideas, the failure to demonstrate connection between thought and action.

That weakness is not, however, peculiar to the sub-branch of military history. Action is essentially destructive of all institutional studies; just as it compromises the purity of doctrines, it damages the integrity of structures, upsets the balance of relationships, interrupts the network of communication which the institutional historian struggles to identify and, having identified, to crystallize."²

1. From Arthur Marwick, The Nature of History, page 174.

2. John Keegan, The Face of Battle, page 29.

I write history as if it is composed of a series of interreacting trends forming a general movement; a progression (but which does not imply PROGRESS). History then is a continuation, a connected and continuous process incorporating disjunctures and contradictions, occasionally absorbing ruptures but remaining essentially a process of development. The chief interreactions occur between ideas and material conditions. Not all ideas have the same status, but they all evolve from some earlier historical relationship. The most important ideas should be understood as dominating ideologies which inform action, but which are constrained by material factors, and which are sometimes radically influenced by them. Thus the most significant ideas of any time assume a status that can be as powerful as material conditions, however, material conditions have a substantive and enduring influence which ideas cannot match. Conditions will impose limitations in a way that ideas cannot, although there will be periods when the influence of an idea or set of ideas approaches that of the existing material conditions. In any case it is important to understand that these two historical elements are inextricably interlinked, profoundly influence one another, and should not be analysed in isolation.

In one sense, material conditions impose absolute limits during certain periods. We may theorise about interplanetary flight but it is not a present option. A theory of air power before the advent of fixed wing flight was neither impossible nor irrational - ideas are not determined materially in that sense. Such an idea could have no direct influence on activity in the period before flight. Of course precursors, or proto-theories are common; George Quester¹ for example, has amply demonstrated the theoretical tendencies of general deterrence theory in the period immediately before the advent of nuclear weapons.

In another sense material conditions are products of the relationship between theory and practice. There will be some tendency for ideas to inform action in such a way as to create material conditions more conducive to the initial idea. The history of what can be shown to be a dominant idea is thus central to an understanding of the concurrent conditions and decisions.

The subject of this thesis is a set of military ideas, subsumed within a military tendency which could be described as 'the strategy of the direct

1. George Quester, Deterrence before Hiroshima.

approach'. This strategy consists in the ready acceptance, as appropriate agents of warfare, of the increasingly destructive capabilities that industrialization and science have made available. By the use of the word 'genesis' in my title I wish to convey the sense that the origins out of which and the process by which the theory of nuclear deterrence was formulated and developed are the keys not only to an adequate understanding of the theory itself but are essential also to establishing the place of the theory within the wider tendency, and demonstrating the impact of other ideas. This is why I have concentrated on those historical periods and experiences which can be demonstrated to have shaped the theory prior to attempting a critique of the theory itself. Such an approach provides the material and ideological background to the concept of nuclear deterrence. By seeking to establish the genesis, precursors and influence of an idea on the theory, one of my chief aims has been to rebut the notions (i) that the invention of nuclear weapons themselves imposed an inescapable theoretical outcome: i.e., that circumstances dominated thinking, action and decision so completely that nuclear deterrence was and is an inevitable fact of life. (ii) That a profound historical rupture occurred with the invention of nuclear weapons: a rupture akin to a revolution which marked a departure from previous conceptions and the beginning of a novel epoch in military strategy. It would be entirely wrong to assume that ideas are autonomous, or that they take on a powerful influence simply because they are 'good' or important ideas. No individual, or even group, is so significant that they can just argue an idea into influence. We have to acknowledge that an idea will only become prominent when material conditions favour its acceptance and development.

In addition, those ideas which come to exert a dominating influence do so because they stand in a sympathetic relationship to the existing general tendency. It is because they conform with existing orthodoxies that they are able to develop. Thus, the history of an idea should also illuminate the broader themes, as well as establishing that dominant ideas are neither autonomous nor omnipotent. My choice of the theory of nuclear deterrence as a subject is an obvious one for an historian because of the profound influence this theory has on contemporary military strategy and on the popular conception of warfare and international relations. What I have sought to establish is that it is not a thing in itself, but an aspect of a much wider military conception. This conception, which is the underlying subject of the thesis, is the product of a school of air power. I will argue that if the relationship between air power and

nuclear deterrence is carefully analysed, not only will the problems of nuclear deterrence become more accessible, but the central role of air power theory will be established much more soundly than it is at the moment. For while it is widely accepted that the air dominates practical military strategy, I believe there has been an incomplete appreciation of the extent to which air power ideas have dominated the intellectual development of military policy.

Itself an element of the broad historical movement to which I have already referred, this school of air power is founded on the primacy of strategic bombardment. That it could be given credence depended on the milieu in which it was formed; its articulation, however, was not determined by that milieu. At least three other influences must be taken into account. The first is the need of Trenchard and his air enthusiasts to produce an argument to justify the RAF. This was found in the putatively independent nature of air power, of which the bomber fleet was the sole expression. The second was the enduring acceptance of a vision of military victory based on the crushing of the enemy's economic and social ability to maintain and continue military operations in the field. The third arose from the glimpses of air versatility provided by the First World War and enhanced by RAF participation in some inter-war colonial campaigns. Aircraft easily bypassed the trenchline stalemate and later provided some instances of previously unknown flexibility - in Irak for example. The case for strategic air power that was put by the RAF in the 1920s and 1930s was, however, by no means the only, logical or universally accepted statement on air power that existed. Simply making it did not guarantee success or survival.

This brings me to a most important point. If the status of an idea is to be judged by the extent or efficacy of its material application, then the evidence of 1934-1942 would suggest that there was no bomber school of air power in the RAF before the advent of the Portal/Harris combination in the Air Staff and Bomber Command. In fact the documentary evidence for a bomber school before the war is unassailable. The disjuncture between theory and practice had a number of causes: the exaggerated claims of the bomber polemicists; restrictions on military expenditure; a failure of operational appreciation and training; the need to assuage political requirements and inter-service rivalries; and a surprisingly unscientific approach to the design of equipment.

This is not to say that the future, or future dominance, of the idea was assured under any circumstances, and that it would have flourished solely as a result of forceful advocacy. What I wish to establish is that one cannot convincingly deduce from an examination of decisions and actions the validity or otherwise of a particular theory. Theory and practice are related with such a complexity as to render so simple an a posteriori deduction invalid. By the same standard, although my approach concentrates on ideas, it is wrong to assume automatically a direct or dominant influence on decisions and action. The currency of the idea must be established from the evidence and by reference to its history.

This point may be further illustrated by an examination of the crisis in bomber theory. I have said that my understanding of history involves comprehending a pattern of continuity. The fundamental pattern of the post-Napoleonic military continuity is an escalation of the direct application of force. Of course, there are exceptions to be found: for example, in some of the colonial campaigns, in some campaigns of the American Civil War and in Churchill's eastern strategy of World War I (which, incidentally, failed for reasons of execution and then served as a case to be made for the folly of strategic manoeuvre). The exceptions did not check the advance or the hold of the general approach. The advent of air power did not imply a radical departure, merely necessitated an accommodation. The issue became one of whether air power would be subordinated to traditional approaches, or would throw up a new orthodoxy of its own. Any judgement based on the period to November 1941 would have to conclude that the RAF's claim to a new orthodoxy was flawed. However, by the summer of 1945 bombing orthodoxy was established in the minds of most contemporary strategists, and a bomber fleet fully commensurate with the dictates of pre-war theory had been brought into existence. The nature of this new orthodoxy, and the components of its brief history, are my first subjects. But that is not to explain why and how the idea survived its early and unsuccessful implementation. One cannot conclude from the existence of the later bomber fleet that it was an idea whose time had come, or that it was an inevitability, or in some sense a logical extension of the preceding strategy, or even that it was a correct application of resources. It is still necessary to analyse the crisis and explain the survival of the idea.

It should be clear from what I have said about my approach to history that I do not subscribe to the notion that 'things happen because they

happen'; nor to the 'great man' theory of history; nor to the belief that history is a series of unexpected turns and shocking consequences. I reject empiricism because I cannot accept that facts are able to speak for themselves. Yet it would be foolish to deny that catastrophic surprises do occasionally happen to shift events; or that individuals can be decisive at moments; or that the unexpected has been important. Thus we can observe that an idea about air power (a clever, plausible idea) but perhaps political in origin and invented by Trenchard as a weapon in his fight for the independence of the RAF, was able to survive and succeed in a military context. Initial success may have been on account of its relevance to the military tendency of the time, but this can hardly explain its survival after the failures of the early months of the war. Perhaps Sir Charles Portal's influence on Winston Churchill (who then dominated the War Cabinet) was vital; perhaps it was simply Churchill's own feeling that bombing was the only way to get at the enemy; perhaps British leaders thirsted for revenge in kind for the blitz of 1940/41. I make no judgement at this point, I merely assert that the strategic bombing of 1942-45 and the primacy of bomber doctrine in 1945 cannot explain the decisions taken in November 1941. Furthermore I do not wish to suggest that all history is a pattern of steady development and measured interplay between ideas and material conditions. Social revolutions, of course, can shatter this pattern. In such times social and material forces come together with new concepts to propel a fresh ideology to prominence, via a period of intense struggle. Such times are rare. I have already asserted that there was no revolutionary period in Britain after the Second World War. Instead, the period is better understood as one of development.

Brian Bond, in his book on Liddell Hart's military thought, quotes a comment of Spencer Wilkinson's on Liddell Hart's approach to history.

'By that (i.e. being doctrinaire) I mean that you set out to teach the dead generals how much better they would have done had they been imbued with your views of the indirect approach, whereas I think the historical method consists in finding out in each case, as far as possible, how it was that they acted precisely as they did. My idea is that most of those great commanders very well knew their business and did the best it was possible in the conditions.'

1. Brian Bond, Liddell Hart: A Study of his Military Thought, page 57.

This statement now seems a trifle generous to the First World War commanders; what it invites is the question 'precisely what business was it that they knew very well'. The business that the Air Marshals knew by 1945 was strategic bombing. The years they spent learning and refining the lessons are the first vital part in establishing the connection between theory and practice in post-war policy. Certainly, during the war they were sustained more by an idea of what could be done than by experience of what had been done. By the end of the war theory and experience came together, strategic air power was established. It was then that an orthodoxy based on theory and experience can be demonstrated. The extent to which the air power advocates felt vindicated by the strategic bombing campaign is suggested by the labelling of the war as 'the first great air war'. It was out of this conjuncture of theory and practice that the strategy of nuclear deterrence directly evolved. The survival of an idea and an analysis of the events leading to the creation of the heavy bomber force and the appointment of Sir Arthur Harris are vital to a complete history of British air power, but may be treated descriptively in an analysis of post-war policy. In saying that the bombing campaign of 1942-45 is what really matters because it provided experience which was drawn on for justification, I do not wish to denigrate the power of an idea in the face of evidence. One need only consider the endurance of the notion of the 'big push' on the Western Front under the influence of Field Marshal Haig to appreciate the power of a well established or forcefully advocated concept. What I wish to do is to establish the appropriate starting point - that is the point at which theory becomes orthodoxy.

However, whatever the pre-eminence of the idea after 1945, to ignore the impact of post-war events and new or traditional contending strategies would be to gloss over the subtleties of the evolution of deterrence theory. These post-war 'events' are best treated in three categories.

- (i) The transition from war to peace and the start of the Cold War.
- (ii) The pace of scientific discoveries.
- (iii) The influence of contending strategies.

The financial restraint placed on the RAF in the post-war period was not as great as it might have been, and anyway, was not the most important aspect of demobilization. The budget fell quite sharply to 1948, climbed gradually to 1950, and then expanded rapidly. Rather more significant was the shortage of service personnel. The effects of this were felt in terms of absolute numbers, but more critically in the shortage of skilled men to service aircraft and train

new crews. Finally, the transition of the economy placed a limit on the number of replacement aircraft that could be produced. These aspects of the return to peace need to be treated with care, because a simple picture of the RAF crushed and desperate under the government's 'peace programme' is misleading. It did become clear that a much less extravagant use of personnel would be essential and that the physical establishment of the force would have to be much smaller. Yet, due to the persisting military need to provide tactical fighter and bomber support for the army in Germany, and the overwhelming political requirement to provide for the interim air defence of Great Britain, the fighter component of the Air Force remained large and was steadily modernised.

What did become obvious was the fact that the days of a vast bomber fleet were over for the RAF. The projection made in 1941 of a requirement for 4000 operational heavy bombers is one standard, admittedly the product of reaction to the failures of the bomber fleet in the first years of war and of a political need to impress on the War Cabinet the enormity of the priority required by the RAF. Another standard can be found in the approximately 1500 'heavies' operational in May 1945, out of which was maintained a regularly available force of 700-1000 for consistent raiding. Such force levels became impossible, unthinkable for Britain after the war. The Air Staff asked for 240 V bombers in the first place, finally sought 200 and eventually operated (at differing times) 104 Valiants, 134 Vulcans and 84 Victors. The advent of the atomic bomb allowed such an order of battle to make sense, although the problems of attrition and servicing imply that such a reduced battle fleet was a very precarious vehicle for a strategy of strategic bombing. The fact is, therefore, that what adjustments were made in the pursuit of peace (in addition to creating a service-wide crisis of staffing) affected primarily the practical implementation of the strategic bombing concept.

The march of science had even more complex consequences for bomber strategy. The prospects for air defence against manned bombers appeared much improved. Thus Bomber Command's problem in penetrating to its targets was greatly enlarged, and seemed to require the application of substantial scientific equipment and effort. The problem was thus not only of numbers, but also of very advanced technology. The research, the expense, the training formed one nexus of difficulty. But the steady application of science to air defence also seemed to impose on the

bombers the need for a qualitative leap forward in technique and equipment. In going for a 'great leap' in design and performance a scientific imperative was being met at the expense of a long gap in practical capability. Whether the size of this gap was fully appreciated at the time is an interesting question. I doubt that it was, and recourse to arguments about a supposed '10-year rule' and the eventual excellence of the aeroplanes seems to me to conceal an admission about the surprises that the scientific programme gave rise to.

The scientific explosion had an additional impact on the practical application of British air power theory. There were so many options that Britain could not afford to exploit them all. It has been put to me (by Sir Geoffrey Tuttle and Mr Humphrey Wynn, for example) that therefore the service chiefs chose what courses they believed essential and to be in accord with Britain's existing practice and expertise. Thus the scientific path was both sensible and more or less determined. This notion must be challenged. Some choices had to be made, but where any coherent direction of scientific effort is discernible, I believe that the choices were influenced by strategic preconception or misperception. An example of the latter is the case of supersonic flight - not only was there doubt as to the reaction of the human body, but there was a failure of appreciation of the implications for the future of war in the air. Another case is the decision to ignore long-range strategic rockets. There is a good case to be made for regarding this as a doctrinal rejection. The Staff went as far as acknowledging the rocket as the weapon of the future - but a future so far distant as to be irrelevant to British military planning for at least 15 years. This perspective endured in spite of the known and tested advances made by the Germans before the end of the war. Thus although the range of scientific possibilities were almost impossibly great, and the choices that were of necessity made should not be condemned for lacking Cassandra's touch, an examination of the direction of science, of the independent factors it injected into the process of military development, and of the central choices that were actually made will throw light on the strength and influence of doctrinal preconceptions.

The invention of long range rockets cast a very deep shadow after the war. It was almost universally assumed that against these weapons of the future, there could be no defence. At the same time many arguments were offered to show what limited and hopelessly futuristic weapons they were:

inaccurate, short range, low payload, high cost, non-reusable; thus setting the menace at a long arm's distance. One of the consequences was that air defence remained for the time being both a practical and a theoretical issue. Almost no-one believed that air forces should be organized as defensive entities, or that their strategic use should be other than offensive. To argue otherwise was to fly in the face of the more established orthodoxy, established irrespective of rockets but apparently to be further enhanced upon their introduction. To write of defence as a contending strategy requires, as I have already observed, the most careful clarification. Yet defence was, throughout this period, a concern of central importance.

There remained, however muted, alternative ideas of how air power might be used that should not be entirely discounted. There was indeed an incentive to incorporate the support role of air power as a subordinate function within the general theory, always provided that it did not take on excessive significance or come to be understood as a challenge to the concept of the independent nature of air power. To the support role was ascribed a theatre application. The use of tactical air power in support of land forces was not a contentious matter because its exercise in Europe after June 1944 (and indeed in the Western Desert especially in the summer and autumn of 1942) came to be accepted as a model properly belonging to the application of air power as a conceptual totality. It is this model to which Tedder, I believe, was committed, although he chose to conflate the themes of air power rather than challenge his own service's orthodoxy. Much of the currency of air power derived from its exemplary support role, and it cannot be denied that many RAF officers accorded the theatre role of air a very high significance. I think it is also true to say that the idea of air supremacy, or control of the air, which tended to occupy a central position in theory, actually derives from this subordinate model. Its transference into the area of general strategic theory was not a happy development, and was to give rise to a great deal of confused and ambiguous thinking.

All of these formed the chief currents in the strategic milieu that affected strategic bombing doctrine after 1945. As one examines the pre-war genesis of the idea, the passage of the crisis of 1939-41, and the maturation of theory and practice in the campaign of 1942-45; as well as the way in which the doctrine was shaped by the transition to peace, the

scientific advances, and contending strategic concepts inevitably, one is drawn back to the men who finally made the decisions. Even if one only seeks to find out how it was that they acted precisely as they did, an underlying implication will exist that there were not only other ways, but that some of the other ways were better ones. Just as things do not happen because they do, neither do men behave as they did because they had no alternative. A direct criticism is both valid and necessary because it is on that basis that an analysis of better alternatives rests. One of the implications of Wilkinson's position is that we cannot really show how wrong they were, when such a demonstration may in fact be quite vital.

When Michael Howard wrote "nobody stressed more often the need for ruthlessly dispassionate analysis as a basis for both history and theory; but he (Liddell Hart) himself sought to escape from the dilemma of his generation by what was, in the context of his times, little more than rationalisation of nostalgic wishful thinking"¹ he was explaining the strength of passion Liddell Hart felt about the First World War's casualties. Perhaps serious historians should allow such passions to impinge a little upon their thinking - in my opinion no historian can help but seek 'escape from the dilemma of his [or her] generation', which, in the case of this generation is the grave problem of nuclear deterrence.

¹ The quote is from Michael Howard in Encounter, April 1970, page 42: - my source is Brian Bond, Liddell Hart, A Study of his Military Thought in which the quote is used on page 115.

Chapter 2

The wartime campaign

The Royal Air Force entered the war with a bombing strategy the objectives of which did not accord with the political and military outlook of the Chamberlain cabinet. In any case, Bomber Command was not properly prepared for its task. The bomber fleet was too small to strike decisively at the enemy, and was deficient also by virtue of inadequate aircraft, poor training and short-sighted operational techniques.

Yet in spite of this early discrepancy between strategic objectives, political aims and military capability, the essentials of the theory were to survive and exercise an abiding influence on the war in the air fought by the British. For if the initial efforts of Bomber Command proved to be a warped reflection of the bomber theorists' grand design of unproven precepts and untested tactics, as well as a demonstration of how ill conceived were the pre-war preparations, it did not follow that the immediate outcome would be a revision of the central philosophy. What occurred instead was a long period of operational and technical readjustment - an interplay between brutal reality and unshakeable precepts. The RAF began anew to prepare for the war of the strategic bomber.

It is reasonable to consider why those principles were so resilient in the face of the early shocks. A set of political and military imperatives imposed some shape upon developments, and the larger course of events proved surprisingly amenable to the Air Staff's vision. The two most important principles were those of the primacy of the bomber, and of the strategic nature of air power. These principles endured because the leaders of the RAF were determined to preserve them as the keystone of British air policy, because Britain's war leaders (especially after 10 May 1940) were committed to attack and unwilling to accept a defensive posture or countenance a negotiated peace, and because for a long period of the war strategic air power offered the only readily available method of taking the war to the enemy. Strategic bombing enabled Britain to project what power it had back onto the Continent at a time when the army had been driven out and the offensive potential of the navy stalemated by the extent of German conquests. Strategic bombing thus took on one of the crucial roles of traditional British policy - the application of Continental power without the commitment of a Continental army.

The potency of strategic air power as a military option varied with the degree to which the British war effort was able to assume the offensive rather than being forced back onto the defence. Thus, when Britain was nearest to defeat in the Battle of the Atlantic, or in the Western Desert, then the internal challenge to the air offensive was greatest and the call to divert the bombers to defensive tasks most urgent. Hence the wider course of the war influenced the development of the bomber offensive just as the inherent dynamic of the air war over Germany produced subtle shifts within the corpus of air power theory. These two factors gave rise to a coherent structure of theory and practice which was to serve as a solid foundation for post-war military policy. The construct retained the fundamentals of the pre-war doctrine, modified in battle and given a legitimacy by drawing on a model of judged success. When the campaign was viewed as an historical experience, it began to impose rigid limits to the development of doctrine.

1. Pre-war influences - military and political.

The activities of Bomber Command, in the opening days of the war, were determined by two decades of planning. The shape of the force and the substance of strategy had begun to form during the First World War. Bomber Command was formed in July 1936, but the Air Staff had, under the influence of Lord Trenchard, had been bomber-minded since 1918. International and domestic political and military constraints had influenced British bombing plans in the years leading up to 1939, and these must be considered briefly as contributory factors to the initial failures. But the constraints of the 1930s cannot explain fully the nature of the early campaign, nor can they entirely account for its inadequacy. They were important to the planning process, and left a residue in the thinking of the post-war years; in other ways they were less vital to the course taken by the wartime campaign.

1) The fear of air attack on British cities .

At the start of the war, and for some eight months following, Bomber Command concentrated on unequivocally military targets - an experience which helped produce a tendency to disdain such targets in future. Part of the reason for this limited focus lay in the desire to avoid provoking an attack on British (and French) cities. During the 1930s many minds were exercised by the prospect of mass air bombardment on cities, it was

in fact a central theme in the plans of Bomber Command. For much of the decade British policy approached the issue along three lines.

i) Treaty agreements were sought to either outlaw bombing or restrict targets. Related efforts were made to secure international agreement to limit the size and power of air forces, or at least to establish an agreed parity of forces such that no side could expect to overwhelm the other (at any rate not without fear of retaliation in equal measure). Much of the rationale behind these negotiations lay in the policy of appeasement, based on the perfectly sound concept that disputes between states should be resolved by rational measures of compromise, the establishment of effective international negotiating fora, and the setting of careful force levels which would guarantee to all an assured defence while denying to any particular state the capability to threaten or attack another. British governments were serious in their desires for such an international system, and were careful not to initiate military policies which could indicate bad faith or suggest underlying pessimism as to the eventual efficacy of the system. Thus military spending was kept at a low level (a range of domestic considerations also influenced the spending level), and a conscious effort was made to avoid spending on offensive weapons. A strategic bombing force was the most obviously offensive concept of its day - its advocates pressed it on these very grounds. As a direct tenet of policy its development was therefore deliberately not advanced.

ii) Another important theme in the policy aimed at preventing direct attack on cities in war was the traditional concept of deterrence, based on an active capability to threaten punishment at just the necessary level to deter an attacker from striking cities. This notion of minimum deterrence was aimed at preventing war becoming total war by demonstrating the ability to extract an equal punishment for acts which exceeded certain levels of violence. This concept of deterrence, very familiar to national strategy and military thinking, related only obliquely to the RAF doctrine of strategic bombing. It did not posit strategic bombing as a war winning technique designed to destroy an enemy's ability to carry on the war, but rather as a defensive and retaliatory mechanism, based on retribution in kind and designed to ensure that certain classes of military activity would not be engaged in for fear of the consequences. As a policy concept it formed part of government thinking. As a military reality it suffered fatally from the

desire not to spend money on bomber forces (both for reasons of appeasement and because the practical requirements for even such a limited policy of deterrence were not adequately understood). It also suffered because the Air Staff regarded it as a defensive, and therefore inappropriate, use of air power. They did not wish to create a bomber force for such a task, even if they had been given the opportunity. Finally, the policy was doomed because it was not credible at any stage of its articulation; some states were prepared to take the risk, others were self-deterred by a conviction that a process of punishment and reprisal would be too damaging whatever the outcome.

It has to be concluded that this approach to deterrence was not given the chance to succeed, because the necessary forces (in Britain and France) were not created, and because the necessary political process of threat was not established, or at least never developed in such a way as to cause an aggressor to pause over his intentions. However, the notion of deterrence, as applied to air power generally and strategic bombardment in particular, became a feature in the thinking about air warfare¹. During the war itself, limited measures of intra-war deterrence were attempted by both sides. Once the grand offensive began, any serious British thoughts of deterrence in operational terms fell away in favour of the effort to achieve decisive results through massive destruction.

Because, in 1939, any hope of deterring a German attack on British cities by threatening punishment in kind was thought to be vain, it was decided to refrain from actions which could provoke such an attack. The Air Staff tacitly recognized that a full blooded bomber offensive over Germany was beyond its means at that time.

What was not out of reach was a defensive strategy based on denying the air space over Britain to the bomber forces of Germany. RAF Fighter Command was also formed in 1936. The theory and practice of fighter defence against bomber forces was so actively and thoroughly pursued as to eventually defeat the German bomber offensive. The Battle of Britain at least suggested that the dictum that the bomber would always get through was false.

1. See for example George Quester Deterrence Before Hiroshima and Malcolm Smith British Air Strategy Between the Wars.

iii) The third line of policy, then, designed to counter the threat of air bombardment of British cities was defensive: that of fighting a traditional battle which could be measured by all the standard military gauges. The implementation of defensive plans accelerated after 1936, as confidence in treaties began to wane and the prospects for an effective minimum deterrence in the short term were recognized as increasingly hopeless. An important consequence of this approach was that resources for the Air Force (although increased) were concentrated on fighter defence at the expense of the build up of Bomber Command.

In July 1934, scheme A (on the size of the RAF) envisaged a force of 41 bomber squadrons and 28 fighter squadrons by 1939. Thereafter this ratio steadily shifted in favour of fighter squadrons, so that in September 1939 Bomber Command had 33 operational squadrons consisting of 528 front line bombers while Fighter Command had 35 squadrons containing 773 front line interceptors¹. The provision of aircraft, pilots and ground crews to an expanding and modernizing Fighter Command was necessarily at the expense of the expansion of Bomber Command.

" the Air Staff now adopted without further question the policy of giving priority in construction and personnel to Fighter Command. But the Air Staff could not accept this situation as anything but a temporary one. It had to be admitted that their own bombers could not at present always get through and were certainly unable by a counter-offensive to protect Britain from German attack. The policy of defence must, therefore, be given priority for the time being. But the Air Staff still had hopes for the future when Bomber Command would be rearmed with heavier aircraft. There was no question of setting up a new ratio of fighters to bombers. The size of the fighter force was determined by the size of the area to be defended and the probable scale of attack. But there must also be a bomber force at least comparable in power with that of the potential enemy. It was essential to any system of defence, a powerful deterrent in peace and the most effective means of exerting pressure in war. It was not enough to avoid losing a war. It had to be won and that could not be done simply by a policy of defence."²

1. Figures from Malcolm Smith, British Air Strategy Between the Wars, page 338; and Denis Richards, The Royal Air Force 1939-1945 Vol. 1, Appendix V, page 410.

2. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. 1, pages 101-102.

The new priority accorded to Fighter Command was only one aspect of the limitation imposed by the new emphasis on defence - and it should not be over stressed. The numerical expansion of Bomber Command did continue, research proceeded on the development and production of the 'heavies' specified in 1936 and due to be operational in 1942. Construction and commissioning of existing bomber marks was by no means negligible.

There were other consequences of the limitation set on the bomber force. A shift in emphasis within the RAF towards meeting the threat of aerial bombardment by fighter defence produced a policy of winning a defensive battle first (being the only way to survive in the war long enough to launch the air offensive), and reserving the bomber effort until a later stage. Further, the continuing paucity of operational and tactical planning for a bomber offensive gave rise to a pause in developing the technical aids eventually necessary to a successful offensive. ✓

The Committee for the Scientific Survey of Air Defence was set up in 1935. The Air Defence Committee was responsible for directing and developing as operational aids the latest scientific techniques relevant to air defence. Special attention was given to radar and radio communications. The location of enemy aircraft, the direction of fighters to the enemy, and the control of the aerial battle were closely studied by the Committee. The fact that suitable fighters in the Hurricane and Spitfire were entering service was a fortunate coincidence - but the fact also that Fighter Command took the possibilities very seriously, and detailed fighter stations and squadrons to cooperate with the scientists and practise the perfection of new techniques was an example of an energetic military response to scientific possibilities that was not at that time a notable feature in Bomber Command. It must be said however, that even had Bomber Command been as receptive to the promise of science as was Fighter Command, most of the scientific energies, money and equipment were channelled to defence. Bomber Command perforce entered the war with technical limitations that had existed during the First World War, and which left the bomber arm far behind the relative capabilities of the fighter arm. The Scientific Committee on Air Offence (formed in 1937) was not a fruitful gathering: the problems of navigation, target location, maximisation of damage and bomber defences were left for later years and bitter experience.

2) The reorientation of strategy.

At the outbreak of war, then, Bomber Command operations were to be limited by the political and military imperative to avoid anything which might provoke a German attack on British cities. However, it was widely regarded as a certainty that, in the long run, Britain was doomed to suffer an attempt to apply to her the knockout blow that the RAF had advocated since the 1920s.

While the British government hastily prepared for war by accelerating the rearmament programme and starting serious military discussions with the French, it also took the political initiative of declaring a policy of air-warfare restrictions. Perhaps these would not prevent the Germans employing unrestricted air warfare but at least the initiator of aerial bombardment of cities could then be presented more effectively as the barbaric aggressor in the face of 'sincere' restrictive declarations. On the other hand, as long as the British government took its own declarations seriously, they served to limit even further the already limited scope for Bomber Command operations.

"In view of the British air inferiority it is not surprising to find that the possibility of restricted bombing to purely military objectives now received fresh and sympathetic consideration. Such restriction had indeed always been part of official policy if the means could be found to make it effective. On 21st June 1938 the Prime Minister announced in the House of Commons that Britain would only bomb purely military objectives and even so would take due care to avoid civilian casualties. There was, of course, no strict definition of what was a purely military objective. Both the Air Officer Commanding-in-Chief, Bomber Command and the Air Ministry were of the opinion that restrictions on bombing would be an advantage and official orders were sent to the former to confine his attacks to the W.A.1 and W.A.4 plans which were obviously aimed at military objectives."¹

The military accepted the idea of air warfare restrictions because of the imbalance of air forces which had developed in Europe². As I have already noted, the RAF's bombing strength grew slowly during the 1930s. The pace of German rearmament had produced a multi-purpose air force which was judged to be pre-eminent in Europe. The British were sure that any prospect for successful deterrence depended on at least a parity of forces. As parity did not exist, little could be achieved by trying to carry out the threats of deterrence. The Air Staff was convinced that a

1. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. 1, page 99.

2. It is now evident that the imbalance between the protagonists was not as stark as was believed at the time. See, for example, George Quester Deterrence Before Hiroshima, page 82.

belated effort to deter the Germans from bombing cities would not work. There was agreement that any threatened retaliation would ultimately be exposed as an empty gesture, and there was hesitation about the wisdom of even attempting any sort of demonstration¹.

The outcome of the decision to concentrate on air defence and to accept self-imposed restrictions on bombing activity, which was the product of the perception of air inferiority and the belief that deterrence based on retaliatory threats had broken down, was the proposal to conserve the bomber force in being until the Germans demonstrated their own intentions - or at least until conditions appeared more favourable to the prospects of British strategic bombing. Britain thus surrendered the initiative in the air. Air power theorists such as L E O Charlton, P R C Groves and J M Spaight had argued that prompt offensive action was vital to the correct use of air power. They held that the correct method of meeting the German threat was to deliver simultaneously (or even pre-emptively) bombing strikes aimed at collapsing the enemy's will and ability to continue the war. Surrender of the offensive was to run the risk of being knocked out first - acceptance of a defensive posture was to invite a fatal inferiority.

The Air Staff accepted this view of the ideal employment of air power, but, for the reasons outlined, was forced to rethink its approach to the opening stages of hostilities to take account of the loss of the initiative. Planning concentrated on suitable naval and military targets that could be attacked and on preparations for a strategic counter-attack in riposte to German opening blows. The military targets were chosen with a view to the effect that their destruction would have on the overall defensive effort, and with attention to the necessity that they be clear of civilian areas. This reasoning lay behind the early concentration on the German Fleet anchored in the North Sea ports. The

1. An example of this kind of evaluation is to be found in the appreciation of the situation in the event of war against Germany in 1939 (26 October 1936) by the Joint Planning Sub-Committee (on which A T Harris was the Air Staff representative), which is reproduced in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, pages 88-95. "It is, consequently, unsafe to assume that under our present programme our Air Force, even with the cooperation of the French, will be able, by attacking the morale of the German people, to produce an effect in any way comparable with that which would result from German air attack against our own." (page 89)

dominance of the limited warfare policy is clear in the strategic thinking that informed immediate pre-war planning.

This emphasis is evident in the Western Air Plans, although one should not fail to recognize the offensive options that were retained, both as long-term intentions and as proposals for a desperate throw should the outright success of German arms seem imminent. The first set of Western Air Plans was completed in 1937, revisions to September 1939 expanded some of the categories. Thereafter, Bomber Command received operational objectives from the Air Staff which were based on the Western Air Plans. Of the 16 plans existing in September 1939, only three can be regarded as strategic - and of those two dealt solely with attacks on German administrative centres and afforested areas. The remaining 13 cover attacks on communications related to military concentration and supply movements, attacks on the German Air Force and Navy, and strikes aimed at enhancing the activities of the British Army and Navy.

The three plans given priority were: W.A. 1/6 - attack on the German air striking force including bases, supply organization and the German aircraft industry. W.A.4 - attack on communications to hinder military concentration and delay an invasion in the West. W.A.5 - attack on German war industry and power supplies (primarily oil, and electricity generation) in the Ruhr area. Only W.A.5 was properly a strategic plan. The consequence of the planning was to define a set of military targets to be attacked, and then only when the Germans opened their Western offensive. In addition to attacking unequivocally military targets the opening role of Bomber Command was to operate in tactical support of the army in France by attacking German troop concentrations, interdicting their avenues of approach and striking at logistics in rear battle areas.

So significant was the re-orientation of strategy immediately before the war, that Bomber Command's principal role was altered from that of delivering devastating blows to the German economy and homeland to one of operating in close tactical support of the army in France and attacking those elements of the German armed forces that were remote from centres of population. It is true that the close support role was allocated to the light bombers of the Advanced Air Striking Force (AASF). All the same, the overall emphasis on army support and a limited counter-force strategy, coupled with the surrender of the strategic offensive, meant that the RAF entered the war by reversing two of its most important

doctrinal precepts. There were practical problems as well. Bomber Command was supposed to be trained for high level, deep penetration raids on fixed industrial targets, using particular flying formations and target approach techniques. It was now to be called upon to attack at low level, targets approximate to the heavily defended battle front, or targets small, mobile and remote from identifiable aiming points and fixed landmarks.

Having noted this re-orientation, however, we must remember that the Western Air Plans did have strategic aspects, and that the Air Staff was ready to launch an offensive as soon as conditions permitted. There were three primary targets.

The value of an attack on the German aircraft industry (for which a target list of airframe and aero-engine factories was prepared) was judged to hinge on how soon such an effort could materially influence German front line strength. Thus a decision was related directly to immediate defensive considerations, and because the conclusion was negative, such attacks only began in strength after the Battle of Britain.

The Oil Plan was a favourite from the earliest stages of planning, and endured, as a distinct strategy, until the end of the war. Oil was identified as a weak point in the German economy, sources of natural oil being limited and much being produced synthetically within the borders of the Reich. Many of the synthetic oil plants were within range of Bomber Command in 1939; they were considered easy targets to locate and easy to destroy because they were classed as 'self-illuminating'. An attack on German oil production covered the range of strategic approaches. As a defensive approach, it was estimated that destruction of plant resulting from a concentrated assault would disrupt German logistics sufficiently to influence the outcome of fighting in the Western Theatre. As an offensive approach, it was most forcefully argued that sustained attack on the synthetic plants would quickly disrupt the German war effort across the spectrum of transport, industrial output and economic infrastructure.

The Ruhr Plan was based on the fact that the Ruhr was the closest concentration of German industry to the British bomber bases. When it would be attacked depended both on the short-term effect that this could

have on the German offensive in the West, and on the consideration that attacking it would form part of the longer term strategic effort envisaged by the Air Staff. This plan was subject to deep concern about the losses Bomber Command could expect over such a target. The Ruhr Plan of 1939 dictated 'precision' attacks on a range of utilities in the conglomeration - oil, electricity stations, gas works, coking plants.

3) Conclusion.

Far from opening the war with a devastating attack on the enemy, the future of strategic bombing came to depend, in 1939, on the outcome of a defensive struggle in which Bomber Command could play only a marginal part. The effect of British bombing in the early months of the war must be judged in the light of the political and military restrictions placed on it, and the very unfavourable strategic position. The initiative was in the hands of the Germans, any counter-attack, let alone independent offensive, would be determined and constrained by the course of the Germans' offensive. If it could be checked then the survival of the bomber fleet was so great a priority that no early riposte could be anticipated.

The strategic offensive was postponed to a distant and more propitious future. Wing Commander H R Allen¹ accounts for this situation by arguing that the Air Staff failed utterly to understand the implications of their own bombing policy, and that their misappreciation of what would be involved in a strategic offensive (not to say their wild irresponsibility in advocating it at the expense of fighter defence) was the basis of the RAF's difficulties in meeting the challenge of German air power when it came. We must also recognize that political factors beyond the control of the Air Staff; the policy of appeasement; the diplomatic attempts to restrict air warfare; the tight budgets imposed by governments on the development and expansion of the RAF as a whole - were influential factors underlying Bomber Command's inability to plan successfully for and carry out its putative role in the national war effort.

In spite of the force of circumstances that constrained the planners of the strategic offensive, however, it is also true that for too long the Air Staff believed that it could achieve results which evidence suggested

1. H R Allen, The Legacy of Lord Trenchard.

were beyond current capabilities. The enormity of the theoretical task was simply not grasped. There was wholly inadequate attention to the training of personnel of all echelons. The lack of appreciation of scientific developments and opportunities was an amazing failure in what was supposed to be the most modern arm.

"The RAF's misfortune was that it had believed its own public image. For twenty years it had luxuriated in the conviction 'we are, ergo we are capable of a strategic bombing offensive'. Now, in the first years of the war, the RAF would become the victim of its own pre-war propaganda. The British army and the Royal Navy would vent their spleen upon the Air Marshals for their inability to fulfil the promises of peace. In reality, the RAF's strengths were considerable and its qualitative shortcomings were little worse than those of its enemies, far less grave than those of its allies. Bomber Command and its leading airmen, however, would be judged not by comparison with the Luftwaffe, but by the standard of their pre-war promises. The core of Trenchard's thesis had been that it was unnecessary first to defeat the enemy's air force in order to wage an effective bomber offensive, and - by implication revealed in the RAF's conduct of its own affairs between the wars - that it was not necessary to concentrate much attention where the bombs fell on enemy territory in order to achieve the desired results. Now, the airmen perceived with bleak clarity that they had made no attempt to reconcile their ends with the means available to achieve them. Nothing would persuade them to renounce their purpose before the government or the other two services. But by the spring of 1940, the Air Staff's confident strategy of twenty years' standing had been replaced by a courageous yet empty determination to make the best of a bad job, and pray for the time to build, the means to pursue their great strategic ambitions."¹

2. Attempted economic precision, September 1939 - March 1942

In September 1939 Bomber Command comprised four operational groups in England plus one training group and one group forming. A seventh group (the AASF) was based in France, administratively part of Bomber Command, but devoted entirely to the support of army operations. The AASF originally consisted of Bomber Command's ten squadrons of Battles (light bombers - notionally 160 aircraft). Later, some of the Blenheim squadrons joined the AASF in France. (There were, of course, also British fighter squadrons in France: known as the air component of the British Expeditionary Force, comprising 6 Hurricane squadrons on 10th May 1940.)

1. Max Hastings, Bomber Command, pages 56-57.

Of the 33 operational squadrons, the ten Battle squadrons and six Blenheim squadrons did not have aircraft of range or bomb load to be considered part of a strategic force; thus Bomber Command in September 1939 disposed of 17 operational squadrons (equipped with Wellingtons, Whitleys and Hampdens) which could contribute to strategic air warfare. All squadrons had an establishment of 16 aircraft, but because of unservicability, shortage of crews and the fact that not all squadrons were at establishment strength, the actual force available was never more than 272 aircraft. The average daily availability in Bomber Command of aircraft, in September 1939, was: 77 Wellingtons, 61 Whitleys, and 71 Hampdens (for a total of 209) [with 140 Blenheims, the total (excluding AASF) of aircraft available was 349]. The average daily availability of aircraft with crews (including Blenheims) was 280¹.

However one weighs any advantages accruing from Bomber Command's more limited role, the inescapable fact is that the force was to be obliged to operate in an unwelcome and unplanned for environment. Having failed to fulfil its deterrent function, and being judged incapable of taking the initiative in a strategic offensive for which the force was supposedly designed, Bomber Command was ordered to contribute to conventional defence by attacking military targets on the Continent, a role for which it was quite unprepared.

In the six weeks of the Battle of France Bomber Command operated in support both of the army and the Royal Navy: striking primarily at the communications, supply lines and march routes of the German army; and undertaking extensive sea and river mouth mining. In this brief phase some attention was already being given to a number of industrial targets in German cities, especially oil installations.

In the period following the fall of France up to the time when the German night Blitz on Britain began, Bomber Command attacked, without decisive result, a variety of targets in Europe. Any semblance of the principle of concentration was surrendered to the need to play some part in the defence of Britain. In spite of scepticism at the Air Ministry, the

1. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, Appendixes 38 and 39, pages 400-402 and page 428.

German aircraft industry was at this time accorded priority - aircraft parks and aeroengine factories were attacked, and six airframe assembly plants were earmarked for elimination. German airfields were also attacked. The concentrations of invasion barges were bombed (and continued to be bombed well beyond the time that invasion had been discounted as a threat) and sea and river mining continued. The communications network in Europe remained a target, as did the German fleet and naval bases.

Throughout 1940 the bombing force was used reactively and piecemeal. Very little attention was given to a consistent targetting strategy or to a regular programme of raiding. It is easy to understand why this was so. A structured approach was gradually taking shape however, as both sides progressed towards unlimited warfare - responding to each other's actions and assumed intentions by widening the scope of targets and level of destruction.

What consistency there was was based on the Oil Plan. May 1940 marked the removal of some of the more limiting political restrictions on Bomber Command, and that autumn and winter saw the most direct threat of invasion recede, allowing the Command more latitude in its choice of targets. On the night of 15th May 1940, 99 bombers were sent to attack oil refineries and railways in the Ruhr. On the night of 24th August the first bombs fell on central London, and on the following night, Bomber Command bombed Berlin. In the period to November 1941, 43,777 sorties were to be flown, and 44,592 tons of bombs dropped.

In accord with established theory, the aim was to dislocate the German economy and thus damage the war effort. Increasingly from the autumn of 1940 onwards, Bomber Command attacked a wide range of industrial targets in Germany, with a tendency to concentrate on oil installations, the communications network and aircraft factories. In the pre-war planning the chief purpose of the bomber offensive had been to attack the enemy economy by selective targetting thus creating, it was expected, 'bottlenecks'. Oil storage and production facilities were prime 'bottleneck' targets because it seemed certain that over a given period the complete disruption of Germany's fuel supplies would inevitably tell decisively on the enemy's ability to wage war and because such a target seemed ideally suited to the circumstances and capabilities of Bomber Command. The attacks were now made by night, and oil installations were

supposed to be the best 'self illuminating' targets. They existed as defined targets within urban and industrial areas at a time when crews were given specific points within the economic complex to attack. Finally, because of their inherent combustability, it was believed that even the limited force of medium bombers then available could create a real impact on these targets. It is also important to record that the Oil Plan was worked up on the basis of a coherent (if in practice slightly fanciful) structure of mathematical calculation. The German output and consumption of oil products was calculated, the main plants identified, and the weight of bombs/number of sorties/time scale required to break the cycle of supply and demand was set down as an operational programme. The design failed because the systemic assumptions were not wholly realistic but primarily because Bomber Command was not capable of meeting the requirements of the programme.

A raid on the oil plant at Gelsenkirchen on 24th December 1940 proved to have a fatal influence on the future of the Oil Plan. Detailed photographic reconnaissance of the outcome was carefully studied, and revealed a very disappointing level of destruction. Inevitably it was accepted that this was typical of the consequences of other raids on oil targets. "There was no sign of any important repairs having been carried out and few bomb craters could be seen in the vicinity. It was obvious that the majority of the crews of the 196 aircraft which claimed to have attacked these targets had been mistaken and that the greater part of the 260 tons of bombs, excluding incendiaries, which they reported as having fallen on them, had not done so, and, on the contrary, had missed by an immeasurable distance."¹

The 1940-41 Oil Plan and its abandonment represents an important phase in the working out of bomber strategy. It was the jewel in the array of target systems prepared by the bomber theorists who believed in the precision bombing of economic categories. Which, after all, was the official Air Staff position - in theory Bomber Command was conceived of as a precision instrument. It was accepted that there would be collateral damage, but British plans did not envisage success via indiscriminate or terror bombing. The idea of attacking morale as a secondary target was a minority position in 1939 - the idea of attacking it alone was hardly considered.

1. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. I, page 228.

The suspicion that the Oil Plan was not working was confirmed by Mr Butt's report in the summer of 1941; its abandonment earlier that year gave impetus to proposals that indiscriminate bombing of cities be accepted as policy. The failure of the Oil Plan can be traced back to a decision taken by the Air Staff early in 1940 to switch from daylight bombing to night bombing in response to the high costs of the early daylight raids against German targets. It is in some ways surprising that daylight bombing against targets defended by enemy fighters and anti-aircraft guns was undertaken so sanguinely by Bomber Command in 1939. British bombers then possessed none of the strengths that daylight bombing was later found to require. They were supposed to be self defending against fighters and thus did not operate with a fighter escort. It was a longstanding doctrine in the RAF that long-range fighter protection was not practicable. But the medium bombers had too few guns to defend themselves and their location on the aircraft left gaps in the defensive field of fire. An effort was made to fly in formation to provide mutually supporting fields of fire, but the formation design was not efficient and the crews were not sufficiently skilled in formation flying. Even unladen they were not fast enough to outrun the fighters and, obviously, were not as manoeuvrable in the air. The maximum altitude ceiling of the bombers did not enable them to fly beyond the reach of the fighters and in any case, to bomb accurately they had to approach the target at less than 20,000 feet. Finally, although the construction of some of the British bomber types gave extraordinary resilience to hits, the protection of the crew, instruments, engines and fuel tanks was disastrously inadequate.

The earliest daylight raids were carried out by Blenheims and Wellingtons of groups 2 and 3 on units of the German fleet in the Wilhelmshaven roads. In the course of the raids on 14th and 18th December, more than half of the attacking forces were shot down by fighters. Although there was not then a complete understanding of the true vulnerability of the bombers, the inevitable conclusion was drawn (particularly in view of the negligible effects on the German fleet). "By May 1940, when the 'phony war' abruptly finished, Bomber Command had flown 990 night sorties for the loss of 28 aircraft and 393 daylight sorties from which 45 aircraft had been lost. It had been estimated that Bomber Command could not sustain a loss rate of more than 5% in continuous operations. The daylight rate had averaged 11.5% while that for night flights had been an

acceptable 2.8%. In this way Bomber Command was forced to become primarily a night bombing force."¹

However compelling the reasons, the decision to switch a force trained and designed for day bombing, over a short period, to night bombing operations, was bound to have deleterious consequences. Most of the operational thinking and much of the training of 20 years was made redundant by this decision. The related problems of dealing with the weather during night flights, successful navigation to the target area, the identification of the target itself and the evasion of what enemy defences there would be all had now to be approached from first principles. The structure and training of the force had to be reorganized. Only the Whitley squadrons of number 4 group were night bombers, the Command as a whole existed as a day bombing force. Leaving aside mechanical aids, aircraft design and tactical principles, and considering only air crew training, one can immediately perceive the additional handicap placed on bomber operations. "The training of crews in night flying was, indeed, obviously a difficult problem and it was never really faced in the pre-war period. In the first place it was impossible to obtain conditions such as would occur in war when no lights would be allowed to show from the ground. Civil aircraft were now able to fly with remarkable consistency in most kinds of weather. They had the assistance of a directional wireless beam and their landing grounds were well lighted. It was, of course, quite a different thing to provide the same facilities for the whole of Bomber Command and they were often lacking. Consequently, Group Commanders hardly dared send up their crews on flights of any length at night or if the weather was not set fair."²

Central to the failure of strategic bombing in 1940 and 1941 was the lack of comprehension as to what was implied, for operations and planning, by the switch from day to night bombing. The progression from precision to area bombing stemmed from the growing awareness that the technologies of the time more or less imposed area bombing as a corollary of night bombing.

1. Martin Middlebrook, The Nuremburg Raid, page 2.
Sir Charles Webster and Noble Frankland, in The Strategic Air Offensive Against Germany 1939-1945, analyse this decision in detail in Vol. I, pages 190-212.

2. *ibid.* Vol. I, page 113.

Instead, it was for some time hoped, and predicted, that night bombing would be about as accurate as day bombing, and that specific military and economic targets in urban areas could be destroyed. However, trials before the war had suggested that even daylight bombing, in ideal conditions, would not be very accurate. Reports were written calling for better bombsights, different and bigger bombs, and revised bombing tactics in order to achieve a more complete destruction of targets. These recommendations were not acted upon, and it was optimistically assumed that the average error would be 300 yards from the aiming point. Operational experience invalidated this assumption. Yet, once the decision had been made to concentrate on night bombing, the 300 yard error assumption was retained, and operational plans were based on it. The coincidence of night bombing and the attempt to hit precise targets in Germany compounded the difficulties faced by Bomber Command and made it more certain that the objectives would not be achieved. Why then was a major operational revision only gradually accompanied by a comprehensive re-evaluation of strategy? One would have expected either revised objectives or concentration on new techniques - especially in view of all the other shortcomings revealed in the preparation for the strategic bombing campaign.

First, the commanders had little choice but to retain the principle of precision targetting. With a small force only precision bombing made sense. The number of aircraft available and the tonnage of bombs they could deliver, coupled with the limitations on raids imposed by the weather and navigational handicaps all pointed to the need to strike particular targets within the German economic system. It was for these sorts of reasons that the Oil Plan had such an enduring attraction.

Second, the planners were not yet ready to surrender the principle of precision targetting. Collateral damage and attack on morale came to be accorded a status in the bombing directives, but the principal targets remained selected economic categories, in accordance with pre-war theories of attacking economic bottlenecks. Existing experience of night operations suggested that the new modus operandi should not impose unbearably heavy penalties on navigation and accuracy. Number 4 group had operated far and wide over Germany by night, delivering propaganda leaflets, facing very little opposition and suffering minimal losses. The Germans had no effective night fighter defence system at that time. Navigation and visibility seemed to be manageable factors as the crews

reported favourably on their ability to find their way and locate features in the dark landscape below. Unfortunately the loads of non-destructive leaflets made objective verification impossible.

After a year of dropping more explosive loads on Germany objective judgements could be made: this was the task given to Mr Butt by Lord Cherwell. His report (completed in August 1941) analysed photographs taken from bombers as the bombs were dropped, during operations in June and July 1941 and claimed to represent a broadly accurate picture of the profound failure of precision night bombing. It was a picture accepted by the leaders of the British war effort. It must also have confirmed the suspicions of many within Bomber Command.

The report found that of the aircraft recorded as having attacked their targets, an average of one in three was actually within five miles of the target and if all sorties were considered only one in five of the bombers, on average, dropped bombs within five miles of the target.

"Thus, of the 6,103 aircraft sent out during the period reviewed by the report, from which 4,065 claimed to have attacked their targets, it now appeared that only about 1,200 had even bombed an area of 75 square miles around them. In the case of the Ruhr, where the defences were stiff and an industrial haze common, it seemed that only about seven out of every hundred bombers dispatched, got even this somewhat imprecise result."¹

Of course, to bomb merely within five miles of the target was in fact no achievement at all in terms of the aims of precision bombing. The notion of rational and mathematical operational programming was blown wide open. This refutation of the then current approach to strategic bombing coincided with other forms of disruption in the planning being carried out for Bomber Command by the Air Staff. It will be recalled that once the bombing of Germany began in May 1940, the bombers had been ordered to focus on oil, communications and the German aircraft industry. Oil had been the most important target for the economic planners at the Air Ministry but the Oil Plan was terminated by a directive of 9th March 1941². This committed Bomber Command to concentrate on targets relevant

1. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, vol. I, page 247.

2. From Air Chief Marshal Sir Wilfrid Freeman (Vice Chief of the Air Staff) to Air Marshal Sir Richard Peirse, printed in *ibid*, Vol IV, pages 133-134.

to the current phase of the Battle of the Atlantic. The main points of Bomber Command's contribution were 'mass industrial attacks' on submarine construction yards and factories producing the Condor bombers. German naval units at sea and in harbour, U-boat pens and airfields operating the German long-range air force were also attacked.

The next change came with the directive of 9th July 1941, initiating the Transport Plan.

"I am directed to inform you that a comprehensive review of the enemy's present political, economic and military situation discloses that the weakest points in his armour lie in the morale of the civil population and in his inland transportation system. The wide extension of his military activities is placing an ever increasing strain on the German transportation system, and there are many signs that our recent attacks on industrial towns are having great effect on the morale of the civil population.

2. Subject, therefore, to para. 7 below, I am to request that you will direct the main effort of the bomber force, until further instructions, towards dislocating the German transportation system and to destroy the morale of the civil population as a whole and of the industrial workers in particular.

5. Most of the railway centres listed in Appendix 'A' lie in congested industrial areas and near concentrations of workers' dwellings. These objectives are therefore to be considered as suitably located for obtaining incidental effect on the morale of the industrial population. Moreover, the dislocation of the railway system will serve further to disturb the normal life of the community and will consequently have an indirect effect on the morale of the population, even when they are not subject to direct attack."

As with the previous plans, a target list was carefully prepared and justified, a raiding programme set up, and the calculations underlying the scheme explained. As in the past, it was made clear to Bomber Command what was required and what results should be expected. That this was actually a transitional plan is shown by the compromise contained amongst the quantifications. It was a compromise between the idea of precision attacks on economic targets and an attack on workers' morale in a broadly defined urban area. Gradually, the form and content of strategy was being brought into line with what was operationally possible. The Transport Plan was in practice an area attack on a group of German cities in the Ruhr rationalised as a precise attack on the railway targets in those cities.

1. Air Vice Marshal N H Bottomley (Deputy Chief of the Air Staff) to Air Marshal Sir Richard Peirse, printed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, pages 135-140

Like many compromises, it remained a flawed design. The Commander-in-Chief Sir Richard Peirse did not have at his disposal the bomb lift capability to dehouse the workers on the Ruhr, nor the navigational aids to find the transport bottlenecks. The Command played out the Transport Plan until the Butt Report had been digested. Then, sustained heavy losses and the realization that most bombers were not finding or hitting their targets gave rise to a decision to conserve the force for a renewed, and redirected, offensive in the spring of 1942. On 13th November 1941 Bomber Command withdrew from its current offensive in order to regroup, and long distance raids over Germany were suspended.

In the three months December 1941-February 1942 operational sorties declined and fewer aircraft were lost. The bombers were sent to different targets, often by day. Between 10th December 1941 and 20th January 1942 37% of Bomber Command effort was directed at the German cruisers Scharnhorst, Gneisenau and Prinz Eugen moored at Brest. I believe that Middlebrook is accurate in writing that "This was undoubtedly the lowest point in Bomber Command's war. The leaders had reluctantly to accept that many of their ambitions and claims had been too optimistic. The air crews had little to show for their endurance and the loss of so many of their comrades. It would have been easy at this time for both the bomber force and the strategic bombing theory to be abandoned in favour of waging war by more conventional means."¹

Three factors told in favour of strategic bombing. First, Winston Churchill believed in bombing, and gave the campaign his political support in the War Cabinet. He did not believe it could win the war, and he was not attracted by sophisticated theories of cost and benefit. He did feel that a large tonnage of bombs on Germany would significantly influence the outcome of the war.

"It must be remembered that we place great hopes of affecting German production and German morale by ever more severe and more accurate bombing of their cities and harbours, and that this, combined with their Russian defeats, may produce important effects upon the will to fight of the German people, with consequential internal reactions upon the German Government."²

1. Martin Middlebrook, The Nuremburg Raid, page 6.

2. Paper by Winston Churchill for President Roosevelt, 16th December 1941, part I, 'The Atlantic Front' printed in Winston Churchill, The Second World War, Vol. 3, page 577.

Second, great faith was placed in the navigational aid GEE, which was to enter service in 1942. This radio direction finding device would permit greater accuracy over targets in Western Germany, notably the Ruhr area. Concurrently, sophisticated equipment was being developed which promised not only a breakthrough in the struggle against the weather, the difficulties of long-range navigation at night and the uncertainties of locating targets across Germany, but, in addition, a real advance in the ability to deceive and evade German night defences. Third, and probably most importantly from the immediate point of view of the Command itself, a substantial degree of doctrinal consensus and operational clarity had been achieved by February 1942. The Air Staff position on the strategic campaign could now be put to the Chiefs of Staff unhesitatingly and consistently - and there was a real prospect that it could be profitably implemented.

3. Strategy redefined.

The Air Staff position that was articulated in the directive dated 14th February 1942¹ was an important modification of what had gone before. The Oil Plan represented one realization of the theory of independent strategic air power, the area bombing conducted by Air Marshal Harris, another. The transitional phase that was marked by the Transport Plan illustrates the changing command perspectives. For the time being, a distinct style of strategic bombing had failed. This transition was not, it must be stressed, characterised by an even development of decision making in the face of operational experience or as an outcome of innovative thinking about the practicalities of air warfare. Rather, it was marked by an amazingly disjointed and confused array of changing and competing plans, and a series of conflicting perspectives. These were played out in parallel to a fuller understanding of the capabilities and effectiveness of the bomber force, which was epitomised by the Butt Report. The outcome (prefigured in the directive of 9th July 1941) was given authority in the February 1942 directive that Air Marshal Harris found awaiting him at Bomber Command Headquarters. The new plan for strategic bombing emphasized three things which marked it out from the Air Staff planning that began with the first draft of the Western Air Plans in 1937.

1. See below, pages 64-65.

i) The city, as a totality, was becoming the central object of bombing strategy. Certainly, in 1942, the military value of cities was still largely judged to depend on the concentrations of industry and workers' homes that they contained, and therefore it is not accurate to say that the city at once became a target per se, irrespective of its contents or significance to the war effort. But the trend was established; it was to be one of Air Marshal Harris's contributions to bombing strategy to transform cities into worthwhile targets simply because they were cities.

ii) The creation of the city as target implied a strategy of area bombardment, because points within the city were no longer specified as the only target for destruction (but became integral to the destruction of the city) and because cities are too big to be defined as point targets. In addition to this logical connection, area bombing was undertaken because it could be made to work - the objective was brought into line with the capability.

iii) The conscious targetting of suburbs where the German workers lived marked the move from accepting collateral damage as a useful bonus, to the promotion of the workers' morale as the primary strategic target. A few had always argued that morale was the most useful target. In February 1942 it was seen as one of the important economic targets - admittedly a crude one - which coexisted with industrial plant and urban infrastructure.

These adjustments in strategic theory carried with them the practical realization that the size of the bomber fleet would have to be made much greater than anything envisaged by the pre-war theorists or conceived of by the Air Staff. The Air Staff expansion plan proposed a force of 4,000 heavy bombers. This plan represents a significant landmark in the development of air strategy, because it contains a different concept of the concentration of force. It was part of the idea that sheer weight of bombs, or level of destruction, was a key measure of concentration. The task had not merely become bigger, nor the target simply more diffuse; the power of a force of 4,000 heavy bombers lay at the heart of a notion of concentrated, pulverizing, destructiveness. Such a capability would signal a vast jump in the application of force. It would be a capability that was never to be achieved with conventional weapons, although what was achieved used up an enormous proportion of the British war potential. For Air Marshal Harris, failure to reach that level of force was to

become one of the reasons why he believed that air power alone did not win the war.

4. Unrestricted bombing.

There had been ambiguity in air power theory about whether strategic bombing alone could win a war, but there was no ambiguity in the mind of Air Marshal Sir Arthur Harris whom, when Deputy Director Plans, Ellington (then Chief of the Air Staff) had allowed "Full rein to develop his rather immoderate views. During Ellington's tenure, the Air Staff moved markedly towards air power extremism. Harris's view that the bomber was the decisive weapon in war became more and more prominent in Air Staff papers."¹ Between March 1942 and April 1944 Harris built up a truly independent strategic bombing force and conducted an independent strategic offensive aimed at bringing the German economy to its knees and enforcing surrender without the intervention of land and sea forces².

In his account of the campaign Harris makes clear his belief in the independent potential of the bomber.

"It is an obvious and most certain conclusion that if we had had the force we used in 1944 a year earlier, and if we had then been allowed

1. Malcolm Smith, British Air Strategy Between the Wars, page 39.

2. Sir Henry Tizard, commenting upon - and questioning the rationale for - the approach epitomised by the ideas of Sir Arthur Harris, makes it clear that such a strategy had enjoyed advocacy from the start of the war and that Harris expressed the views of a number of highly placed officers. "On the facts you may say that right at the beginning of the war there was a divergence of opinion, or at any rate there was a new idea introduced. The old fundamental idea was that you could only win the war if you brought the enemy's armed forces to battle somewhere and destroyed them. The new idea, which was taken to the extreme by some people, was after all, all that now did not matter, because what mattered was that by the use of the air you could destroy the enemy's economy, and therefore make his armed forces of no use whatsoever. This is the extreme idea beyond what is called the strategic air offensive. Some highly placed officers went so far as to say that other things were of no importance: what was important was to concentrate on the air and destroy the country. There is a fundamental thing here and that is in a highly industrialised country provided the raw materials are there, the machinery is there, the power supplies are there and the methods of transport are there, the capacity for production is immense. It is far greater than the production that is necessary for the use in battle." From the second day's transcript of discussions during 'Exercise Thunderbolt', 11-16 August 1947. Chief of the Air Staff papers, PRO - AIR 8/1536.

to use it together with the whole American bomber force, and without interruption, Germany would have been defeated outright by bombing as Japan was; the two atom bombs only added 3% to the already existing devastation, and their use against two cities merely gave the Japanese, as all American authorities agree, a pretext for immediate surrender when they had already been defeated by area bombing of the same kind as that used against Germany."

Harris was able to exercise his theories about air power at the point at which Bomber Command was beginning to acquire the sort of military capability which made his plans feasible. The squadrons were being equipped with heavy bombers throughout 1942, and by the summer of 1943, the numerical strength of the Command had reached the level at which really telling concentrations of force could be put over targets in Germany. During the same period a range of scientific aids to navigation and target location came into service. If these did not necessarily allow of pinpoint bombing, they certainly did facilitate a fairly accurate arrival over an aiming point in an urban area and a reasonable expectation that most of the bomb loads would fall within that area. The material strength was only one side of the picture. Harris and his staff at Bomber Command made numerous intelligent and successful tactical innovations. Much attention was given to means of evading and confusing the enemy defences. The pathfinder force was developed in order to increase accuracy, and another specialist group, no. 100 group, was set up to conduct radio counter-measures. The principle of mass and concentration was constantly followed and extended; new techniques of approach and bombing patterns were the result. Finally, the bomb load was made more effective, and a science was made of ways in which to maximise destruction with a given weight of ordnance.

When Air Marshal Harris took over Bomber Command, many of the uncertainties that had surrounded the strategic offensive up to then had been cleared up. The Air Staff directive of 14th February 1942 settled the issue of objectives and put an end to the fluctuation in planning that had gone before it.

"5. In accordance with these principles and conditions, a review has been made of the directions given to you in Air Ministry letter dated 9.7.41, and it has been decided that the primary object of your operations should now be focussed on the morale of the enemy civil population and in particular, of the industrial workers. With this aim in view, a list of selected area targets (taking account of the anticipated range of the TR.1335 equipment [GEE]) is attached in Annex 'A' to this letter. An additional list of targets beyond this range,

which can be attacked when conditions are particularly favourable and when a correct assumption of the accuracy and powers of concentration obtainable with the equipment has been made, are also included in Annex 'A'."

Harris himself was absolutely resolved on what was the correct use of air power, and was a determined enough commander to stick to his strategy. The directive, by specifying attack on morale, gave an official sanction to his preconceived policy. In addition, the force had come to terms with the realities of night bombing and had discarded the attempt to hit specific economic targets within urban areas. Henceforward, the vast majority of targets would be cities themselves. This practice of area bombing had been dictated by the initial inability of the force to hit, with consistent accuracy, anything smaller than cities at night. It was now made a virtue, and operational procedures and developments were concentrated on the city as the prime target.

By the spring of 1942 the arrival in the service of the first 4-engined heavy bombers and the increased flow of properly trained air crew progressively removed from Bomber Command the old liability of having plans which it could not adequately carry out. The fundamental capability to lift a substantial and increasing tonnage of bombs into German cities gave to the policy of area bombing what the old plans had not had - credibility. Portal and Harris well understood what advantages the removal of these uncertainties afforded to the air force and to their doctrine of air power.

Air Marshal Harris skillfully planned a campaign that would underline the new legitimacy of area bombing. The raids on Rostock and Lubeck were designed to show the potential of area attacks using fire razing tactics, and the 1,000 bomber raid on Cologne in May 1942 was a demonstration both of what a concentrated mass attack could achieve and, indeed, that such a concentration was operationally possible. Although the Germans were able to counter GEE within six months, its initial use ensured that the

1. Air Vice Marshal N H Bottomley (Deputy Chief of the Air Staff) to Air Marshal J E A Baldwin (Acting Air Officer Commanding in Chief, Bomber Command) printed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, pages 143-148. The towns listed in Annex 'A' (within range) were: Essen, Duisberg, Dusseldorf, Cologne, Bremen, Wilhelmshaven, Emden; (not within range): Hamburg, Kiel, Lubeck, Rostock, Berlin, Kassel, Hanover, Frankfurt, Mannheim, Schweinfurt, Stuttgart.

majority of bombs fell within the area aiming point at a time when proof of effectiveness was most needed. The pathfinder force was formed in August 1942 as a permanent aid to the bombers' ability to find their targets.

If the performance of the Command under Harris and the improved material circumstances of the force were reasons for satisfaction in the Air Staff, they did not yet add up to reasons why the pressures for alternative allocation of resources should subside. For much of that year the Admiralty (in particular) and the Middle and Far Eastern Commands continued to press for more air support. It was still being suggested that the independent bombing offensive had failed, and that the resources taken by Bomber Command could not be spared. We have already seen how the exigencies of the naval situation were summoned as reasons for diverting Bomber Command from German industrial targets to submarine factories and bases, and to the capital ships of the German fleet. The most crucial period in the Battle of the Atlantic was during the second half of 1942 and the first half of 1943. Especially in this period the Admiralty demanded the transfer of bomber squadrons to Coastal Command, and attacks on submarine targets. The grounds on which this diversion was argued were that defeat at sea would mean the end for Britain. The airmen resisted most of the demands, but the issue formed the basis of an extended controversy between Admiralty views on air power and the Air Staff belief that diversion to the Atlantic was a defensive and wasteful use of air power.

Improving the performance of Bomber Command was important for other reasons as well. Not only did Churchill's support have to be maintained, but as Russia and then America entered the war, so other avenues to the defeat of Germany opened up. A seaborne invasion of the Continent was under active preparation from the summer of 1942. The improving results of and prospects for the strategic bombing campaign did not extinguish the doctrinal controversy completely or for good. The more traditional group of theorists who had argued that specific classes of economic targets should be attacked (by precision bombing if possible, by saturation bombing if not) were only temporarily silenced. Their case was less easy to prove than Harris's was to assert. The Air Marshal and his staff had drawn up a list of sixty German towns containing more than 100,000 people, which were to be devastated. Some contained important industries, others were simply large urban areas. Lord Cherwell's

'dehousing' paper sent to Churchill in March 1942 started from a similar foundation.¹ To achieve success on these terms, the proponents of area bombing had to ensure that populated areas were repeatedly and heavily attacked. In the final three months of 1941 6,685 tons of bombs were dropped; in the same period of 1942 the amount increased to 8,946 tons; comparing the two years' totals reveals an increase of 50% by the end of 1942. Night sorties increased from 27,101 to 32,737, reflecting the fact that Bomber Command was able to carry a larger bomb load per plane. "During this period there was virtually no quantitative expansion in the available front line strength of Bomber Command. In November 1941 the daily average of aircraft available with crews for operations was 506. In January 1943 it was 515. But the force of January 1943 had undergone an important qualitative improvement. In terms of aircraft available for operations, it included a daily average of 178 Lancasters and 17 Mosquitoes. It did not include any Blenheims, Whitleys or Hampdens"²

The arrival of Harris and the issuing of the February 1942 directive gave the Command the stability, purpose and strength it required to be able to undertake an effective campaign to destroy Germany. But 1942 was in essence a transitional year and there were few notable successes after the 30th May raid on Cologne. Air Marshal Harris had to wait a little longer before he was able to concentrate the weight he knew to be essential. Meanwhile, if the threat to the offensive from within the British Command declined as the balance of the war began to shift so a different type of challenge was to be posed by American entry into the war.

The United States Army Air Force (USAAF) supported the Washington War Conference decision to concentrate on defeating Germany first because its leaders were anxious to apply their own theories of strategic bombing. It appeared that Japan would be out of reach for some time to come, whilst Germany was immediately available.

American theory differed from the British in important ways. Although both believed in the potential of independent bomber-based air power to

1. Lord Cherwell's paper is fully discussed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. I, pages 331-336, and Max Hastings, Bomber Command, pages 127-132.

2. *ibid.*, Webster and Frankland, Vol. I page 309

destroy the enemy's economy, American theory was much more specific than the British had been about what that entailed. The USAAF held that the enemy economy could be rapidly crippled by absolutely precise (or pinpoint) attacks on a defined group of targets. To achieve pinpoint accuracy the Americans devoted great efforts to their bombsights and bombing methods - they also planned to bomb their targets in daylight. Because they expected to be able to hit what they were aiming at, weight of bombload was much less important than it was for the British.

In common with initial RAF thinking, the USAAF believed in daylight bombing. Because precision was so fundamental to their thinking, the Americans would not even consider the option of bombing by night.¹ Unlike the British they had thought through rationally the implications of daylight bombing, and as a result operated heavily armoured and armed bombers and trained their crews to a high level in navigation and formation flying. This underscored another important doctrinal difference. The Americans accepted as necessary the obligation to meet and defeat the German Air Force in the skies over Germany. They would not seek to evade the defences but to destroy them - and thus establish command of the air. In this, American thinking was entirely at variance with British thinking.

Intrinsically, these differences need not have prevented fruitful cooperation between the two forces. The basing of the Eighth Army Air Force in Britain, and an American campaign under their own precepts against Germany need have caused no friction with their Allies. What gave the differences signal importance was the intention of the Allied leaders to formulate a joint campaign of all arms in order to defeat the Axis. At the Casablanca Conference in January 1943, when so much of the essentials of Allied grand strategy was agreed, the quintessentially independent character of strategic air power was taken away at almost the moment when Sir Arthur Harris was ready to launch his most powerful offensive over the Ruhr. Whereas Harris wished to defeat Germany by bombing alone, the Americans (and indeed many of the British leaders at Casablanca) did not believe this to be possible, and the outcome of the

1. American attitudes to daylight bombing and Sir Charles Portal's reaction, are discussed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. I, pages 353-363.

Casablanca discussions was to define the role of strategic air power as being that of preparing for the creation of air supremacy at the point at which the Allied armies returned to the Continent.

The Casablanca Directive, which was issued to Sir Arthur Harris on 4th February 1943 contained the following opening -

"Your primary object will be the progressive destruction and dislocation of the German military, industrial and economic system, and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened.
2. Within that general concept, your primary objectives, subject to the exigencies of weather and of tactical feasibility, will for the present be in the following order of priority:
(a) German submarine construction yards.
(b) The German aircraft industry.
(c) Transportation.
(d) Oil plants.
(e) Other targets in enemy war industry."¹

That Harris interpreted the first paragraph to mean that the central purpose of the attack on Germany had as its chief objective (i.e. was aimed at undermining) the morale of the German people has been much commented upon, and indeed demonstrates where his intentions lay. He also made it clear that he took this attack on morale to be the task assigned to Bomber Command. He thus established his readiness to resist the patterns which the wider course of the war was taking. He was able to do this, not only because he was an independent minded man, but also because the fruits of the decision on the allocation of British war resources, made by Winston Churchill and the War Cabinet in 1941 began to be gathered in by the RAF. Not only his prestige, but also his control of material, gave him great freedom of action. By March 1944 his daily average of aircraft available was 974, including about 600 Lancasters. In August 1943 a record monthly tonnage of bombs was dropped (20,149) a record which was broken in March 1944 (27,698).

The significance of the Casablanca developments is that air power theory acquired a new set of permutations - a range of competing approaches

1. Combined Chiefs of Staff Directive for the Bomber Offensive from the United Kingdom, printed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, pages 153-154

being given serious attention by a variety of groups and interests. It is possible to think of Harris's situation as one of a race against time. How long would Bomber Command have before Overlord made one of its goals irrelevant, or before the urgency of the Eighth Army Air Forces' situation compelled obedience to the combined offensive? That a challenge was being thrown down by the Combined Chiefs of Staff is implicit in the Pointblank Directive of 10th June 1943.

"1. The mission.

(a) The mission of the United States and British bomber forces, as prescribed by the Combined Chiefs of Staff at Casablanca, is a follows:

to conduct a joint United States-British air offensive to accomplish the the progressive destruction and dislocation of the German military, industrial and economic system, and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened. This is construed as meaning so weakened as to permit initiation of the final combined operations on the Continent.

3. Intermediate objective

(b) Hence the successful prosecution of the air offensive against the principal objects is dependent on a prior (or simultaneous) offensive against the Germany fighter strength.

(c) To carry out the Eighth Air Forces' part of this combined bomber offensive it will be necessary to attack precision targets deep in German territory in daylight. The principal obstacle to this is the growing strength of the German Air Force."

The sentence which I have emphasized had been added in order to underscore the subservience of air power to the land forces that would invade the Continent. Yet Sir Arthur Harris wished to win the war by bombing alone. In a minute to Winston Churchill on 17th June 1942 Harris wrote, "We are free, if we will, to employ our rapidly increasing air strength in the proper manner. In such a manner as would avail to knock Germany out of the war in a matter of months, if we decide upon the right course. It is imperative, if we hope to win the war, to abandon the disastrous policy of military intervention in the land campaigns of Europe, and to concentrate our air power against the enemy's weakest spots"¹. Immediately before the Battle of Berlin, in another minute

1. The Combined Bomber Offensive from the United Kingdom (Pointblank) as approved by the Combined Chiefs of Staff, 14th May 1943, printed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, pages 273-283. Emphasis added.

2. Quoted in, Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. I, pages 340-341.

to Churchill, he reiterated this view: "We can wreck Berlin from end to end if the USAAF will come in on it. It will cost between 400-500 aircraft. It will cost Germany the war."¹ In attempting to back up these claims, Air Marshal Harris, in the twelve months following February 1943, conducted three great battles of area bombardment. They were a mighty struggle of attrition in pursuit of independent victory and conducted in defiance of the requirements set out in 'Pointblank'. The Battle of the Ruhr was a success; in Harris's view that industrial conurbation was 'out'; but Germany did not collapse as a result.

In the Battle of Hamburg, a stunning success, Bomber Command (assisted by two daylight raids by the USAAF) came as close as it ever was to, over nine nights and four major air raids, to achieving perfection in strategic bombardment. The concentration of bomb weight and the attack in time, coupled with very precise bombing of a predefined area created, in Hamburg, enormous destruction and a situation which was entirely out of control on the ground. While the attack lasted the city was helpless. One of the reasons for this remarkable concentration was the number of heavy bombers Bomber Command had at its disposal to put over the target. Another was the carefully calculated method of 'streaming' the bombers through the German defences and the finely balanced system of organizing the bombers over the target. The struggle with the German night fighter defences had reached a new pitch of intensity and ingenuity that increasingly characterized the seesaw struggle between the tactics of evasion and the methods of interception. On this occasion the advantage was fatally against the Germans because the RAF used 'window' for the first time and were able to hopelessly confuse the fighters and the anti-aircraft guns. So significant was Hamburg, that Albert Speer wrote, "Hamburg had put the fear of God in me. At the meeting of the Central Planning on July 29 I pointed out: 'if the air raids continue on the present scale, within three months we shall be relieved of a number of questions we are at present discussing. We shall simply be coasting downhill, smoothly and relatively swiftly.'"²

Hamburg showed what was possible, the subsequent Battle of Berlin was a defeat from which Bomber Command took months to recover - months in which

1. Quoted in, Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. II, page 48.

2. Albert Speer, Inside the Third Reich, page 284.

the operations in support of Overlord and the ultimate achievement of air supremacy served to alter radically the conditions under which the air war was fought. The Battle of Berlin was ended in March 1944. In the preceding month, Harris had finally ordered the much demanded, and by then, actually symbolic, attack on Schweinfurt. The imperatives of Pointblank were finally acknowledged.

In the period of the three battles a theory of air power was properly tested. After the summer of 1944 the German air defence system was breached by the advance of the Allied armies and the depredations of the fighter squadrons. The Germans fatally surrendered the advantage of depth. The reference in Pointblank of the ability of the USAAF to achieve its aims signifies the growing importance of the American struggle against the Luftwaffe, and of the attempt to achieve air supremacy. Sir Arthur Harris argued that Bomber Command had been reorganized to attack German morale by night time area bombing and that by the summer of 1943 it had begun this task in earnest and with success. He also argued that there was little the Command could do to affect the strength of the German defences - this was the task that the USAAF had set itself. The issue was one of the relationship between area and precision. In October 1943, when the Americans were forced to retire from the campaign in order to regroup, it looked as if Harris's arguments had been correct. Yet by the following February, when British bombs at last fell on the now dispersed ballbearing factories at Schweinfurt the situation had changed radically. Bomber Command was about to withdraw from the Battle of Berlin, forced to desist because of the heavy losses sustained. And this was just at the point when the transference of its bomber squadrons to General Eisenhower was at hand, while by then the USAAF had at last overcome, to all intents and purposes, the German day fighters.

5. The conclusion of the air war in Europe.

Once the Allies had established themselves on the Continent, and certainly by the middle of August 1944, many of the earlier controversies surrounding independent air power became academic, at least in as far as they related to the war against Germany. Independent air power had not, and now could not, win this war. What it did do was to contribute

enormously to the success of the land campaigns, primarily through the interventions of tactical air power and carpet bombing by strategic forces. Practical and theoretical attention shifted to this aspect of air power, and Air Marshal Tedder, who was to succeed Sir Charles Portal as CAS in 1946, came into his own inheritance. Yet, putting aside the state of the German defences, the autumn and winter of 1944/1945 was the time at which the plans laid for British strategic air power in 1936/1937, and confirmed and augmented at the end of 1941, came to their most abundant fruition. Air Marshal Harris had at his disposal 1,500 heavy bombers, 350,000 personnel and the products of an immensely impressive scientific effort. Tactical and operational innovations were by 1945 enormously effective. This illustration of the requirements and imperatives of modern industrial warfare (not least of all its necessary time scale) was too vivid to be missed by those who led the post-war British military effort.

Three important conclusions emerge from this analysis of the evolution of air power theory during the strategic bombing campaign.

- i) The strategic bombing forces were used with great success in the support of the army in France. This actually served to enhance the reputation of air power and generated the axiom that air power was the dominant factor in modern war, and would continue to be so for the foreseeable future.
- ii) Command of the air was established and maintained by long-range escort fighters. This permitted something approaching strategic bombing at will - the most sorties were flown and by far the greatest monthly tonnage of bombs dropped in the period September 1944 to March 1945. Freed to bomb selectively, the USAAF attack on German oil ultimately did have a decisive and catastrophic effect on the German war effort. The area attacks were halted before the end of the war, but in a very real sense, Bomber Command had run out of area targets. Churchill made the point that, "The moment has come when the question of bombing German cities simply for the sake of increasing the terror, though under other pretexts, should be reviewed. Otherwise we shall come into control of an utterly ruined land. I am of the opinion that military objectives must henceforward be more strictly studied in our own interests rather than that of the enemy. I feel the need for more precise concentration upon military objectives, such as oil and communications

behind the immediate battle zone, rather than on the mere acts of terror and wanton destruction, however impressive."¹

iii) Nowhere was there evidence of collapse of German morale solely as a result of air raids; nor on a significant scale as to produce civil disobedience or the cessation of industrial production as a result of the refusal of German workers to work.

1. Memorandum for the Chiefs of Staff Committee and the Chief of the Air Staff from Winston Churchill, 28th March 1945, quoted from AHB File, in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945 Volume III, page 112.

Chapter 3

Some lessons of the campaign

"In the perspective of history, the conquest of Constantinople by Mohammed II in 1453 is important, inter alia, because it inaugurated the revolution in warfare produced by the introduction of artillery. For Mohammed, however, what was important was not the inauguration of a revolution in warfare but the capture of a city."

There are two standards by which the strategic air offensive against Germany may be assessed. I have referred to the campaign as a model of judged success which influenced the thinking of those who were associated with it, and many of those who planned Britain's post-war military policy. That is one standard. Another is to subject the campaign to an analysis using the categories common to all analyses of military campaigns. In this chapter I am primarily interested in applying the first assessment, but in the end, both standards have to be taken into account.

The bombing of Germany was undertaken with a number of aims in view, and in accord with a range of air power precepts. It would be pointless to analyse the campaign without reference to these factors, and the best way to come to grips with them is to consider what was the state of British air theory in the period leading up to 1939.

The basic tenet was the independent nature of air power, from which followed the importance of the heavy bomber and the primacy of the offensive. The ground on which the claim of independence was based was the intention to attack the enemy economy: directly, without assistance from the army or navy, and without having to overcome, as a preliminary, the armed forces of the enemy. (What comprised the enemy economy will call for careful analysis.) These four elements are so intimately bound up that they can be taken as forming the bedrock of British air power theory.

Between the discussions on Sir Hugh Trenchard's memorandum on 'The War Object of an Air Force'¹ in May 1928, and the Joint Planning Sub-Committee's appreciation of the 'Situation in the Event of War Against

1. Louis Halle, The Cold War as History, page 118.

2. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, pages 71-76.

Germany in 1939', of October 1936¹, there were important changes in the Air Staff's view on how the RAF would be employed upon the opening of hostilities. These changes derived from a force of circumstances which obliged the Air Staff to plan operations with an inadequate bombing force and facing an air threat thought to be possibly decisive, and from the fact that the potential enemy was identified and was considered to hold the initiative in the air, by virtue of its superiority in both offensive and defensive air forces. I have already outlined these circumstances: for the moment it is possible to regard Trenchard's statement as a theoretic exposition of the ideal, in which, if any particular enemy was envisaged, it was perhaps still France.

In Trenchard's view, future wars would open with bombing attacks on the belligerents' cities, aimed both at destroying the capacity to sustain the armed forces in the field, and undermining the civilian populations' ability and desire to continue the war. He did not claim that air attack alone could win the war, nor did he subscribe to any extreme notion of the knock-out blow.

".... In the view of the Air Staff the object to be sought by air action will be to paralyse from the very outset the enemy's productive centres of munitions of war of every sort and to stop all communications or transport."²

The term 'from the very outset' demonstrates that Trenchard believed that air action should form the opening offensive of future hostilities, and he further stressed that persistent offensive activity was the key to the first stage of a successful strategy, the gaining of air superiority. For Trenchard, the matter of air superiority hinged on two factors - i) the determined penetration of enemy air space by offensive bomber formations, and ii) the maintenance of the offensive until the enemy's own offensive efforts are reduced in preference to defensive action to protect his economy. At this moment an important turning point in the campaign will have been reached.

"The gaining of air superiority will be incidental to this main direct offensive upon the enemy's vital centres and simultaneous with it. The stronger side, by developing the more powerful offensive, will provide in his weaker enemy increasingly insistent calls for the protective employment of aircraft. In this way he will throw the enemy onto the defensive."³

1. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, pages 88-95.

2. Memorandum on 'The War Object of an Air Force', May 1928, printed in *ibid.*, Vol. IV, page 72.

3. Memorandum on 'The War Object of an Air Force', May 1928, printed in *ibid.*, Vol. IV, page 73.

Trenchard visualised a period of struggle during which both sides' offensive forces would strike at the other's vital centres. The superior strength, which would produce the denouement of the weaker side changing to a defensive posture, would seem to be formed of two elements - the endurance of national will to continue, and a preponderance of bombing forces available and committed to the struggle. According to the minutes of a Conference at the Air Ministry in July 1923¹, Trenchard said;

"Would it be best to have less fighters and more bombers to bomb the enemy and trust to their people cracking before ours, or have more fighters in order to bring down more of the enemy bombers. It would be rather like putting two teams to play each other at football, and telling one team they must only defend their own goal. I feel that although there would be an outcry, the French in a bombing duel would probably squeal before we did. That was really the final thing. The nation that would stand being bombed longest would win in the end."²

The Air Staff always judged fighter and bomber requirements by different measurements. Fighter strength was understood to depend on political pressures for home defence, and on the relationship between the extent of vital areas to be defended, and the anticipated scale of enemy attack. Required bomber strength would be gauged by comparison with the bomber strength of the anticipated enemy. It was held that a preponderance of force was needed in order to be able to persistently strike harder at the vital centres of the enemy than he could strike at your own: that is - in order to sustain the offensive. This is why parity was regarded as an important yardstick. Without at least an equal force it might not prove possible to oblige the enemy to turn to a defensive strategy first.

1. Printed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, pages 62-70.

2. This strategic conception is mirrored in Herman Kahn's book On Thermonuclear War in which he argues that the critical measure of successful deterrence is the ability of one's own nation to survive and endure the worst enemy attacks while striking with a strength too great for the enemy to suffer. "Credibility depends on being willing to accept the other side's retaliatory blow. It depends on the harm he can do, not on the harm we can do. It depends as much on air defence and civil defence as on air offence. It depends on will as well as capability. It depends on the provocation and on the state of our mind when the provocation occurs. One should also note that being able to use a credible first strike capability to influence Soviet or European behaviour depends not only on our will, but also on Soviet and European estimates of our will. Serious problems may be created for us if either of them does not believe in our willingness to attack under certain kinds of provocation." page 32.

The significance of the bomber's role in persistently and damagingly penetrating the enemy's air space lay not only in Trenchard's attitude to air superiority, which in essence consisted of a dynamic between offensive and defensive postures. It also arose out of his views on the nature of the struggle in the air. The achievement of air superiority was not conditional upon defeating the enemy's air forces. Indeed one of the great advantages of air power was the fact that it could over-fly the enemy forces-in-being and inflict damage by attacking the weak points rather than engaging the armed forces directly, which form the strongest point.

"It is not necessary for an air force, in order to defeat the enemy nation, to defeat its armed forces first. Air power can dispense with that intermediate step, can pass over the enemy's navies and armies and penetrate the air defences and attack direct the centres of production, transportation and communication from which the enemy war effort is maintained. This does not mean that air fighting will not take place. On the contrary, intense air fighting will be inevitable, but it will not take the form of a series of battles between the opposing air forces to gain supremacy as a first step before the victor proceeds to the attack of other objectives."

The role of air defence, then, was to reduce the scale of the enemy's bomber strikes by attacking the bomber formations en route to target. It was not the function of the fighter to win control of the air because air space could not be taken and held, rather in the way in which it was argued that areas of sea could not be taken and held. In any case, it was not believed that fighters could operate successfully in the air space over enemy territory, which was the area that mattered. It was the bomber's role to dominate this air space by conducting the air offensive from within it. The role of fighters was secondary also in the sense that it was thought that, although they would intervene in the struggle by attacking incoming bombers, they would not be able to prevail over a sufficiently powerful and coherently mounted bomber offensive. Ultimately, it would be the relative weight and effectiveness of the attacks that would decide the issue of air superiority. Even when one side had gone over to the defensive, this general principle was held to be valid, because it was thought that bombers would hold their own against fighters, and because, once the offensive initiative had been decided, the defensive belligerent would get progressively weaker as its war potential was smashed by the bombers, while the offensive power would grow steadily stronger.

1. Memorandum on 'The War Object of an Air Force', May 1928, printed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, page 72.

This brings into focus the final key consideration, the exact nature of the targets. Trenchard was emphatically against what we could call a counter-force strategy. He did not entirely rule out attacks on enemy air bases, but he regarded them as much less profitable targets than the centres of production. Military bases and concentrations of armed force will be well defended, but the main virtue of the economy as a target lay in the fact that it was the source of armed strength and its reinforcement. "Among military objectives" he wrote in the memorandum "must be included the factories in which war material (including aircraft) is made, the depots in which it is stored, the railway termini and docks at which it is loaded or troops in train or embark, and in general the means of communication and transportation of military personnel and material."¹ This conception of destroying the enemy war potential at source, while not new, was one of the great novelties of Trenchard's formulation because of his contention that it should be attempted decisively and at once, and could be achieved without first defeating the enemy's armed forces or even undertaking an aerial conflict aimed at sweeping aside air forces interposed between the attackers and their targets. On these grounds was the air offensive judged to be strategic in nature and independent in operation. The Air Staff did not propose the indiscriminate bombing of cities for any reason, let alone for the purpose of terrorising or wantonly killing the civilian population. The emphasis was very strongly on the economical use of armed force, the rational application of strength to the enemy's most vulnerable (and accessible) source of military power. The targets were therefore to be specific points in his possession which, it is clear from the reference above, were regarded as military targets. Although the notion of attacking morale alone was foreign to this conception there was, however, a very clear understanding that heavy air raids along the lines proposed would have a detrimental effect on the morale of the enemy workers and their consequent willingness to work, and this effect was welcomed.

This, then, can reasonably be taken as the fullest picture available of British air power theory before 1939. Trenchard's position was not absolutely iconoclastic - for example he quite explicitly argues against

1. Memorandum on 'The War Object of an Air Force', May 1928, printed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, page 73.

the view that bombers alone could win the next war. Rather, he is putting the Air Staff's case for the correct use of air power in a situation where the commanders of the other services only grudgingly acknowledged the importance of air power. Apart from their scepticism about the ability of bombers to hit the industrial and communications targets assigned to them, the Chief of the Imperial General Staff and the Chief of the Naval Staff concentrated most of their criticism on i) the contention that air defence would not have the influence that defence forces traditionally had been able to exert, and ii) Trenchard's neglect of British vulnerability to the type of attack that he was proposing.

I have said that this summary of Trenchard's thinking represents an ideal vision. In the Air Staff of the 1920s and 1930s there were no doubt ambiguities of theory, differing views and emphases, some uncertainties. Any very careful examination of the period must reveal a welter of contradictory finer detail.¹ However, given Trenchard's widely acknowledged dominance in the pre-war Air Staff, and his prominent role in codifying air force doctrine, it would seem unnecessary to doubt too radically that his was the model which formed the basis for future development and adaption of British air power theory.

That a rounded theory of this sort did inform Air Staff planning and action before the war, just as a consolidation of theory informed it after the war, seems to me undeniable. Yet there tends to be some hesitation in asserting this, which stems not from the imprecisions in the theory or its articulation, but from the fact that the progression of British air power is muddled by the circumstances of its employment. In comparison, the theories of the German armoured Blitzkrieg and of the American daylight precision bombing provide no such incentives for hesitation. The theories themselves were no more rounded than was British air power theory - what they possessed were commanders as resolute as Guderian, Spaatz and Eaker, who themselves had the forces necessary to fully implement the theory. The relatively smooth success²

1. See for example Malcolm Smith, British Air Strategy Between the Wars and U Bieler, The Shadow of the Bomber.

2. It could be argued that the success of the USAAF's daylight bombing was hardly smooth - but this would be pertinent only in a minor sense. The Americans set out to bomb precisely by daylight. When they found the bombers alone could not overcome German defences, long range fighters were introduced. Daylight bombing was the principle, not self-defending bomber

in practice seems to remove much of the doubts about the coherence of the pre-existing theory.

By comparison, British air power theory underwent a series of adjustments and was to be employed at the start of the war in a manner contrary to that expounded by the Air Staff of the late 1920s. It is this which produces the uncertainty about the relationship between theory and practice.

Initially, the accommodations which occurred primarily in response to the abandonment of bomber parity and the acceptance of temporary inferiority, with a consequent emphasis on air defence, demonstrate an almost complete retreat from the ideal strategy set out by Trenchard in 1928. It was accepted by 1936 that Bomber Command did not have the strength decisively to attack the German economy, let alone to force the German air effort onto the defensive. The central problem had become one of how to mitigate the effects of a German air attack on Britain, and consideration was switched to the ability of Fighter Command to meet the German effort. The role of Bomber Command in this defensive struggle was revised, by the Joint Planning Subcommittee, to what Trenchard had held to be one of the least useful - that of counter attack against the enemy striking force.

"It appears that in these circumstances we should be forced to direct the bulk of our counter air offensive against the enemy's air striking force and its maintenance organization as the most immediate method of reducing, however inadequately, the scale of enemy air attack. Nevertheless this course would only be adopted faute de mieux, and could be no more than a palliative holding out no hope of eventual victory, even if it could avert defeat."¹

Thus theory seemed to be stood on its head. But as I have pointed out, these proposals stemmed from offensive inferiority and the surrender of the initiative. It was foreseen that if the attack could be held, then Bomber Command would readopt its former role and to allow for this, the greatest possible conservation of force was advisable.

"Such action [attack on air striking force] is, however, a purely defensive strategy, and, since we cannot apply effective pressure on Germany until we attack her vulnerable points, it is essential that at least a proportion of our air striking force should take the offensive against such objectives as soon as possible."²

1. Appreciation of The situation in the event of war against Germany in 1939, 26th October 1936, printed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol.

IV, from page 90.

2. *ibid.* page 92.

The adjustment to the pre-war balance of power was given operational shape in the Western Air Plans, the first draft of which was completed in 1937. These plans were the Air Staff's effort to reconcile its doctrine of the bomber offensive with British strategic requirements in the event of war beginning before the RAF's strength had expanded. They were drawn up concurrently with a very rapid expansion of the numbers, and improvement in the operational techniques, of Fighter Command. At the same time, however, the expansion plans for Bomber Command were maintained; plans which involved increased production of the existing marks of heavy bomber, and accelerated development of the next generation of 'heavies' of which the Short Stirling and the Avro Manchester were the chief examples.

The Air Staff based the Western Air Plans on the assumption that the Germans would start the war in the West with one of two strategic options.¹ Either they would first attempt to knock out Britain (and/or France) by major air attack on cities; or they would invade France, employing air power to shatter the tactical air forces and give close support to the German army. Although the correspondence was not absolutely clear cut, it is broadly true that WA1, the Plan 'for attack on the German air striking force and its maintenance organization (including aircraft industry)' was devised to meet the former option. WA4, the Plan 'for the attack of German military rail, canal and road communications' was to be employed against the second option. Only WA5 retains the elements of a strategic air offensive as originally envisaged - '(a) the attack of German war industry; (b) the attack of the Ruhr and its effect on the military lines of communication in Western Germany; (c) attack on Germany's war resources of oil.'²

1. Malcolm Smith in British Air Strategy Between the Wars, writes "In the Western Air Plans all the aspirations of the British school of air power were centred." (page 269) It seems to me that this is a misinterpretation of the Plans and the impulses that underlay them. That they were a compromise - an effort to reconcile theory with strategic necessity - is demonstrated by the fact that only Plan 5 (of the 16 that existed in 1939) contains the sort of options that informed the doctrine of a strategic offensive against vital economic targets. Furthermore, plan 5 was explicitly reserved for a counter attack once German intentions had become clear, and only then when it could be undertaken with acceptable losses: i.e. - when the air power balance had been stabilized. Sir John Slessor in his memoirs (The Central Blue) makes it clear that the Western Air Plans were transitional, see pp. 205-214 and 238-239.

2. The Plans and their subjects are listed in Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, Appendix 6, pages 99-102.

In the event the strategic assumptions behind these plans proved to be overly pessimistic (from the RAF's point of view). The pause between September 1939 and May 1940 gave the RAF time to adjust to the balance of power in the air, and the rapid collapse of France quickly removed the rationale for Plan WA4. Plan WA1, which was anyway considered by the Air Staff as the most 'irresponsible' Plan, was never really put into operation - Fighter Command proved able to check the first rush of German bombing. The night Blitz which formed the second phase was endured by British citizens in much the manner envisaged in the conception of a duel between bomber forces. It was Plan WA5 that was in fact implemented from May 1940, when the strategic offensive did begin, and it was WA5 which formed the basis of Bomber Command's first proper strategic plan - the Oil Plan. We can see then that the Western Air Plans implied the surrender of the intention to deliver, as an opening strategy, an independent attack on strategic targets. The need to employ heavy bombers in cooperation with other arms was acknowledged. Also accepted in the plans was the potential power of air defence, and the utility (in some circumstances) of a counter-force strategy against German air power in being, as opposed to air power in production. A belief in the bombers' ability to penetrate enemy defences was not abandoned, it was merely recognized that the small size of the British force, and the preponderance of German air power, would lead to unacceptably high proportionate losses if a strategic offensive was mounted immediately. Thus it was decided to conserve the main heavy bomber force until a strategic offensive could be mounted, with acceptable losses, against vital targets.

The point to be emphasized in relation to the Western Air Plans is that they were conditioned by the numerical inferiority of the British bombing force compared to that of the German. This weakness, and the fact that British war strategy took as a premise that the Allies would begin the war in a defensive position, determined the character of British air strategy in 1939. The original themes of strategy were retained, except that they were now to make up the substance of a counter attack. What produced a more fundamental re-evaluation of the schema laid down by Trenchard in 1928 were the actual experiences with bombers in combat.

The eventual course of the strategic air offensive, 1939-1945, threw up challenges which were met by evolving the original air power theory. Most of the adjustments took place within a framework of the original

precepts, although some of the challenges did radically compromise the 'ideal' formulation.

The counter-attack, as it was styled, that opened in May 1940 utilizing Plan WA5, was Bomber Command's response to the opening German moves, and although aircraft factories were accorded priority status, in reality signalled the demise of Plans WA1 and WA4. Thus, the campaign, in however an inadequate a fashion, did open with the attempt to paralyse the enemy war economy by attacks on vital points, and continued with this objective for the next two years.

The conversion of the force to night bombing did not, in the short term, impinge on this objective. Indeed, it did not mark any change in the fundamental conception of bomber strategy. It had been maintained that the bomber would be able to penetrate the air defences. The decision to carry this out at night was simply the recognition that too great a faith had been placed on the bomber's ability to defend itself in daylight raids, not an adjustment in the estimation of the power of the defence per se. What night bombing did signal was the beginning of a strategy of evasion as a means of penetration, replacing the idea of a contested journey to the target. What was not foreseen in the summer of 1940 was the potential power of night defences to attack the bombers and when this potential became apparent, much effort was put into the task of confusing and deceiving the defences by electronic warfare.

Another consequence of night bombing, in particular, but also of the overall deficiency in Bomber Command's ability to navigate accurately, and to hit and destroy specific economic targets under even the most ideal circumstances, was the growth of a body of opinion which favoured abandoning precision targetting. The outcome, established theoretically by February 1942, and the ruling operational tenet by March 1943, was the decision to target whole cities (area bombing) with the stated object of breaking enemy morale. At one level simply a matter of bombing technique, this decision in fact represented a major adjustment to the pre-war vision: and one which would set serious difficulties in the way of evaluating the effects of the campaign.

Strategic bombing had been seen by the Air Staff as a precise operation aimed at paralysing the enemy war effort by striking decisively at its

vital points.¹ This was not only an efficient use of force, it was one that could have been measured reasonably accurately, and thus justifiable as a contribution to the military effort. In 1941 it came to be clearly perceived how crucial was the ability to judge effect in meeting the arguments of those service chiefs who had other plans for air power. At that stage the Air Staff was sure that Bomber Command was too small to achieve decisive results over Germany, but the Staff had little to counter the fact (as revealed by Mr Butt) that Bomber Command was achieving almost no results at all.

The problem hinged on navigation and accuracy. Neither a fullscale return to daylight bombing, nor the exploration of a course that would allow such a return to be undertaken successfully were seriously considered. The problem was approached from the angle of how to make night bombing more potent. This search led inexorably to the decision to attack what could be hit at night: i.e. large urban concentrations, and to define the object of the attack as something both generalized in extent but specific in importance, that is the morale of the industrial workers. The intention in February 1942 behind focussing 'on the morale of the enemy's civil population and in particular, of the industrial workers' was, in spirit, still generated by the original impulse for efficiency. Morale appeared to be something that would materially affect the war effort. The impulse was not inherently terroristic, nor aimed at destruction for its own sake, but that is what it was to become because there was no accurate way to measure the state of morale. The models used to underpin area bombing were derived from the German attack on Coventry and from the calculations of Lord Cherwell on how rapidly and with what effort German workers could be dehoused. Both of these models suppose an end product of measurable diminution of economic activity. Yet the central problem remained, that it was difficult to judge the state of enemy morale and its relationship to industrial output. For example, would morale suddenly collapse, or gradually decline; and how would a lowering of morale in one area transmit its effects to another area?

1. Malcolm Smith, British Air Strategy Between the Wars, makes the valuable point that the populist interwar advocates of air power (such as L E O Charlton) stressed the terrorising and destructive effects of indiscriminate massed bombing, and criticised Trenchard for thinking in terms of a stiletto rather than a club.

At an Air Staff exercise in 1947, Professor Zuckerman presented a critique of the decision to turn to area bombing, and suggested some answers to the questions posed by targetting cities, as such, during a strategic bombing campaign. It is an instructive analysis - not least because of the way in which he suggests the decision determined the course of armament development.

"With regard to Air Chief Marshal Sir Norman Bottomley's address this morning, he stressed very heavily the technical reasons why area bombing was forced upon us. It was impossible to bomb accurately and losses were high, and he gave the reasons that lead to the adoption of this policy. I do not think the other side of the picture has been emphasized sufficiently - the facts which, when put together, make the towns into the best unit targets we could attack. That did occur at the same time in all the discussions that have taken place about our bombing. We knew what was happening in this country but it was extraordinarily difficult to show that the German attacks were really disrupting our production. The only index which we could get of the efficacy of German attacks here was the destruction of housing and the killing of people and dislocation of services, and, in so far as it was possible to relate any production losses to air attacks, we did assume that the disruption of services in the cities was the responsible factor. And in the period when there was considerable controversy about the virtues of the bombing policy it was necessary to stress the policy side, and towns as such emerged as unit targets. I will not discuss for the moment whether or not that was a good or a bad thing, but I do want to emphasize this: that the very fact that towns emerged as the best unit targets, irrespective of the technical limitations of bombing, caused a vicious circle and not a vicious spiral, because it turned all development in that direction; and that is a point which Air Chief Marshal Bottomley has not emphasized this morning. Armament development was very largely concerned with the development of weapons to burn down cities and not with the development of weapons such as Tallboy, which was wanted afterwards when we could attack precise targets. As we all remember, the Tallboy in 'grand slam' period began only in the spring of 1944 from the point of view of production, and from the point of view of use began after D Day. I believe quite definitely that this vicious circle, the development of the idea of towns as jolly good things to destroy, was responsible for this technical development. In addition, it was responsible for the belief that other more specific targets were not as good as towns. This is a very important fact, because in many subsequent discussions I believe the virtue of towns dominated people's minds so that, whether or not the reasons were good or bad in favour of attacking some other system, the other system was ruled out of order. That certainly did occur.

I said it is impossible to say at this moment whether or not it was a good or bad thing that towns did emerge, and here too I believe Sir Norman has not emphasized the real effects of the attacks on towns as such - that matter has now been studied exhaustively. The Americans have made a survey and their overall estimate is that the German war production was not affected by more than about 10% or so. We have done two similar surveys in two different directions with two different approaches, and our most direct approach to this problem has not shown that all the destruction of cities affected German war production as such by more than a factor of about two or three per cent, and that with the overall consumer production thrown in it did

not amount to more than 10%; and that was the most optimistic answer we could get. It is a very important fact, and we have got to clear our minds on it, that although we destroyed as much as we did of the German cities and towns, we did not affect German war production very much: and I have a feeling that one of the lessons emerging from this is that it was not only a period of consolidation of our forces and techniques; it was also perhaps a period of consolidation of some very bad ideas about what it was worth doing. That is something we should do well to remember when we are trying to overcome technical difficulties in the future as we may have to, in regard to bombing.

If I may say one more word I think it is very important to consider what towns really do represent. The ex C-in-C Bomber Command we are told, described towns as containing the sinews of war, General Arnold believed indiscriminate bombing was of no consequence. Now, the question is, what did the towns contain? We know they contained people - 300,000 were killed. We know they contained houses - about 6 million were destroyed. The point is how much production capacity did they contain? We know the figures now so far as Germany was concerned. We know that if we take the whole list of Bomber Command's targets, say 70 towns, and throw in also towns with a labour force down to below 10,000 and bomb them all, we do not account for 50% of Germany's production capacity; and bearing in mind that we heard yesterday that over that period Germany was operating on a single shift basis, we realize that 50% could be made up by people working a double shift in industry - that is very important. We must remember that in other vast industrial civilizations which we might be called upon to attack we might discover that the actual proportion of industrial capacity in the towns is less than it was in Germany and far less than it is in this country today: and some of the figures given in this morning's paper show that. It cost the Germans one ton of bombs to kill one person in this country, it cost the allied forces seven tons of bombs to kill one German. I imagine the reason for that is not worse bombing but the greater extent of the country and when we have a wider area to cover we may be dealing with figures which do not go up by a square law but by a cube or quadruple law."

Evidently the progression of events which led from the decision to bomb by night to the decision to attack morale, and finally, to pursue a policy of destruction for its own sake, did in the end have a major impact on British air power theory. At its most profound level strategic bombing slipped into the mould of attritional warfare, with all its inefficiencies, uncertainties and terrible costs. The definition of the object was lost and was replaced by a titanic effort to deliver one last push to the edifice which would topple it. Air Marshal Harris's approach to the Battle of Berlin in the winter of 1943/44 epitomises this perspective. The ability to strike precisely and decisively at points in the enemy war economy had been vital to the original conception because of the economy of force implied, because it was not an attritional

1. From the second day's transcript of discussions during 'Exercise Thunderbolt', 11-16 August 1947. Chief of the Air Staff papers PRO - AIR 8/1536.

approach and because the impact would be swift and measurable. The operational inability to implement the strategic prescription induced Bomber Command to abandon those advantageous features and simply attack what could be reached and destroyed. The crudity of this sort of response did not go unchallenged - the school of thought which advocated attack on specific sets of economic targets survived in the Air Ministry. Concentrating area bombing on a few cities, chosen because of the industry they contained, it was argued, could still create a 'bottleneck' in the system. Harris rejected even this adaptation of the original scheme because he did not believe in bottlenecks, and because he was not convinced that a particular class of activity could be stopped by attacks on cities. For him the object was to destroy the system as a whole; to achieve a systemic collapse as a consequence of a mounting and finally intolerable level of destruction. In the end even morale became secondary. This search for a type of cataclysmic collapse underscores some of the thinking about strategic air power in the atomic age. During the war itself, to reiterate, it legitimised an attritional struggle in which the claim for independence was made a hostage to the ability to produce a collapse.

An aspect of Trenchard's 1928 statement, which was secondary to his central themes and more or less unrelated to the issue of independent attack on economic targets, was the question of air superiority. Because Trenchard believed in the supremacy of the bomber, both in the sense that it is the offensive essence of air power and in the sense that no impenetrable air defence system was conceivable, he did not favour the strategy of attacking the enemy air defences directly. Even the counter-force strategy of plan WA1 was directed solely at German bombing capability. If it was to prove possible for air defence to defeat a sustained and coherent bomber offensive, three consequences of significance for air power would follow - i) the importance of the offensive would be in doubt, with a defensive strategy becoming a viable military option in air warfare; ii) the primacy of the bomber would be placed in question; iii) it would have to be admitted that the enemy force-in-being could have a direct impact on the course of the air offensive and thus that the struggle in the air depends on the defeat of military forces, just as is the case in operations of armies and navies. Air superiority would be thrust to the centre of the stage, as it was in Douhet's theory, implying an aerial battle for the command of the air in which control of air space could be gained much in the same way that control of areas of land or sea could be achieved.

The issue hinged ultimately on the relationship between offence and defence. British theory emphasized offence not only because that is a positive approach to victory in military operations, but also because a bomber offensive promised to bring a quick and decisive outcome to the war. If air warfare eventually proved to be a rather more complicated struggle in which air forces met in direct confrontation, as a preliminary to the bombing effort, then not only the claims of air defence were resurrected. In addition the concept of overflying the enemy forces and avoiding the bloody business of defeating them as a prelude to victory would be shown to be invalid and the air would lose one of its supposedly unique qualities. Both the Americans and the British held to this idea of uniqueness. However, when the Americans found reason to question their own approach to self defending bomber formations they examined their rationale and switched to an aerial battle for supremacy rather than convert to night bombing or some other form of evasion. It is true, in any case, that American theory had, from the start, emphasized the destruction of the German air force in production, and thus gave greater weight to the importance of air defence than had the British.

That the British were wrong about air superiority is evident. Michael Howard, for example argues that "Command of the air could not be won without first destroying the enemy air force in a subtle and long drawn out battle of attrition: and without command of the air it was not possible to strike effectively either at the enemy population or at his sources of economic strength."¹ It would seem therefore that the evidence of the war suggests that the gaining of air superiority is the sine qua non of a successful strategic bombing campaign. Only after the USAAF had defeated the German defensive forces over Germany, during the first half of 1944, was strategic bombing to achieve its full potential and, incidentally, deliver the greatest tonnage of bombs to German targets. Even this ability was proportional to the defeat of the German armies. The most destructive month of the air war was March 1945.

This throws up a final aspect of an analysis of the strategy of the campaign; the resilience of an economy subject to bombing, and the relationship between such an economy and front line strength. Of the

1. Michael Howard, Inaugural Lecture at King's College London, May 1964, in International Affairs, July 1964, page 398.

principal themes of the original vision, one that Bomber Command was able to validate is the claim that in any strategic bombing duel one side would eventually be forced onto the defensive. The Germans, it can be argued, never took their strategic bombing very seriously, and chose to conclude it partially because of losses but primarily because they preferred to employ their available bombers in a tactical role in Russia. Be that as it may, the bombing of Germany provoked an enormous defensive effort, ultimately diverting aircraft production from bombers (which could have been employed against Britain, or in the army support role) to fighters and indeed, diverting a large number of the fighter formations to the defence. At least it can be argued, on the grounds that Britain won and held the strategic initiative in the air, that the bombing campaign served the interests of British defence by ruling out the resumption of German strategic bombing. However, if one allows that argument, it is necessary to ask whether the gaining of the strategic offensive in the air had an effect beyond forcing the enemy onto the defensive. Was the relatively 'unfettered' ability to bomb the German economy, while British industries remained unharmed, effective in reducing the enemy's war making potential such that the functioning of their field forces was jeopardised? That, after all, was the purpose of forcing the enemy onto the defensive in the air. To put the question another way, was the enemy's economy really a strategic target, and was bomber based air power really an independent factor in producing a decision in the war?

Evidently, the answer to the question depends on what use is made of the strategic offensive. Trenchard had conceived of the war economy consisting of a duality: the centres producing the munitions of war, and communications and transport, both for the supplying of industry and the distribution of its products. Against this there was some force in Air Marshal Harris's characterization of certain targets as panaceas. Attacks on such heavy industrial objectives as submarine yards, air frame and aero-engine factories, ball bearing and vehicle engine factories, even when the works were actually hit, achieved quite small amounts of damage to the plant, and a small loss in output. For this reason, and because the directors of the German war effort were able to disperse production, utilize a large reserve of spare capacity and draw on stockpiles, German industrial output expanded at a faster rate than the tonnage of bombs being dropped on Germany, until the autumn of 1944. Most noticeable was the ability of the German economy to produce fighter

aircraft at roughly twice the rate that the Allies could destroy them.¹ Yet Trenchard's duality stands as the most pertinent understanding. It was transport, and its vital ancillary, oil, that proved in the end to be the weak points, the destruction of which would paralyse the war effort. The American plans only partially accounted for this, because for the USAAF the destruction of the German Air Force became the essential preliminary to an attack on the economy, and because heavy industries such as submarine construction and ball bearings appeared so vulnerable to precision attack.

The importance of the initiative, and of forcing the enemy onto the strategic defensive is thus not an end in itself; its value depends on the capability of the offensive bombing force, and a correct understanding of what are the 'soft' targets. The relationship between economy and front line strength is thus functional and not absolute. Attack on the economy is subject to the same rules as an attack on the front line forces. What in fact occurs in the process of widening the war to include direct attacks on the enemy economy, is a process by which the economy and the workers become part of the military machine. The scope of the war expands but the central considerations remain the same. The hope of discovering an alternative target to which different rules apply is futile.

The conclusion is therefore, that for Bomber Command the war was one of attrition as opposed to rapid strategic decision. It was a struggle in which the Command did not achieve, and did not seriously attempt to gain, air superiority - a condition which proved to be of paramount importance to a successful strategic offensive. Finally, the British approach to the destruction of the sources of the enemy's military power was flawed; for most of the war the wrong targets were being attacked.

1. The prolific capacity, and adaptability, of the German economy under attack (and, although to a lesser extent, of the British economy) is now well established. The diagrams in Lord Tedder's Air Power in War are instructive. Also refer to Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, in which there is a full discussion of the effects of bombing. The chapter in Max Hastings, Bomber Command entitled 'The balance sheet', pages 346-352, when taken in conjunction with his appendixes D and F and with appendix 44 in Webster and Frankland, provides a comprehensive account.

How then, can the campaign be referred to as a model of judged success? Part of the justification lies in the fact that the conclusions I have drawn were not and could not be made until some time after the war. To an extent the claims of Bomber Command were uncritically accepted; especially the not entirely unreasonable contention that massive destruction per se was bound to have an effect on the war effort. There was, of course, always a controversy about the operations of Bomber Command. This arose primarily from the fact that Germany did not collapse under the weight of bombing. When Sir John Slessor writes:

"There is a curious tendency today for clever people to write books of which the general effect is that the bomber offensive had no decisive results, was a frightful waste of effort and lives, and how much better it would have been if all that effort had been put into supporting the army or the navy."

(referring presumably to writers such as Blackett and Dickens) his rejoinder concentrates inevitably on the levels of destruction achieved. There can be no assessment of what impact this destruction actually had on fighting capability, beyond an appeal to common sense along the lines that all that rubble must have meant something. The value of destruction became important to later arguments about atomic strategy. On its record during the war Bomber Command was always potentially on the defensive intellectually because, it was bound to be so unclear what area bombing had achieved.

In fact the real basis on which the campaign was judged a success lies in an evaluation made from a perspective different from that of Bomber Command, and which concentrated on the provision of air support to the armies, and the counter-force role which ultimately gave rise to the destruction of the Luftwaffe, not only as a strategic force², but also as

1. Air Chief Marshal Sir John Slessor, 'The Past Development of Air Power', in Journal of the Royal United Services Institute, May 1949, page 225.

2. On page 42 of Air Power in War, Lord Tedder uses one of the arguments prominent before the war. "Step by step, after losing the Battle of Britain, the Germans had been forced back more and more on the defensive, and they never regained the initiative. More and more was their effort diverted to passive defence - fighters, AA and radar defences, ARP measures, etc. More and more did their striking force the bombers - the dynamic element in their air force - fade away."

a force capable of intervening in the land or sea battle. From this perspective air power as a whole was dominant in the second world war, and was widely acknowledged by most commanders to have been dominant. Slessor cites Montgomery to support this contention; "The late CIGS has constantly stressed the vital importance of air superiority. I quote verbatim from one of his many statements on the subject: 'the first and basic principle is that you must win the air battle before you embark on the land or sea battle.' As a matter of fact I think he overstates his case here; and there may be a lesson in that."¹ When Sir Norman Bottomley said in a lecture:

"Let us see what the present CIGS has to say about the lessons of the immediate past. In a recent important statement of army doctrine at a recent conference of his commanders in chief, Lord Montgomery gave what he called certain basic fundamentals as vital to the use of air power in connection with land operations. He stated: (a) 'It is necessary to win the air battle before embarking upon the land battle. If this is not done, then operations on land will be conducted at a great disadvantage. (b) It is not possible to conduct successful offensive operations on land against an enemy with a superior air force, other things being equal. The enemy's air force must be subdued before the land offensive is launched.'"²

he was using Montgomery's appreciation not in order to justify the strategic bombing campaign, but to develop an argument based on the freedom enjoyed by the allied armies on the Continent after 6th June 1944 from the intervention of the Luftwaffe, and the benefits accruing from plentiful close air support. What occurred, in the aftermath of the war, was the extension of British air power theory as a whole, in which the bomber offensive still dominated, but in which the notion of the dominance of air power in all its applications came to be regarded, at least in the air ministry, as the single most fundamental lesson of the war. In this context it is easy to understand how the role of the bomber offensive was at the same time preserved and adapted.

Because of the accepted dominance of air power, a frankness about combined arms operations did not present the threat it had done before 1939. It had the opposite effect of reinforcing the dependence of the other arms on the air service. It came to be argued by the more advanced thinkers that the decisive nature of air support after D-Day derived

1. Air Chief Marshal Sir John Slessor, 'The past development of air power', page 227.

2. From a lecture to the RAF Staff College, 28 January 1947, Bottomley Papers, File 71/2/77.

fundamentally from the independent strategic bombing of the German economy because of the defensive frame into which this pushed the Germans - thereby influencing the outcome of the land campaign.

"The point I do want to impress upon you is that this happy state of affairs was not due to the fighters which could be seen overhead; or at least only in small part. One can get temporary local air superiority by using fighters well - as we did for instance at Dunkirk; but that is a precarious and very local affair. The thing that produced that extraordinary degree of air supremacy was the relentless, day in night out, ding-dong pressure against the heart of Germany, starting in small beginnings back in 1940 and culminating in that terrific Anglo-American onslaught that reduced Germany to a rubble heap. The main air war in fact was fought out over Germany, and not over England, or our narrow seas, or over the land battlefields. It threw them onto the defensive and kept them there until, by the end of the war, the cream of their remaining crews had been concentrated in their night fighter force in Germany, and they were producing hardly any bombers but more fighters than the British and Americans put together, which we were destroying almost as quickly as they were produced.

It is clear from this the extent to which much the same theory of strategic bombing had been wrapped up in a more comprehensive air power formula. Sir Norman Bottomley makes a related point in a lecture shortly after the war.

"Let me now turn to another important aspect of the strategic bombing - the attack on enemy air power. In their Directive of June 1943, the Combined Chiefs of Staff emphasized the fact, that the plan for the combined bomber offensive against Germany and against selected target systems in Germany, was conditional on the immediate arresting of the growth of the German fighter force. [After describing the course of the conflict, Bottomley concludes] All these factors made it impossible for the German air force to assert itself really effectively during 1944. There can be no doubt that this was a critical factor in our success in the war. Certainly air superiority was very rightly regarded by the Combined Chiefs of Staff as a prerequisite of a successful entry onto the Continent. For this reason the aircraft industry and the German air force retained top priority of strategic targets until June 1944."²

Bottomley's judgement here is profoundly conditioned by the post-war dominance of the air to which I have referred and by his own position within the Air Staff at a time when Bomber Command enjoyed a great measure of independence. As a demonstration of the extent to which Bottomley's perspective was a British one, it is valuable to compare his emphasis on the attack on enemy air power as 'another important aspect' with Spaatz's emphasis on it:

".... It took time to gain control of the air, the absolutely necessary prerequisite for sustained strategic bombing. The German

1. Air Chief Marshal Sir John Slessor, 'The past development of air power', page 228.

2. Bottomley Papers, File 71/2/78.

air force, although designed primarily to support ground troops, was a formidable defence - a fighting wall in the air. The task was to smash the wall, not only in order to clear the way for our heavy bombers over Germany, but also so as to remove the threat of air attack on our surface forces during and after the planned invasion. Towards the end of 1943 there was at last sufficient force in hand. The long range fighters needed to combat the enemy fighter defences had been perfected, ... The strategic air forces were ready to smash the German air wall, and then to proceed with the combined bomber offensive."

I think it is also fair to say that the major post-war theorists, such as Slessor and Bottomley, still operated from within most of the original assumptions of air power theory, for example the bomber and offensive primacy, and the strategic nature of the economic target.² The advent of the atom bomb postponed the need to ask some of the more awkward questions, such as the ones about air superiority and attrition. The only major concession to wartime experience was to modify the original claim of independence. This framework became the basis of the post-war articulation of theory and development of force structure, because, from within this framework the bomber theorists were able, plausibly, to claim to be describing a model of success. It seems to me to be important to conclude this analysis with a brief attempt to move outside that framework.

1) The objective. Strategic air power cannot convincingly claim to enjoy unique access to the source of enemy power. Conceived of as a totality, the economy (or the war economy) is part of a wider network which includes the fighting forces, among other things. To attack the economy is simply to expand the scope and range of targets - it is not to discover a separate category of objective, nor a uniquely valuable class of target.

1. General Carl Spaatz, 'Strategic Air Power: Fulfilment of a Concept', in Foreign Affairs, April 1946, pages 391-392.

2. "For future war, we can therefore state the aim of the strategic air forces in general terms only; that is, to paralyse the enemy's war-making machine in its vital elements whatever they may be at the time. Incidentally this will force the enemy onto the strategic defensive, and keep him there in the widest sense, economically as well as militarily. This will cause him to produce weapons of defence instead of weapons of offence, fighters and AA defences instead of bombers. It will cause him to tie up great numbers in the defensive system generally. In this way he will be denied the ability to sustain his own offensive." From a lecture to the RAF Staff College, 28 January 1947, Bottomley Papers, File 71/2/77.

2) The problem of concentration. Although it was previously recognized, and the war showed this perception to be correct, that one of the keys to a successful bombing campaign was the concentration of force, bomber forces were not in fact any more able to achieve this concentration than other military formations. Although great weight could be concentrated on an area, it proved very difficult to achieve the necessary concentration in time. It was properly achieved only once, over Hamburg in the summer of 1943. As for the matter of bringing about a maximum concentration of force against the weakest point of the enemy, in order to achieve a resolution of the conflict, the judgement and effort needed to do this proved as complex as that required by armies and navies. In addition, in the case of Bomber Command, the problem of concentration was exacerbated by the failure to gain air superiority. Bombing concentration required returning to the same area repeatedly - with the defences still intact this became prohibitively costly. Even the normal low concentration levels were further vitiated by the need to organize 'spoof' raids, frequent target changes, and eventually the splitting of the main force between two targets.

3. Operational method. In the same way that I have argued that armed forces and economy form a totality (and not a hierarchy with the former dependent on the latter, and thus susceptible to 'withering' without being directly attacked), so I would argue that air defence is not an impossible concept but operates in line with the principles of all military defence. In an operational sense then, evasion cannot produce a decision, and the defensive efforts of the enemy have to be dealt with directly. Thus air superiority is a viable concept and air space can be controlled in a sense akin to the control of land or sea.

4. Strategic character. Air power is only strategic to the extent that its employment entails the wider use of force directed towards a major alteration in the overall balance of forces and geographic positions. Its use in any form is not inherently strategic, but is always dependent upon the broad movement of the conflict.

The beginnings of a persuasive critique of strategic air power existed in the few years after 1945. They were ineffective because British air power theory dominated military thinking, and because the RAF was able to exploit its wartime record to its material benefit during the post-war cutbacks. It is to that effort that we must now turn.

Chapter 4

The post-war contraction of the RAF

After the war the inevitable contraction of the armed forces was ordered by the government. This was not an ill considered, or even especially hurried process, but one in which the government established its own wide ranging priorities, and expected the services to formulate their own with due reference to the government's policy. These peacetime priorities, and the economic, financial and international crises that were to plague the country over the following few years, had an impact on the formation of British strategy no less significant than the influence of established military orthodoxy or the impact of the course of the recently concluded war. It follows that no examination of post-war British military strategy, and the themes underlying the development of British nuclear deterrence, can ignore the effects of demobilization and the practical activity which it entailed.

In adopting this approach I have been conscious of the inevitable separation it entails between the post-war planning process and events occurring in the international environment - such as the deterioration of the Grand Alliance and the circumstances leading to the opening of the Cold War. In this environment British leaders attempted to play a role commensurate with the status of a member of the Big Three, increasingly sought the formation of long-term alliances, and decided to make the atom bomb. I have therefore tried to relate the various internal and external themes when their coincidence was most important - especially at the start of the Berlin Blockade in 1948 and of the Korean War in 1950.

From the synthesis of the government's economic and military programme, and the RAF's judgement on what constituted its own composition as a military entity, it is possible to state a set of priorities. The Air Staff's priorities, corresponding to a greater or lesser degree with the government's perspective¹, can be stated, in the broadest terms, as follows.

- 1) The preservation of a viable military capability. The effective front-line strength of the RAF shrank, under the impact of the post-

1. In my treatment, I have left the government's priorities and perspectives to develop by implication where they are relevant to the discussion of military strategy.

war adjustment to a level that alarmed the Air Staff. In response it sought to retain a framework for expansion when the most acute phase of post-war contraction was over and some firm decision had been made about the peace-time size, and strategic orientation, of the British military effort.

- 2) The maintenance of the doctrines of air power at that time enshrined in Air Staff thinking. The most important specific example of this priority is to be found in the attention given to a new generation of manned long-range strategic bombers. The underlying concern, however, stemmed from the futuristic possibilities science held out for the advent of missile air power. At this time in air force thinking there was a deep commitment to the concept of manned military aircraft of all types.
- 3) The fullest exploitation of the opportunities and challenges presented by scientific innovations then taking place. The RAF had become extremely science minded, having fully internalised the value of the role played by science in the 1939-1945 air war. The Air Staff believed that air forces stood to gain most from scientific research and development, and was encouraged by the government's stated intention to devote large resources to the work of military science.

In Appendix I I describe the system of management and the duties of the senior staff officers. My purpose is to show how the organization of the RAF worked, at which points in it the important decisions were taken, and who were most influential in shaping what can be described as the Air Staff position on major matters of policy. In Chapter 1 I have suggested some reasons for describing the bureaucratic structure of the RAF. I also believe that the material presented, particularly in Chapters 4 and 5, is made more accessible by the inclusion of the information given in Appendix I. I have listed, in addition, the names of the officers who held the important posts so that the service careers of the individuals who controlled the RAF can be followed¹.

1. See Appendix II. These lists are presented, furthermore, in support of the contention that a small group in the most senior positions were able to exercise a powerful influence on the decision-making process.

1. Management of the priorities

The direction of post-war research and development, and the reconstruction of the RAF with modern aircraft and equipment was determined not only by strategic doctrine and the ruling air power orthodoxy. The process was also influenced by economic and financial factors which impinged on the eventual shape of the force, and on the speed at which it was restored to satisfactory front line size and efficiency. Certainly, the survival of an independent and viable air force was never in doubt, but there were times at which unwelcome choices had to be made, when strategic preferences became secondary to structural and organizational priorities. It is important to bear in mind, however, that the expectations for a prolonged period of peace after World War II were short lived, and that the requirement for an advanced air force-in-being which had become fundamental to air power thinking, was also determined by the strategic situation. This requirement was influenced by the complexity of modern weapons, which needed lengthy production spans; by the belief that a future war would open with a very destructive phase, precluding the opportunity to build up strength after the outbreak of hostilities¹; and by the appreciation that successful nuclear deterrence would demand the creation of a permanent deterrent force.

Immediately after the war, economic considerations were paramount. The government was determined to transform the war economy as speedily as possible, in order to implement its political programme and to restore the country's trading and manufacturing position. One of the most obvious manifestations of these intentions was the reduction of expenditure on the armed forces. Another was the wish to reallocate manpower employed in armaments manufacture and serving in the forces to the civilian sectors of the economy. There was also an immediate

1. For example, the Sub-Committee for Air, Coast and Seaward Defences, in a report on 'Requirements for the Air Defence of the United Kingdom', based its outline plan for such a defence on a set of assumptions, one of which was "7. Warning Period. We can only expect a brief period of warning in which to prepare for a major war after which heavy attacks may be carried out with little or no tactical warning. Our defences therefore must be capable of being fully manned with the minimum possible delay during whatever warning period we are fortunate enough to receive." In Annex to Report, COS(ACS) (48) 11, 6th April 1948. Chiefs of Staff Committee. PRO - DEFE 2/1650.

Sir Frederick Handley Page in an article on 'Aircraft Design, Development and Production' stresses the time-span required to translate an Air Staff requirement into a modern operational aircraft. Journal of the Royal United Service Institute, February 1950, Vol. 95, no. 577, pp19-33.

reduction in the war related scientific effort, a very sharp cut-back in orders for military aircraft (and of course, naval vessels and army equipment) and a diversion of construction materials and workers away from capital projects for the military in the direction of civilian rehousing programmes. Construction problems were in no sense the most serious for the RAF at this stage. A vast programme had been implemented during the war - runways, hangars, control towers, etc. - all the permanent establishments needed to carry out the strategic offensive. As the main force contracted, it was inevitable that a substantial majority of the air bases would be made non-operational (either closed completely or relegated to care and maintenance). Given the overall contractions, there was not a great call for construction, (always excepting the severe shortage of accommodation suitable for the personnel who enlisted for post-war service). Only when the force began to expand again was the neglect of building and establishments more acutely felt.

It was the shortage of personnel and aircraft (but primarily serviceable aircraft) that most seriously frustrated the Air Staff's attempts to preserve its front line strength. The post-war White Papers were unambiguous on the need for retrenchment; The following Statement is typical :

"Meanwhile, developments in recent months have stressed the urgent need of restoring a balanced peace economy at the earliest moment, and by all practicable measures. in the interests of the restoration of the country's economy and the revival of trade, [the necessity arises] of limiting the production of war material to the minimum needed for current maintenance, preservation of nucleus war potential and for the introduction on a modest scale of the latest types of equipment."¹

One year later the message is even more anxious -

"The fuel crisis of February 1947, and difficulties experienced throughout the year in supply of labour and materials for the production of equipment for the services, have caused severe dislocation of the 1947-48 production programmes, and there will be large underspendings on this account by the service departments. [Labour force fallen by 100 000.] The need to restore the economic position of the UK has imposed even greater limitations upon the production of equipment and stores for the services (in 47/48 48/49). It has been possible to provide for little more than the minimum requirements of maintenance....."²

1. Statement relating to Defence, February 1947, Command 7042
2. Statement relating to defence, February 1948, Command 7327

1948 was, however, the last post-war year in which this sort of tone predominated. The papers for 1946-48 had been meagre, hesitant documents, full of economic doom, with extremely little to say about military policy and strategy, and of value only for the bare figures they give on manpower and finance. Quite clearly the situation had improved by February 1949. The Defence White Paper is longer, contains much more information, and has a much bolder note about it. As was also reflected in the figures, the period of mere cadre preservation was over for the RAF.

In the face of the government's demobilization and retrenchment plans the immediate task was to ensure the continuity of the RAF. "In 1947-48 as in 1946-47, the main problem confronting the Air Council will be to preserve the structure and continuity of the RAF."¹ The Air Staff achieved this by employing a cadre system to reorganize the force.² The cadred force would provide the basis for future peacetime expansion, and a nucleus of force for use in case war should threaten to break out. The cadre system and the manpower and squadron targets on which it was based, was explained by the Chief of the Air Staff to the Commanders-in-Chief at a meeting in the Air Ministry in March 1946.³

"The cadre system it is proposed to adopt deploys all number plates in the Commands to which they belong. For this purpose it is proposed that units reduced to cadre should be combined into the form of a squadron, each flight of the squadron carrying the number plate of one of the squadrons in the target force. For example, if two heavy bomber squadrons are to be reduced to cadre in a particular command, one cadre squadron would be formed each flight carrying one squadron number plate. The organization thus produced could function operationally as a squadron, but flights would, as part of their duty, look after such things as the records of the squadron which they represent; collect the squadron silver; and organize annual dinners and other social activities associated with the squadron."⁴

The object of the contraction plan (which in March 1946 was Plan C) was to devise a means by which a greatly reduced number of personnel (the RAF

1. Memorandum by the Secretary of State for Air to accompany the 1947/48 Air Estimates, 26th February 1947, Command 7053.

2. Cadre here should be understood as a framework, an organizational structure retaining the experience and skills necessary to a potential for coherent development along predetermined lines. The strictly military sense is also apposite - 'the compliment of officers of a regiment; the permanent establishment forming the framework of a regiment'. (Shorter Oxford English Dictionary)

3. Chief of the Air Staff notes on the Contraction Programme for meeting with Commanders-in-Chief, March 1946, IO3/1136 (PRO - AIR 8/1531)

4. Ibid, paragraph 8.

allocation for the end of 1946 was 305,000, a reduction of 805,000 from the May 1945 level) could be deployed so as to provide staffing for a 130 squadron force. This force would be a transitional one, essentially a framework retaining some fighting capability but also capable of rapid expansion. The squadron number plate (referred to in the quote above) was the plate or emblem on which the squadron number was stamped. In some sense it must have represented the soul of the squadron. Cadred squadrons would be reduced to the strength of a flight, and amalgamated with another squadron, only the headquarters of which would survive in the original form, also carrying a number plate. Thus three squadrons would be formed into one. Actual strength was further reduced by having only 8 aircraft per squadron, not all of which would be operational at the same time. Not all squadrons were to be cadred, and the system was only to apply to the Home Commands (thus not to BAFO nor the Middle nor Far Eastern Commands). The intention was to keep as many squadrons as possible fully effective. Thus the 130 squadrons that comprised the Plan C force consisted of both cadred squadrons and individually formed (i.e.: non-cadred) squadrons.

"The total of 275,000 men, plus 30,000 trainees, would, even if fully trained, be inadequate to man the front-line strength originally proposed by the Chiefs of Staff. We had concluded that we should be able eventually to maintain 130 front-line squadrons. Even this reduced figure of 130 squadrons would for some time remain purely nominal. It would not be necessary to assess accurately what proportion of this nominal front-line could be kept in effective state. Our success in this would depend largely on the results produced by the 'bounty' scheme; we estimated that the period of greatest difficulty would be between June of this year and June 1947. Our intention was to concentrate in an as limited number of squadrons as may be practicable the experienced personnel - those serving on voluntary engagements and to reduce¹ to a cadre basis those squadrons which could not be kept effective."

Contraction Plan C was revised as Contraction Plan D, which was to be a further reduced force of 134 cadred and effective squadrons. (In Plan D, there were to be more cadred squadrons and fewer individually formed squadrons than was proposed in Plan C.) Plan D, with its revised strength and disposition of RAF squadrons, was presented to the Commanders-in-Chief at a conference in August 1946. The cabling system itself remained unaltered and although the pressures for reductions had intensified by that August, it is obvious from the record of the

1. Minutes of meeting with Commanders-in-Chief, March 1946, IO3/1136 (PRO - AIR 8/1531) paragraph 6.

conference¹ that the Air Staff had by then developed a coherent plan to deal with demobilization. The structure of the force was guaranteed and the number of operational aircraft stabilized. The over-riding problem remained shortage of trained personnel. At this conference the CAS was able to state the following short term objective for the RAF:

"The effect of this on the RAF is that our primary object should be to build the most effective air force that is practicable to achieve by the end of 1949. During the interim period we must face a situation in which the service is virtually emasculated in order that we can retrain and reorganize a force which not only has an effective front-line but which is also an efficient nucleus for expansion."²

His analysis of the previous March that the most difficult time would occur between June 1946 and June 1947 proved correct; by the end of 1947 the rundown of the RAF had levelled off, to be followed by periods of consolidation and then rapid growth. It had been a difficult 2 years for the RAF, during which the problems of setting up an ideal cadre structure were not easily solved. The difficulties of sustaining an adequate force-in-being hinged on the shortage of personnel, and at times the fighting qualities of the RAF had been seriously deficient. But overall, the period of contraction was short, reasonably painless, and not excessively disruptive. Compared to the Royal Navy, the RAF escaped lightly from the retrenchment period.

If the CAS sought to maintain a structure which could be ready for war within two years, or at least by the end of 1949, his thinking was in the first place more or less in line with the Cabinet's. As he said at the August conference:

"Before leaving members of the Council to explain further our short-term problems I think we should bear in mind the political background against which we are working. I would say, in the most general terms, that the political background that we have to keep in mind in planning the future development of the service is an international situation which is full of uncertainties and instability. We have a ruling from the Cabinet that we may assume that there will be no major war in the next two to three years. We must emphasize that this does not in any way imply that there will be a war at the end of that period,³ this period is the furthest we can see ahead at the present time."

During 1947 this perspective shifted, and the expectation of there being a danger of hostilities was revised. German strength had been utterly destroyed, and no other challenge from Europe was envisaged in the medium term. Only when the growing estrangement of the Soviet Union was manifest in the Berlin Blockade was a renewed note of anxiety injected

1. Conference with Commanders-in-Chief, August 1946. (PRO - AIR 8/1532)

2. *ibid.* paragraph 13.

3. *ibid.* paragraph 12.

into military preparations. Thus, with the sole exception of the air defence of Great Britain (a priority in all defence statements and the reason for the unparalleled attention given to development and commissioning of modern jet fighters) much of the urgency disappeared from the Cabinet's thinking about the building up and modernising of the front-line strength.

"No one believed in 1947 that war was imminent. In August 1947 the Minister of Defence issued a directive that the risk of a major war could be ruled out during the next five years, and that the risk would increase only gradually during the following five years. The risk would vary directly with Britain's offensive strength. 'If attacked we must fight with what we have.'"¹

1. Margaret Gowing, Independence and Deterrence vol. I, page 187. She cites - DO(47)68: DO(47)20th meeting - (PRO ref CAB 131/4&5). There appears to be a controversy as to whether a new Ten Year Rule was imposed. In a footnote to the reference cited above, Margaret Gowing makes the following comment - "But Alfred Goldberg, 'Military Origins of the British Nuclear Deterrent', International Affairs October 1964, P 601, says the Ten Year Rule was adopted in the Winter of 1946. I have not found evidence of this and the Hansard reference given in the article provides no support for it."

Gowing's reference is to the following passage from the article by Goldberg - "Perhaps the most important decision taken during the winter of 1946 was to adopt the Ten Year Rule, which assumed that there would be no major war for a decade. According to A.V. Alexander, speaking as Minister of Defence in 1947, the readoption of the Ten Year Rule by the Labour Government in 1946 (unlike 1919) was a political rather than a military decision." (citing Hansard 435 C 666).

I have found no documentary evidence to support the Ten Year Rule theory. There is no reference to such a ruling in the contemporary defence white papers or Air Estimates. Nor is it mentioned in the editorials of 'Air Force Quarterly', which commented fully and critically on Parliamentary debates. However, the assumption of such a rule could arise from evidence showing that 1957 was fixed as a 'base year' for defence planning by the Chiefs of Staff in 1949 (Report COS(49)313 Final). For example: "6.2. We should accelerate the equipment and development of the forces recommended by the Chiefs of Staff in COS(49)313 Final. The plan as put forward last year had 1957 as a target date, ..." (National Defence, Memorandum by the Minister of Defence, DO(50)56, 21 July 1950 (PRO - CAB 131/9)). "The target date for the first production of all the projects except the air-to-air weapon was 1957 This target date was not closely linked to any planning date for the outbreak of war, but was an estimate based on the time required to carry out the necessary experiments." (Item 1. in Minutes of Cabinet Defence Committee, DO(50) 23rd meeting, 21 December 1950. (PRO - CAB 131/8)). See also the Report by the Chiefs of Staff, DO(50)58, 21 July 1950, (PRO - CAB 131/9).

Thus it could be that the idea of a 'Ten Year Rule' persists because of its political value for attack on Attlee's Labour Government. The implication would be that that government mortgaged Britain's military security and was unwilling to recognize the folly of disarmament. The evidence does not such support such assertions. The levels of military expenditure and effort remained surprisingly high, and in January 1951 Mr Attlee introduced in the Commons a rearmament programme of almost wartime proportions.

The more relaxed approach towards military preparations between the summer of 1946 and the spring of 1948¹ was thus an additional influence on Air Staff planning for the future peacetime RAF. It was the Cabinet's intention that a long-term view be taken and this, in addition to financial stringency and manpower shortage helps to explain the measured pace of re-equipping.

In taking account of these various 'external' influences on the RAF's post-war programme, it is also important to acknowledge the role of the military attitudes held by the Air Staff. It would, for example, be quite wrong to assume, given the overtly and preponderantly political rationale for producing British atomic bombs², that the military staffs were unprepared for such a decision, and found themselves obliged to construct a strategy to accommodate the new weapon. The Air Staff in particular welcomed the atom bomb as a weapon that would confirm the air force as the premier strategic arm, and enhance the role of the bomber. I believe it is correct to argue that (within the substantial latitude that remained after the war for decisions to be made on the basis of military doctrine) coherent choices about weapons and force structure were made. The time lag of a decade between the emergence of the RAF's post-war priorities and the realization of the most important expression of them (in the V-bomber force) should thus not be taken as an indication of either an excessively theoretical outlook, nor of the presence of an inability to relate theory to practice. While there may be something to the argument that the Air Staff's understanding of future operational necessities was flawed by a short-sighted vision, or by doctrinal rigidity³, it is demonstrable that decisions on weapons and operational methods grew out of firm understanding of the connection between practice

1. By the summer of 1946 the immediate post-war retrenchment was completed, and a better measure taken of the forces needed to fulfil outstanding global commitments. In March 1948 the Brussels Treaty was signed, partially in response to Soviet hostility. The Berlin Blockade began in June 1948.

2. Emphasized, for example, by Margaret Gowing (Op cit) and Andrew Pierre, Nuclear Politics.

3. This case is strongest in connection with the misunderstanding about the significance of supersonic flight for future air warfare, and the unwillingness to recognize the threat ground-to-air missiles would pose to the manned bomber. Official recognition of this short sightedness is contained in Command Paper 9388 The Supply of Military Aircraft, February 1955, to which I will refer again. The Air Staff discussions on long range fighters and the interception of the bombers most clearly revealed the fallacies in contemporary thinking.

and theory. However, I do not wish to suggest that there was complete clarity about the practical requirements for a strategic nuclear deterrent force.

2. Personnel

The cutback in the RAF's personnel strength after the war was staggeringly sharp. The strength of the force at the end of the war in Europe had been 1,110,000. At the beginning of 1946 it had fallen to approximately 800,000¹ and 14 months later, in February 1948, it stood at 261,000².

"Britain at the end of the war demobilized fairly quickly. It could probably have proceeded slightly more quickly, but at the Cabinet meeting of 16 August (1945) Bevin requested that it was important not to give the impression that Britain was demobilising too quickly in view of the international position, and other ministers feared temporary unemployment if demobilisation was too rapid. Nevertheless, at the end of the war Britain had 5,100,000 men and women in the forces; by December 1946 this figure had fallen to 1,000,000.

This was still a large number by inter-war standards, and defence expenditure at £1,653 million in 1946, a fifth of gross national product, was high compared to the inter-war average."³

An important reason for this decline in RAF personnel numbers lay not in contemporary government policy, but in the fact that all RAF personnel, who were not regulars before September 1939, served on the basis of "hostilities only" and therefore had the option by right of almost immediate demobilisation. No regular, long-service men were recruited by the air force during the war. The effect of this policy on the numbers and composition of post-war air crew was not only a short-fall, but also

1. Chief of the Air Staff notes on the Contraction Programme for meeting with Commanders-in-Chief, March 1946, IO3/1136 (PRO - AIR 8/1531) paragraph 1. However, Mr Strachey, introducing the Air Estimates for 1946/47 (House of Commons 85) in the Commons on 12 March 1946, gives a figure of 745,000 for 31 December 1945. His speech is quoted in the Journal of the Royal United Service Institution, Air Notes, May 1946, Vol. 91, No. 562, p311, which is also my source for the May 1945 figure of 1,110,000.

2. See Appendix IV, Table: Defence Personnel Levels.

3. Roger Eatwell, The 1945-1951 Labour Governments, page 78.

The figures Eatwell gives for uniformed strength in December 1946, and for defence expenditure in 1946 (presumably fiscal 1946/47) would appear to be approximations.

See Appendix III, 'Discussion of Data on Defence Manpower, Defence Budgets and Defence Expenditure for the period 1945-1952'.

a great shortage of experience, and a reduction in the capability of the force to train new air crew efficiently. A disproportionate number of the re-enlisted, experienced air crew had to be reserved for the training commands and schools. Exactly the same consequences manifested themselves with respect to ground crew. But, in addition to the 'hostilities only' policy, the supply of ground crew was further limited by the fact that the RAF had completely wound up its apprenticeship programmes and facilities for the duration. (Unlike the navy, which retained apprenticeship intake throughout the war.) Instead of training men, the RAF concentrated entirely on recruiting skilled tradesmen, as a way of expanding the force as rapidly as possible. This policy worked but these men were among the most anxious to exercise their right of immediate demobilisation. Furthermore, as there was no apprenticeship programme running at the end of the war, it was not possible to reestablish immediately a flow of regular, Air Force trained, ground crews. It inevitably took some time to re-create the apprenticeship system and accept the first post-war intakes.

The shortage of tradesmen in the RAF was clearly more acute than the air crew shortfall. For long periods a large proportion of the first-line force lay unserviced - on the unit establishment but not able to fly let alone engage in hostilities.

The early post-war memoranda by the Secretary of State for Air to accompany the air estimates are instructive on this subject. In one it is stated that "the main problem is service manpower" regarding both numbers and training¹. A vast reduction was noted, with the most experienced going first. In another the Secretary of State says that the problems of reconstructing a trained, regular force of men 'continue to dominate' the actions of the Air Council.²

A substantial majority of RAF personnel chose not to re-enlist at the cessation of the hostilities. Aside from the influence of the 'hostilities only' character of the RAF, there were other factors which seriously limited the ability of the force either to hold skilled men or recruit new regulars to take their place. These were (a) rates of pay (b) conditions of service in the force, and especially the quality of accommodation available and (c) bureaucratic inefficiencies in handling

1. Command 7053, 26 February 1947.
2. Command 7329, 17 February 1948.

the business of demobilization and re-enlistment. (These inefficiencies were referred to in parliamentary debates on defence after the war, in one of which questions were asked about the loss to the service of officers who did not re-enlist because of excessive delays in processing their papers.)

Such other factors as the attractions of employment in the expanding civil economy, emigration to the colonies, and the inevitable post-war desire to be distanced from things military, were, of course, problems common to all the services. However, one special feature of the expanding civil economy that especially told on the manpower of the RAF was the very rapid growth of civil aviation after 1945. Almost all the requirements of civil airlines and airport authorities were mirrored in the needs of the Air Force, with the notable exceptions of air gunners and bomb-aimers. Ground crew were as valuable as air crew.

It was government policy that there should be very significant reductions. The extent of these can be seen in the Table in Appendix V where the annual levels of maximum permitted strengths are listed. But the Air Staff was not even able to fill this quota (which it in any case consistently regarded as too small) through the desired means of recruitment and re-engagement. Shortly after the war, a complicated process of special pleading about manning levels was conducted. At that time there had been pressure from the Cabinet to demobilise even faster than is indicated in the Air Estimates. The CAS refers to a Cabinet target of 305 000 men by the end of 1946, and to his intention to request an increased allocation of 25 000 achieved through delayed release¹. He must have been successful in his arguments with the Cabinet, as the eventual vote allots 370 000! The Air Staff was obviously better able to persuade the Cabinet to revise its demobilisation demands than it was able to persuade men of the RAF to revise theirs. Hence, while the Air Staff seemed to be successful in slowing the planned rate of demobilisation, the consequent move to defer the release of time-expired men (by up to 3 months in some cases), was most unpopular, could at best be a temporary measure of coercion, and anyway could not be permitted by the government for any length of time. Keeping time-expired men in the force for a few months could not meet the long-term manpower requirements - that expedient was not even enough, (in addition to the other efforts)

1. Conference with Commanders-in-Chief, August 1946. (PRO - AIR 8/1532).

to achieve the maximum allocated. Uniformed strength in April 1948 was 261 000, with an allocation of 325 000; April 1949 was 232 000/255 000; April 1950 202 400/215 000; and April 1951, 230 000/270 000¹.

Naval strength fell more rapidly, and to a lower figure, while the army retained numbers roughly equal to the strength of both the other two services. This balance of forces was accounted for by the extremely pressing demands made on the army - not primarily for imperial defence but for the garrisoning and administration of Germany, and the management and disestablishment of much of the British presence in Asia. The RAF claimed a role in this Eastern 'imperial' deployment, and carried a major share of the responsibility for garrisoning the Middle East, which remained of great strategic importance to Britain for some years after the war. The weakness of the Air Force's Eastern Commands, and the urgency that the defence of home air space and the requirements of BAFO in Germany imposed on the recruiting efforts of the Air Staff indicate how stretched was the RAF's ability to cover its global strategic aspirations, 1945/52.

One approach to a long-term solution lay in persuading skilled men to re-enlist as regulars, or, at the very least, to stay in the service while their replacements were trained and acquired some experience. A bounty scheme was introduced, offering a free suit to men who re-engaged. It had very limited success!

"In reporting to the government on the effect of the coming down to the Plan D ceiling of 305 000 men by the end of 1946, we gave warning of the serious effects that this rapid contraction would have, and also made it clear that the practicability of our plans depend upon estimates of the re-engagement of trained men and of the income of volunteers for the regular Air Force. Unfortunately experience has proved that some of the assumptions and consequently some of the calculations to which we had been working were too optimistic. There has, for example, been a serious shortfall in response to the bounty scheme. The scheme has now been in operation for two months but up to date we have only achieved 1/15 of the number of re-engagements out of planned total of 45000 by 31.12.46. This and other factors which AMP and AMT will explain means that we have got to do a much greater amount of training and re-training than we had calculated on. We have therefore to go to the Cabinet and tell them of our inability to get down to our approved ceiling In other words, we have asked that our ceiling of 305 000 should be raised to 330 000. The Army are up against similar difficulties because of the continued occupational commitments abroad and the Cabinet have agreed to a proportionately greater retardation of release from the army. This will help to make our own shortcomings less difficult to defend politically."²

1. See the tables in Appendices IV and V.

2. Conference with Commanders-in-Chief, August 1946. (PRO - AIR 8/1532).

Conscription was another means of keeping up the numbers in the RAF. Of course the Air Staff found it a most unsatisfactory method. The crisis was one of skills, experience and technology - not of numbers per se¹. The early post-war White Papers on Defence have, as a pervading theme, the shortage of trained and skilled men available to the services. All air crew and most ground crew required lengthy periods of training, and achieved a real peak of efficiency only after undergoing a time of service experience². Yet the Air Staff was still too dependent on conscription to wish it abolished altogether.

However, the proportion of conscripts was supposed to be kept to a minimum while Air Staff devoted itself to persuading skilled men to re-engage, and to efforts to enlist new regular service men, as the basis for the RAF's long-term future.

"Since the end of the war then, RAF recruiting has been directed to two main ends: the retention of skill and experience on the one hand, and the enlistment of fresh ability on the other. The obstacles in both cases have been considerable and the success not entirely insignificant, though still insufficient³..... regular recruiting had been entirely suspended during the war."

1. In the record of a conversation with Air Marshal Sir George Pirie (Air Member for Supply and Organization), 15th March 1949, Sir Basil Liddell Hart writes that "[Pirie] said that he had favoured conscription two years ago, but had completely changed his view since, from seeing the results. It was ruinous to the service - it was impossible to get properly trained ground staffs under that system." Liddell Hart Papers; 11/1949/10.

When, immediately after the outbreak of the Korean War, the Chiefs of Staff put forward new expansion plans in response to the Cabinet's fears about Soviet intentions in Europe, the RAF's dissatisfaction with the high proportion of conscripted National Servicemen in its ranks was still evident. "7.c. RAF Manpower. The present proposals for the RAF would require a considerable increase in uniformed manpower. Although these figures may be reduced somewhat by civilianisation, and despite the considerable increase which is hoped for in regular recruitment, the manpower requirement could only be met by a distinctly high degree of dilution with National Servicemen. Resources of skilled manpower would be strained to the utmost and the main limiting factor on the expansion of the force would be the provision of trained air crews." (Report by the Chiefs of Staff, The Size and Shape of the Armed Forces over the Three Years Beginning 1951/52. COS(50)49. Presented as a Memorandum to the Cabinet Defence Committee, DO(50)81, 12 October 1950, PRO - CAB 131/9.)

2. This matter of personnel training and experience was an expressison of one of the novel requirements of the age of technological warfare, of greatest significance for the arm most dependent on complicated weaponry and techniques. The army, by comparison, remained relatively untouched by this sort of pressure.

3. 'E.R.A.W.', 'Recruiting and the RAF', in The RAF Quarterly, October 1948, Vol. 19.

One of the ways of achieving these targets was to secure improvements in the pay scales - a notorious post-war issue. The Air Staff made regular attempts to have this scale adjusted in line with rates of pay in the civilian economy - without much success. The Air Force advocates in the Lords, such as Lords Trenchard and Portal, frequently raised the matter in debates. Here is a typical example:

"(Lord Portal) then proceeded to consider the national service men and said that it was idle to pretend that this very short service was anything but a most uneconomical use of manpower, particularly in view of the rapidly increasing complexity of modern aircraft. 'One answer is to raise the number of recruits by proper publicity and, above all, by improved conditions the other is to increase the term of national service to the RAF to at least two and if possible three years.'"

Pay was a regular subject in Commons defence debates, and the RAF Quarterly contained frequent pleading about rates of pay. The provision of better accommodation was another common demand, but for five years after the war the RAF was not able to meet the most essential requirements. The Editor of The RAF Quarterly, writing at the most tense time of the Berlin Air Lift, has no doubt about the reasons for the RAF's understrength.

"The whole nation looks to this government to keep us out of war by providing the RAF without further delay, with sufficient trained (skilled) personnel, material and productive capacity to back up an air effort that might at any moment be called upon to maintain a stupendous air war. there will have to be an immediate improvement in the numbers and quality of personnel recruited for the regular air force. Apart from the urgent need to change the present recruiting system, the conditions in the RAF will have to be made far more attractive than they are at present. One of the main causes of poor recruiting is the unpopular new pay code which the services were reluctantly compelled to accept in 1946."²

The first statement on defence by the Conservative government elected in 1951 makes the same point in rather more studied terms.

"In the Army and the Air Force, however, a serious decline in regular recruitment took place between 1947 and 1949. This decline was arrested by the pay increases of September 1950."³

That the Staff was able to persuade the Cabinet to slow demobilisation rates does not alter the fact that the RAF was unable to attract the recruits it needed, or to retain the skills necessary for an efficient transition from war to peace. The influence was felt, not only or primarily, in the RAF's ability to maintain aircraft in properly

1. From the parliamentary report in The RAF Quarterly, January 1949, Vol. 20; relating to debate of 24 November 1948.

2. Editorial in The RAF Quarterly, January 1949 Vol. 20, pp. 1-5.

3. Statement on defence, February 1952. Command 8475.

operational squadrons, but most severely in the training programme for new drafts, and in the development of Air Force training to deal with increasingly sophisticated machinery. It was, in essence, the problems associated with training that led the Air Staff to plead a special case. For the first few years after the war the Air Force was reduced below anything they were able to regard as an efficient and satisfactory military machine.

While cataclysmic contemporary statements on the parlous state of the RAF can easily be found, even the more sober judgements speak of a force reduced to a dangerously enfeebled level. Thus, in a memo the Permanent Secretary writes for the CAS -

"It would be difficult to go beyond this (a press release issued which touched on the difficulties caused by demobilisation and small numbers of re-engagements) without stressing to undesirable degree the present weakness of the RAF as a potential fighting service."¹

So little appeared to have changed four years later that, in a Defence Committee Meeting, the following statement was made on the subject of RAF manpower.

"In the RAF the manpower position was acute. The RAF was 20,000 short on establishment and with the probability of 500 additional jet aircraft [by the end of March 1952] it would be necessary to match them with crews, which meant increased training establishments. There was also the prospect of having to start on a build-up of the Western Union TAF. This would involve a large increase in the manpower available to the RAF including a high proportion of regulars."²

3. Finance

It would have been remarkable had military expenditure not been much reduced after victory in a long war and the advent of peace³. The British nation had large war debts, serious balance of trade and balance of payments deficits, and the Labour Government had an extensive plan of

1. PS to CAS, 9th August 1946, re: press release to follow Conference with Commanders-in-Chief, (PRO - AIR 8/1532).

2. Cabinet Defence Committee, DO(50) 15th meeting, 24 July 1950. Item 4, National Defence. PRO - CAB 131/8.

Air Chief Marshal Sir Guy Garrod echoed this view: "The Air Force has not yet completed its period of peace-time reconstruction. It is still feeling the effects of the shock of post-war demobilisation, followed by financial restrictions Overriding all other difficulties is the problem of manning." ('Let us make the RAF supreme', The RAF Quarterly, January 1951, Vol. 3, no. 1.

3. See Appendix VI, Table of Defence Budgets.

social reconstruction. Contemporary economic orthodoxy demanded that the nation produce goods for sale abroad, and reduce expenditure overseas; at the same time Labour's programme implied a massive growth of internal money and the domestic market. The first thing to do therefore was to return manufacture to peacetime operation by placing the service personnel back in the civilian economy, and cutting back orders for military equipment. The armed forces were quite explicitly expected to 'live' on their wartime stocks and surpluses (provision of jet fighters was about the only exception). Spending on equipment and stocks was thus much reduced.

"We have not so far had to undertake large scale production of existing types of equipment since the war because of the large stocks which were left over at the end of hostilities - we have been using these stocks to meet the current needs of the forces, concentrating our resources on the development and small-scale production of new types of armaments intended for the gradual re-equipment of the postwar Air Forces in the case of aircraft we are stepping up the production of the latest types of jet interceptor fighters to nearly double the former planned rate"

Another goal was the reduction of forces stationed overseas, as this would reduce the amount of money that had to be spent abroad. Of course, as the size of the forces fell, so did the total of service pay shrink. All these sorts of general factors would in any case have been associated with transition to peacetime; probably the only contentious aspect is the extent to which weapons development and production was cut back. It is hard to see, however, that the government had much choice, granting that there is now no argument about the very serious plight of the British economy at that time. It is true that, in view of the government's overall programme, and its judgement that renewed hostilities were most unlikely, the notion that permanently established large-scale forces were either necessary or financially possible was not readily entertained by the Cabinet. By 1951 the perspectives had changed, but before that the political management of defence was not a popular task, and defence spending, as the economic crisis deepened, stood always as one of the prime candidates for savings. It is in my view surprising that the defence budget suffered as little as it did during the crisis of winter and summer of 1947. Roger Eatwell gives a useful description of the Cabinet debate at the time of the preparation of the 1947 Statement on Defence.

1. Minister of Defence, A V Alexander in the Commons, 23rd September 1948, Quoted in The RAF Quarterly Vol. 20, January 1949.

"Dalton's efforts to reduce generally military expenditure in early 1947 had run into serious opposition in the Cabinet. Attlee pointed to the 'disastrous' effects of reducing arms expenditure after the first world war, and Bevin pointed to the dangers of the world situation. However, Dalton received strong support from Cripps and others who were impressed by the economic arguments in favour of cuts. By 21 January the defence estimates had been cut from £913 million to £822 million. Dalton demanded a further cut to £750 million for 1947-1948. This was opposed by the Minister of Defence, A.V. Alexander, who had succeeded Attlee in this post in December 1946, and by the Chiefs of Staff, but on 28 January a compromise was reached on a further cut of 5 per cent. After the convertibility crisis, Attlee announced more cuts."

1. Roger Eatwell, The 1945-1951 Labour Governments, page 90. The figure of £913 million is the budget allocation excluding the terminal payments. The figure in column (a) of Table in Appendix VI for fiscal 1947/1948 is £780.5 million reflecting the further cut of 5% quoted above.

Cabinet discussions on military finance continued to concentrate on reductions until the end of the decade. During 1950 the emphasis changed. By 1949 the Chiefs of Staff had been expressing their concern in forceful terms. In November 1949 the Minister of Defence proposed a budget of £810 million for the year 1950/51, an increase of £50 million over 1949/50. "The Chancellor of the Exchequer said that earlier in the year he had made it quite clear that in his view there was no possibility of finding more than £700 million for defence in future financial years. He saw no possibility whatsoever of finding £810 million in each of the three coming years unless the whole of the present policy of the government were recast."

"The Chief of the Air Staff said that the Chiefs of Staff had now been studying the problem of the size and shape of the armed forces for four years, and throughout this period they had scrupulously tried to avoid asking for more money, or men, or material than they had thought absolutely necessary, even though this meant taking grave risks. Setting aside the past in which they had had to overcome the difficulties of demobilization, the Chiefs of Staff had to deal now first, with the present with its problems of the Occupation and its increasing Cold War responsibilities overseas, and second, with the future and the need to retain the nucleus of a balanced force which could be expanded. In the first instance the Chiefs of Staff had worked on the basis of an annual figure of some £600 million. This had later been changed to £700 million and still later to £810 million. As the Minister of Defence had pointed out, however, even on this figure there were grave risks which from the purely military point of view could not be justified. It was a matter of grave anxiety that under this figure of £810 million the three services would be so pruned down that they would require a long period of warning - say perhaps a year - before they could be got ready for war; In their attempt to look at the problem from a broader point of view, however, the Chiefs of Staff felt that these were risks which ministers might be justified in accepting in as much as with an annual budget of £810 million we should still be just able to discharge our current responsibilities and maintain the minimum balanced nucleus which, given an adequate period of warning, would provide a basis for expansion in war." (Cabinet Defence Committee, Size and Shape of the Armed Forces, 1950-1953, DO(49) 20th meeting, 15th November 1949 (PRO - CAB 131/8).

In the end the Prime Minister decided (at DO(49) 22nd meeting, 25th November 1949) that the 1950/51 estimate should be £780 million.

In spite of the squeeze on military spending, the Labour Government was not radical in its views towards defence, and can hardly be said to have had a commitment to excessive reductions in defence spending. The cuts were dictated by the need for financial stringency rather than by some form of pacifist view of the military machine. A substantially establishment attitude to defence held sway in the Cabinet, and the vocal opponents of the extent of the defence commitments (such as Foot, Mikardo and Crossman) never came close to commanding a majority in the Commons. (The most serious revolt of this period was over the extension of conscription when 72 members of parliament voted against and 76 abstained.) It seems to me that Brookes has struck the correct (if somewhat unctuous) note about the whole of the defence programme when he says the following about the nuclear force:

"It is easy to berate (the Labour government's) unhurried steps towards a nuclear deterrent force between 1945 and 1951, and to make telling and unflattering comparisons with the United States, but this is unfair because the post-war Labour government was beset by a host of economic troubles and conflicting priorities not shared by its American counterpart. In the awareness of the priority that should be accorded to defence, the Labour government was very much reflecting the views of the electorate - when a public opinion poll in March 1951 asked people to choose between spending on defence and housing, the latter being a very scarce commodity, 41% opted for defence first compared with 44% for housing. So when the government trod gingerly between the two, it had got the balance about right. It maintained the atom bomb programme and work on the delivery systems through economic hell and political high water while trying valiantly to resurrect the economy, and it would be churlish and politically naive to chide them for not having done more."

4. Front line strength

The established principle on the provision of military equipment was that wartime stocks should be consumed.² With the exception of the provision of jet interceptor fighters, this principle applied with equal force across the spectrum of equipment, and was still applicable at the end of 1948. The RAF in general was less affected by this ruling than the other two services. Naval re-equipment, for example, was "little more than the maintenance of the existing fleet and the continuation at a reduced rate

1. Andrew Brookes, The History of Britain's Airborne Deterrent, p 35.

2. See, for example, the Defence White Papers, February 1946 Command 6743, and February 1947 Command 7042.

of the construction of ships already being built".¹ In 1949 "only a token provision [was] made for new [warship] construction ..."²

All the same, the front line strength of the RAF declined steeply in numbers, and, except in the case of Fighter Command, quickly fell behind the pace of modern developments. The effect was felt not only in the front line of the other Commands such as Bomber and Coastal Commands, but also in the training units. However, as I have already suggested, the availability of front line aircraft depended as much on difficulties of keeping them serviced for flying, owing to the shortage of ground crews, as on production cutbacks. Initially, Air Staff planning concentrated on how to make the best use of the reduced manpower available to it.

Overall, the effort was determined by the cadre system which I have already described - the front line strength was concentrated in a few fully operational squadrons kept ready for hostilities. The figures given in this section refer to these fully operational squadrons. Only as the wartime aircraft become obsolete, necessitating re-equipment with modern types, did the number and quality of aircraft available become as important an issue as the manpower shortage. It was then that available finance, aircraft production capacity and the progress of research and development became major limiting factors. The table in Appendix VIII sets out the allocation on equipment of what money was available to the RAF.

1. Statement Relating to Defence, February 1947, Command 7042.

2. Statement on Defence, February 1949, Command 7631.

"The naval construction programme for 1945 was reduced to the absolute minimum at the end of the war, and now consisted of only two escort vessels, one submarine, two surveying ships, six small floating docks and some miscellaneous small craft. Only one battleship was under construction - the Vanguard (8 15" guns) cost estimated at £9 millions. Since the VE day the Admiralty had cancelled some 727 vessels from fleet carriers downwards, whose total cost had they been completed, was estimated at £158 millions, of which approximately £32,500,000 had already been spent or was a liability under break-clause conditions, giving a net saving of £125,500,000." (First Lord A V Alexander, introducing in the Commons the Navy estimates 1946/1947, 7th March 1946; reproduced from Navy Notes, Journal of the Royal United Services Institution, May 1946, Vol. 91, No. 562, page 293.

"The material state of the fleet in 1951 can be summarized broadly as being similar to that existing in 1945. No new types of ship or weapon has been put into service since that date." (Paragraph 10, Annex I, Ability of the Armed Forces to meet an Emergency, Report by the Chiefs of Staff to the Cabinet Defence Committee, DO(50)58, 21st July 1950, PRO - CAB 131/9)

At the end of March 1945, the strength and distribution of the RAF, expressed in terms of fully equipped and operational squadrons was as follows.¹

	United Kingdom, Western Europe	Mediterranean	S-E Asia
Heavy Bombers	72	7	6
Bomber Support ²	13	-	-
Light Bombers (Bomber Command)	12	-	-
Light Bombers (Second Tactical Air Force)	14	15	6
Fighters and fighter bombers	90	40	36
Night fighters	14	3	2

For Bomber Command (not including the 13 squadrons with overseas Commands), these squadrons represent the following numbers of operational aircraft:

Heavy Bombers	1591
Mosquitoes	289
Bomber support	265
	<u>2145</u>

Also on unit establishment were 105 non-operational Lancaster Bombers. (The overall strength of Bomber Command, all types, operational and non-operational, was 4362; most of the extra aircraft being with the training units.)³

1. Note by CAS Distribution of RAF Squadrons, Chiefs of Staff Committee - COS (45) 0 (291), 24th April 1945. (PRO - CAB 80/94).

2. Bomber Support comprised the airborne counter measures and electronic warfare squadrons.

U/E means unit establishment and represents the planned number of aircraft per squadron. Aircraft on Charge represents the actual number of aircraft with a squadron, made up of serviceable and unserviceable aircraft. Typically, operational strength is less than the U/E or Aircraft on Charge figure.

3. Figures from the Weekly State of the Metropolitan Air Force in AIR 8/1363-1365; Sir Charles Webster and Noble Frankland The Strategic Air Offensive Against Germany 1939-1945, Vol. IV, page 421; and papers of Air Chief Marshal Sir Norman Bottomley, AC 71/2/76.

An examination of the weekly reports on the State of Operational Aircraft (Home) reveals that although the number of bombers on establishment falls (as would be expected and much in line with the plan) - the number of bombers available for operation falls much more sharply.

Heavy bombers - 29 November 1945¹

Lancaster squadrons	22
Mixed Lancaster/Lincoln squadrons	2
Total squadrons	24
consisting of 597 aircraft (6 Lincolns) of which 382 were operational (5 Lincolns)	

Heavy bombers - 2 May 1946²

Lancaster squadrons	20
Lincoln squadrons	1
Mixed Lancaster/Lincoln squadrons	2
Total squadrons	23
consisting of 307 aircraft (13 Lincolns) of which 101 were operational (2 Lincolns)	

Heavy bombers - 4 July 1946³

Lancaster squadrons	17
Lincoln squadrons	4
consisting of 218 aircraft (40 Lincolns) of which 68 were operational (8 Lincolns)	

Heavy bombers - 31 July 1947⁴

Lancaster squadrons	8
Lincoln squadrons	14
Total squadrons	22
consisting of 128 aircraft (76 Lincolns) of which 42 were operational (22 Lincolns)	

Heavy bombers - 27 November 1947⁵

Lancaster squadrons	8
Lincoln squadrons	14
Total squadrons	22
consisting of 128 aircraft (83 Lincolns) of which 55 were operational (45 Lincolns)	

Thus the lowest point of Bomber Command's strength as a fighting force was reached in July 1947, when there were only 42 serviceable heavy bombers available for operations. The gradual accretion of operational bomber strength after July 1947 initially derived more from the ability of the Command to put available planes into operation than from the flow of new aircraft into service. The figures for RAF strength on 31st January 1951¹ show that compared to May 1946, about the same total strength was available to the Command, while the operational strength had roughly doubled.

	<u>Operational</u>	<u>Total</u>
Bomber Command	186	327
Fighter Command	423	872
Fighter Command Auxiliary*	168	328
British Air Force of Occupation	188	262
Middle East Air Force	192	343
Far East Air Force	168	319
Other Commands	208	2422
	—	—
TOTAL	1513	4873
	—	—

* = Properly known as the Royal Auxiliary Air Force

There was indeed, less and less incentive to accept new Lancasters and Lincolns into service as the time went on. The last Lancaster entered service with Bomber Command in February 1946. By the end of the decade they had been completely superseded by the Lincoln, which itself was to remain in service with the Command until December 1955. By 1949, according to a note by Liddell Hart, the production of Lincolns consisted of one per year as a replacement; altogether 528 were produced.² The reason for this lack of incentive was, of course, the growing obsolescence of the Lincoln. It was necessary that the best use was made of them (being all that was available) but attention was increasingly

1. From Air Ministry, Air Historical Branch, records kindly made available by Mr Humphrey Wynn.

2. Figures and dates from Owen Thetford, Aircraft of the RAF. For the Liddell Hart reference see footnote on page 122 below.

focussed on the day when the new V-bombers would be ready. In the interim, even the brief employment of B29s, supplied as military aid by the Americans, (a total of 88 were deployed between March 1950 and December 1954) was a welcomed addition to the strength of Bomber Command.

"The Committee had before them a memorandum by the Secretary of State for Air (DO(49)13) proposing that 8 RAF squadrons, at present equipped with Lancasters and Lincolns, should be equipped with B 29 aircraft provided that the necessary arrangements could be made to obtain them. The Secretary of State for Air pointed out that the ranges of action of Lancasters and Lincolns were very limited and that there was no prospect of heavy jet bombers being available from British sources before 1954 at the earliest. The production of Lincolns in the next few years was severely limited, even if special steps were taken to increase production. He was accordingly very anxious to obtain 194 B 29 aircraft which were believed to be available in the United States."

In the meantime, the increasing strength of Bomber Command was essentially a numerical rather than a qualitative function of air warfare capability - in contrast to Fighter Command, which expanded both in numbers and in quality. By the turn of the decade Fighter Command's entire front line strength was made up of jet powered aircraft.

The statistical details of the RAF's front line strength show clearly enough the weakened state of the air force between 1945 and 1950, but it is only one standard of measurement. The contemporary judgement on the state of the force is an equally revealing guide. For example, the following extract from a note by the Air Ministry to the Chiefs of Staff Committee sums up all of the anxieties of the Air Staff, and states its view of the fighting effectiveness of the RAF. (Due allowance should be made for the audience being addressed by the Air Staff and any exaggeration that might have been thought necessary in order to reinforce the Air Force's case.)

"[para 2] It is pointed out in COS (46) 36 (0) that the strengths shown in Table 1 of this paper [not reproduced: the table entitled 'Planned location of RAF units at 1st January 1947' was purely hypothetical and bore very little relation to the eventual strength and location on that date] will, for a considerable period, be merely a facade. The acute personnel disturbances caused by the rapid contraction to the new manpower ceiling of 305 000 will upset the essential balance between the different trades and between the air crew categories throughout the world. This will produce a training problem of such magnitude that, together with terminal commitments, the result will be inability to retain more than some 50% of front line units shown in Table 1 capable of operating and these only on a 'police' basis for some months after the height of the disturbances.

1. Cabinet Defence Committee, DO(49)7th meeting, 9th March 1949, Item 2. Equipment of RAF with B 29s. (PRO - CAB 131/8).

Para 3. The extreme weakness of the Royal Air Force as a fighting force resulting from the cuts already imposed can be seen from the following brief review [not reproduced here] of the operational Commands. Even without any further reduction in manpower, it would take a period of years, the exact length of which cannot yet be forecast, but which must extend beyond 1948, to restore the operational efficiency to the force, or to render it a sound nucleus for rapid expansion in emergency.

Para 4. Bomber Command. The process of reducing squadrons to a non-effective cadre will shortly bring the strength of this Command to a level equivalent to only ten long range squadrons of indifferent operational efficiency. This represents a meagre strength for our only force capable of quick offensive action or of acting as a deterrent to aggression. In respect of this Command, there is little real strength behind our facade."

Three months earlier, in another memo to the Chiefs of Staff Committee, the Air Staff reported that the day fighter component of the Air Defence of Great Britain was to be 18 instead of 24 squadrons - "Since not more than half of these will be operational we should have barely enough to man a single sector of the air defences."²

In one of his 'Notes for History' Sir Basil Liddell Hart makes some observations about the state of the RAF at the end of the decade which suggests the general trend in air force development over the previous four years. There were obviously continuing industrial shortages and delays, and a reduction in the scale on which the air force was conceived. It is also clear that a settled structure had begun to emerge which involved a new balance of force within the RAF.

"Coryton [had] declared that even if we could afford a new bomber force, we could not provide the airfields - there was not enough cement, steel, etc. He also mentioned that delivery of a new kind of bullet-proof glass for fighters would take two years because the makers (Austin's) are so fully occupied with their contract for cars for export.

Bomber Command now comprises 20 squadrons. All Lancasters and Lincolns. There is no new production - except about one Lincoln a year as replacement.

Fighter Command comprises 22 regular fighter squadrons - all now equipped with jet fighters - and 20 auxiliary squadrons, of which 4 have been equipped with jet fighters. Delay here is due primarily to the need of extending the runways to the length required, 2000 yards.

1. Note by the Air Ministry Call up of the Forces in the Transitional Period, for the Chiefs of Staff Committee, 4th May 1946, COS (46) 132 (PRO - CAB 80/101)

2. Air Ministry memorandum to the Chiefs of Staff Committee, 7th February 1946, COS (46) 36 (0). (PRO - CAB 80/99).

Most of the present airfields for the auxiliary fighter squadrons have runways of only 1400-1500 yards.

A. Crawley [Parliamentary Under Secretary of State] said (22.3.48) that there are now 6 machines in a fighter flight - and thus 12 in a squadron (in the war some squadrons had 3 flights, but the number of machines in a squadron average 18-20). In a bomber flight there are now 5 machines - 10 in a squadron. But the total of Bomber Command is only about 130-140 serviceable machines at present."

5. Conclusion

I think it accurate to say that, although the RAF suffered a serious diminution of front line strength, and experienced severe manpower shortages, the consequences for the force were acute only during the period roughly from the start of 1946 to the autumn of 1949. By comparison, the navy suffered much more seriously and over a longer period of time. Except in a few areas, such as the processing of applications for post-war re-enlistment, the Air Staff managed the contractions effectively by using the cadre system, and stabilised the structure of the force satisfactorily within two years. I do not wish to suggest that it can have been a happy experience for Bomber Command to have only 42 heavy bombers available for operations in July 1947.

1. Notes for History, 15th March 1949, Liddell Hart papers 11/1949/10. In 1950, the fighting capability of the RAF was judged by the Chiefs of Staff to be as follows: "Para. 4. In July 1951 the first line regular strength of Fighter Command on current plan will be approximately 340 aircraft. Thus, if war breaks out on that date, there will be a deficiency of some 810 aircraft out of the 1150 estimated to be the minimum requirement.

Para. 6. Owing to the grave shortage of war reserves, however, only a small number of the front line aircraft lost or damaged in operations will be replaced and, by D plus 3 months, in spite of the USAF and RAAF reinforcements, it is estimated that the defensive fighter force will be reduced to less than 600 aircraft, i.e.: about one half of the minimum number considered to be the essential minimum for the defence of the United Kingdom.

Para. 11. Only one squadron of Canberra jet bombers will have been formed by July 1951 and this will not become operational for about three months. In July 1951 the bomber force will consist only of some 36 B 29s and 112 Lincolns. By no means all this small force is mobilisable owing to the lack of reserve crews and aircraft; particularly the former. The force is bound to contract sharply under the pressure of war wastage.

Para. 12. Its effectiveness for the strategic bombing of Russia in July 1951 will be insignificant owing to the comparatively short range of the Lincoln and the small number of B 29s; but it will be able to make some contribution to the defence against invasion, the air defence of the United Kingdom and to the protection of our sea lines of communication." (Annex III, Ability of the Armed Forces to meet an Emergency, Report by the Chiefs of Staff to the Cabinet Defence Committee, DO(50)58, 21st July 1950, PRO - CAB 131/9)

However, at least this nominal force was organized in 27 squadrons and, while obviously not worth much should immediate hostilities break out, retained the organization that was capable of later expansion. This was the first goal, and within it was subsumed a degree of optimism about the future. The manpower crisis sprang from the demobilization demands of the government; it was also the product of the RAF's own recruiting and training decisions and programme during the war.

There is also a conclusion to be drawn from the shape of the front line which began to emerge from 1948. The type of aircraft supplied to the RAF depended on a complicated pattern of factors. The government, through the mechanisms of the Defence Committee and a system of setting production targets to guide the Ministry of Supply, reduced the allocation of resources for military aircraft. Therefore, whatever other pressures there might have been, difficult choices about what sort of aircraft to produce would have had to have been made. In fact, there was another pressure - the political (and military) injunction to give priority to the Air Defence of Great Britain. Throughout the post-war period, however, the Air Staff remained committed to the absolute centrality of the bomber as the essential weapon of the offence, the ultimate and real defence of the country, and, increasingly, the prime agent of deterrence.¹ It was to take 20 years to shake this belief in the bomber: but as the 1940s drew to a close the Air Staff faced a dilemma in how to reconcile the three requirements of aircraft supply that impacted on the front line strength. Their conclusion was clearly to apply intermediate and transitional technology to the fighter force as a short term expedient to keep ahead of any potential bomber threat, and apply a 'great leap forward' approach to bomber technology, hoping to stay ahead of the most advanced defences of a decade hence.

There was some substance to this approach. There was a breathing space after the war, and the pace of aviation technology was not that impressive amongst allies and enemies. The sound barrier was reached (in level flight) only in the autumn of 1947; even the Americans did not operate a jet bomber (B47) until the early 50's and no potential enemy

1. "During the first ten years, up to 1955, the relevance of strategic bombing and the manned strategic bomber was never seriously challenged. By 1955, however, the relevance of the latter was called into question by developments in medium and long range ballistic missiles." Professor Ian Cheeseman, Martin Edmonds and John Simpson 'The procurement of military combat aircraft, 1945-1970', page 172, in Frank Gregory et al., Perspectives Upon British Defence Policy 1945-1947.

possessed a strategic bombing force. British jet engine designs were advanced and the RAF's fighters impressive. In fact, the British had a depth of jet fighter experience, and a good knowledge of their design and performance. The first operational RAF jet patrol was flown on 4th August 1944. After the war, the production lines existed to produce a steady flow of replacements for the piston engined fighters. Thus receipt of the next generation of fighters by Fighter Command was in effect the continuation of a process that had begun during the war, and which it was easy to allow to continue after it. The projected totals of operational jet fighters were -

90 by end of 1945

176 by end of June 1946

256 by end of 1946.¹

The Meteor, the Vampire and its derivative the Venom were, in concept, traditional fighters powered with the best jet engines available; giving them greater speed and better performance at height. They were the sort of craft that could make the best use of the jet without setting challenging design problems. There had been a conscious decision not to seek supersonic performance; and aerodynamic matters such as compressibility effects, (handling at trans-sonic speeds) and air frame stress were avoided as far as they could be. Swept wings, the dynamics of supersonic flight and a real advance in engine power (and design) were a long way off for British fighters. This transitional approach appears to have been accepted without difficulty by the Air Staff. Re-equipment was not held up by the search for radical technologies - on the contrary, traditional concepts were actively encouraged. About 1665 of the major day fighting marks of the Meteor (III, IV, and F.8) were made (last deliveries in April 1950), and 1000 of the main fighter variant of the Vampire (F.1) were produced: they were phased out in 1951 by the F.8 Meteor. 1200 of the Vampire fighter-bomber variants were made (FB.5 and FB.9), primarily for service with British Air Forces of Occupation.

1. Memorandum by the Secretary of State for Air, Production Programme for the Royal Air Force, 22nd October 1945, for the Cabinet Defence Committee. DO (45) 21. (PRO - CAB 69/7).

Later expansion of the day fighter force was proposed as follows: (1951 figures are actual strengths in March);

Meteor, rising from 280 in 1951 to a peak of 588 in 1953;

Vampire, rising from 376 in 1951 to a peak of 544 in 1953;

Venom, rising from 16 in 1952 to a peak of 624 in 1955;

F3/48 (the Hawker Hunter), 176 in 1954, 616 in 1955.

(The Progress of Rearmament, Memorandum by the Minister of Defence to the Cabinet Defence Committee, DO(51)58, 19 May 1951. (PRO - CAB 131/11))

On the other hand, the types of capabilities sought, and (indeed) the performances expected, of the next generation of bombers presented numerous technological problems. The approach was underpinned by a dedication to the bomber as the supreme technological achievement of the future. In pursuit of the 'perfect' bomber, enormous obstacles were overcome, frightful delays encountered, and a serious credibility gap allowed to develop.

".... enormous pressure had been exerted to produce the first bombs and the fissile material for them as soon as possible, both as a deterrent and as a symbol of power status: the inability to deliver them must have diminished this effect. If the bombers had been ready first they could still have served a potentially useful military purpose, armed with conventional bombs. Atomic bombs without aircraft suitable to carry them could serve no immediate purpose. The atomic project had enjoyed higher, longer and more consistent priority than the aircraft, while modern aircraft design - the problems of the engine, the air frame and the equipment - is notoriously uncertain."¹

The chosen solution to the aircraft dilemma imposed other penalties on Bomber Command. A numerically large force was precluded, on grounds of cost, not only for the time being, but for the foreseeable future. The atomic bomb partially solved this difficulty but without numbers the strategic bombers could never again be convincingly presented as a conventional strike force. By concentrating on a very advanced design, and implicitly accepting years without any effective force at all, the Air Staff arrived at a position where it was convenient to let the supply of bomber aircraft languish. It was an admission that an effective strategic air fleet-in-being would be a difficult and costly thing to maintain in peace time. It was also less and less politic within the air force.

"Let us be frank and admit that the speech on the Air Estimates by the Secretary of State for Air was a bitter disappointment to us all. What did we expect?

Our expectations were based on the need to lose no time in remedying the unsatisfactory state of affairs in our first line of defence, so that it would be strong enough to resist the first onslaught of Russia, should we be called upon to do so at any time in the near future.

1. Margaret Gowing, Independence and Deterrence, vol. 1, page 235.

Firstly we hoped to hear that the government had a plan to remedy the unsatisfactory manpower situation. It has been their declared policy for some time that the highest possible proportion of the strength of the RAF should consist of regulars. Of the total strength of 228 000 only 126 000 are regulars and of these only 20 000 were serving in 1939. It is clear and admitted openly that our first line of defence is seriously handicapped by the lack of experienced men in certain high-skilled trades.

Secondly, realizing that our defence largely depends upon an adequate numbers of bomber squadrons armed in the latest aircraft and equipment, we hoped to hear (owing to the nearness of the danger which threaten us) that by the end of this year or early in 1950 our bomber striking forces would be of a size, shape and quality which would deter any would-be aggressor. All we did hear was that 'we have had under development a twin-jet bomber, capable of a speed approaching 500 m.p.h., and that it has now been decided to place orders for its production.'

Three years later, it seems very little had changed. In April 1952 G W Waddington wrote:

"It is no secret that Bomber Command squadrons are still largely equipped with the wartime and now obsolescent Lincoln bomber. The overall picture is not bright. As far as the major proportion of Bomber Command is concerned it might be said that very little new is being done. Day to day flying, training and tactics are almost as they were at the end of the war."

The supply of fighter aircraft was regarded as an essential bridge to the fully modernized force of the future. This perspective could remain entirely consistent with orthodox theory, so long as expenditure on or development of fighter strength did not materially threaten the programme

1. Editorial comment on the Air Force Estimates debate (March 1949), from The RAF Quarterly, Vol 20 no. 2 April 1949.

2. 'The first line of offense ', The RAF Quarterly, vol. 4, no. 2. April 1952. Probably neither Flight Lieutenant Waddington nor the Editor of The RAF Quarterly fully appreciated the weakness of Bomber Command at that time. "1. The plan provides for an increase of one squadron (8 aircraft) in 1951/1952, of 8 squadrons in 1952/1953 and 9 squadrons in 1953/1954, giving a total front line of 36 squadrons (288 aircraft) by the end of 1953/1954, together with 3 target marking and 4 photographic reconnaissance squadrons.

2. Most of this force of 36 squadrons will be equipped with the Canberra which can only carry 7500 lb over a radius of 500 miles and its hitting power will be small in relation to the commitments in support of the defence of the United Kingdom and the land battle in Europe.

3. At present nearly the whole of the medium bomber force is equipped with Lincolns. 4 squadrons will remain on Lincolns throughout the period in order to provide for heavy mine laying and for the carriage of heavy bombs. By June 1952 8 squadrons should be re-equipped with Washingtons and the rest with Canberras. The new squadrons to be formed between 1952 and 1954 will all be equipped with Canberras." (From Annex III, 'Expansion of the RAF 1951-1954: Bomber Command', of Report by the Chiefs of Staff on The Size and Shape of the Armed Forces over the Three Years beginning 1951-1952, 12th October 1950, Cabinet Defence Committee, DO(50)81. PRO - CAB 131/9.

leading to the new bombers. The RAF used a dual approach to the problem of a force-in-being able to play its part in the defence effort - intermediate technology in fighters in parallel with the most advanced technology bombers. The political force behind this dual approach hinged on the fact that during the international scares and crises that followed the war, it was the air defence of Britain that was the substance of popular and strategic reaction.

What I have tried to show by drawing out this conclusion is that the answer to the questions - 'what view can we take of the fact that fighter defence was so materially favoured after a war which was supposed to have proved the vulnerability of air defence, and why were so many jet fighters produced before the arrival of any jet bombers?' - is not that the bomber and its advocates had been eclipsed. Rather, it is that the importance of the bomber achieved a new intensity after 1945, and solutions to the profound problems associated with strategic bombing were pursued in the pantheon of technology.

Chapter 5

Science in post-war air policy, and the supply of military aircraft

The Second World War was remarkable for the energy and resources which all the major powers devoted to the application of science for military purposes. In Britain, the essence of the scientific contribution to the war effort lay in the engineering achievements that had transformed established theories into workable military technologies. Furthermore, the work of the Operational Research Sections, advocated and expanded by scientists such as P.M.S. Blackett and J.H.G. Whitehead at Coastal Command and B.G. Dickens at Bomber Command, helped to ensure that the new technologies were correctly employed during the war. Although the Navy was a major beneficiary of these advances in applied science and scientific methods (victory in the Battle of the Atlantic is an obvious example of the triumph of technology used in sea warfare) it was the RAF that gained the most, and had the greatest reason to maintain its scientific connections after the war. The bulk of the air warfare technologies depended on radio physics, principally in the form of radar.

"Radio location has had more effect in this war than any other scientific development. Fortunately, we have been able in the main to keep ahead of the enemy in its application to offensive and defensive action by sea, land and air. Under the pressure of events the rate of technical progress has been spectacular. Nevertheless, we feel that we are still only at the beginning of the application of the science of radio physics, in its various forms, to defensive and offensive warfare. The fundamental science of the subject has necessarily been neglected in many directions during the last five years. There is a large field of work which is practically untouched; in particular we know little or nothing about the region between the longest infra red and the shortest radio wave now used for any purpose, in other words, about the use of electromagnetic waves between one half millimetre and one centimetre in length. Nor has there yet been sufficient exploration of the possibilities inherent in the use of the commonly used frequencies, but in extremely high powers. The pulse technique developed for radar makes possible the attainment of radiation with power much greater than had hitherto been possible."¹

The RAF's receptiveness to new technologies was, however, curiously uneven. Although the basis in radio physics was the same for both defensive and offensive application to air warfare, it is convenient (and in view of post-war progress, pertinent) to consider them as distinct entities. This is because the first thoroughgoing application of the

1. Report by Sir Henry Tizard's 'Ad hoc' Committee on Future development in weapons and methods of war, paragraph 5, page 5; to the Chiefs of Staff Committee, 16th June 1945. COS (45) 402 (O) (PRO - CAB 80/94). (Membership was - H.T. Tizard, P.M.S. Blackett, C.D. Ellis, G.P. Thomson and J.D. Bernal.)

technology was in the field of air defence. As a result of the dual achievements of air defence in defeating the German Blitz, and of scientific intelligence in comprehending the German 'beam bombing' system, there developed an undeniable incentive to apply new techniques to the bomber offensive. In view of the importance this was to have on the prospects for strategic bombing, it is ironic that the early lessons of scientific application and cooperation had come from Fighter Command.

"The first time, I believe, that scientists were ever called in to study the needs of the Services as distinct from their wants, was in 1935, and then only as a last resort. The Air Staff were convinced of the inadequacy of existing methods and equipment to defeat air attack on Great Britain, and a committee was established for the scientific survey of air defence. I want to emphasize that this committee, although it consisted on paper only of scientists, was in fact from the first a committee of scientists and serving officers, working together. It was quickly realized that one could not rely on the sound locator, to the improvement of which so much effort had been devoted, for sufficiently early warning of the approach of enemy aircraft. When Watson-Watt came forward with his proposals for radio location, he found receptive listeners, and the Committee was in a position not only to arrange for the first successful trial, but to influence the rapid development of the new method on a large scale. What is necessary is to emphasize that our own success in the use of radar was not merely due to the fact that we had young scientists of the necessary calibre to undertake the experimental work; in military language it was not only that our tactical strength in science was great. For after all, radar was not an end in itself; it was a means to an end; and the end was the interception of the enemy, whether by aircraft or ship, shell or bomb. Long before radar was a proved practical success in any form, experiments on new methods of interception of aircraft by aircraft, based on its use, were in progress at Biggin Hill under the direction of the Committee. The new methods were adopted by Fighter Command in 1937, and were continuously improved throughout the war."

The intriguing indifference towards scientific possibilities evinced by Bomber Command in the early stages of the war established a pattern which was to endure after the war. The technologies of the offensive, as sophisticated as they were to become, were always to be, in principle, consequent upon advances in defensive technology. In fact, a distinction in conception and practice grew up that was, at times, to produce the situation where research into the defence followed a course tangential to the main themes of offensive thinking. The anomaly grew up that work on defence pointed to air war developments which would nullify contemporary offensive approaches, without actually producing an analytical shift in offensive thinking. This, I believe, was characteristic of the development of air power, theory and practice. For example, in 1940 and

1. Sir Henry Tizard, "Science and the Services", in The Journal of the Royal United Service Institution, August 1946, vol. 91, no. 563, pp 338-339.

1941, failure to grasp the significance that radar could have for any system of air defence, and ignorance of Germany's own defensive radar network, led Bomber Command to resist the need to re-evaluate its methods. Thus radio silence was insisted upon while the bombers were airborne. The scientists who had developed defensive radar and interception techniques were determined, by 1941, that they could help Bomber Command too, but it was only after the crisis in strategic bombing that occurred during 1941 that the Air Staff and the Command were prepared to abandon their faith in dead reckoning navigation and traditional methods of target location and bomb aiming. Thereafter technologies based on radar enormously enhanced the offensive power and defensive capabilities of the bomber. GEE, OBOE, H2S, Broadcast Winds and the control of the bomber stream by a Master Bomber substantially increased the accuracy and destructiveness of bombing attacks. At the same time bomber losses were contained by such techniques as radio jamming, counter broadcasting and Window which confused and deceived the defences, and by the employment of airborne radar (Monica) enabling bombers to detect the proximity of enemy fighters. The formation of 100 Group, which comprised the airborne Radio Counter-measures bombers and the Serrate Mosquitoes which both mimicked and attacked the German night fighters represents the apogee of scientifically inspired bomber defence.

Thus, at the end of the war, the heavy bomber with its enormous load of bombs and complex on board and ground-support equipment to aid navigation, bombing concentration and the penetration of enemy air defences was the outstanding product of the industrial and technological age. The further development of defensive and offensive air warfare technology was influenced by two factors which wartime experience seemed to suggest were vital to progress. The first was cooperation between scientists and servicemen. An emphasis on a close and continuing relationship between science and the services pervades the post-war thinking about the direction of science. For example, Air Chief Marshal Sir Norman Bottomley outlined the model for the future in a lecture to the Royal United Service Institution -

"Another direction in which we [Bomber Command] suffered was in the scientific field. In the early and even the middle stages of the war, we lacked scientific advice, scientific guidance and scientific inspiration. Of the three Services, I think the RAF was the first to recognize this weakness; and once we recognized it, we made rapid progress, and we benefitted enormously; we benefitted particularly from the establishment of Operational Research Sections in all the Commands, and we benefitted from the close liaison between the Service

and scientific and technical establishments. I know that much has been done to integrate scientific effort and scientific personnel with the military machine. In the future, however, we must be absolutely certain that we have the scientific backing which our highly technical and scientific weapons and scientific methods demand; and above all, the RAF must be receptive to scientific thought and scientific progress."

The wartime proliferation of scientific establishments, the incorporation of scientific advisers and their staffs into the military staff structures, and the permanence of the Operational Research Sections at the Command level, all tended to guarantee that the relationship would not be broken down after 1945, but simply adjusted. Not only in the RAF was there this understanding of the contribution science had made to the war effort. A consciousness of the need to exploit existing and new technologies in the future was present as well in the High Command and Government and gave rise to decisions such as that to set up the Defence Research Policy Committee. It was the air force, however, that was to have the most sustained and best provided for scientific effort.

This was due not only to the RAF's evident dependence on high technology, but also to the belief, that had grown up during the war, that the allies had won because of better science. The importance of technological superiority based on a sustained research effort came to be seen as of equal importance to a strong front line - indeed almost a war winning contribution in itself. This was the second factor influencing the development of post-war military science.

"[The defence force of the future] must obviously become more and more dependent on science, and must make it its main business, as the only condition of winning the next war, to exploit the best contemporary weapons that science has to offer, with no more regret when it relinquishes an older weapon than a scientist shows when a hypothesis is exploded, or when he finds a quick and easy method to replace one that was inefficient and laborious."

1. Air Chief Marshal Sir Norman Bottomley, 'The strategic bomber offensive against Germany' in The Journal of the Royal United Service Institution, May 1948, vol. 93, no. 570, page 235.

2. Marshal of the RAF Sir Arthur Harris, Bomber Offensive, page 278. See also, for example - "In any future war there seems every reason to suppose that, if major powers are involved, the opening phases may be so shattering in their effects as to dictate the final outcome. Thus there can be no more vital part of our post-war defence set up than to ensure the full integration of science and strategy if we are to survive or avoid war because our international policy is known to be based upon a solid foundation of the most lethal devices that the most ingenious of our scientists can conceive." Paper by the COS's Secretariat, Central direction of scientific effort, 7 November 1945. COS(45)648. PRO-CAB 80/98

This quest for technological superiority (which is the origin of the contemporary arms race) implied not only a willingness to incorporate new technologies into operational thinking, but also a large allocation of resources to research and development. In fact research did become the government's priority, a priority that overrode all normal production except that of new jet fighters:

- "(a) Concentration on research. Scientific and technical progress at the present time is so rapid that safety lies far more in the maintenance of an adequate organization for pure and applied research than in the building up of stocks of obsolescent equipment.
- (b) Limited introduction of equipment of the most modern kind eg: jet propelled aircraft."

It is certainly true that it was convenient to concentrate on research in order to use up wartime stocks, and prudent in order to arrive at a better understanding of what new weapons would be required, but this priority reflects also an emerging belief in the 'technological fix'.

There had been little basic research conducted during the war, most of the advances were derived from the development of scientific innovations which had occurred during the 1930s. After the war there was marked shift of emphasis towards pure research. In this manner it was hoped not only to keep ahead of enemies, but also to achieve scientific breakthroughs which would make possible a more economical defence effort. At least in the opinion of Sir Robert Cockburn² this led to an overinvestment in research, the products of which Britain never had the resources to translate into military hardware. This sort of approach is summed up in the report of Tizard's 'Ad hoc' Committee.

"If it can be assumed there will be no major war in the immediate future, we believe it necessary to concentrate much of the scientific effort available for defence onto basic research into the physical principles underlying the design of weapons of war, and not on improvements in detail for which there is naturally always a persistent demand from the Service Departments. We have seen much of the proposed Service Programmes for the post-war years, and while we would rule out a few of the items as of no value, we consider that in the effort to provide for the immediate needs of everyone we run the risk of grasping at the shadow of things of the past and losing the substance of things to come"

1. In 'Statement relating to defence', Feb 1946, CMD6743

2. Conversation between Sir Robert Cockburn and Mark Venables, 3rd September 1984, recorded on tape.

3. Report by Sir Henry Tizard's 'Ad hoc' Committee on Future development in weapons and methods of war, paragraph 23, page 9; to the Chiefs of Staff Committee, 16th June 1945. COS (45) 402 (O) (PRO - CAB 80/94).

The overall progression of this research effort in the air warfare field continued to be characterized by the two divergent themes of offence and defence. Because the Air Staff was determined to proceed with the construction of a new bomber fleet, the technology of manned bombers and offensive oriented science was aggressively pursued. The gradualist approach to fighter performances was accompanied by the search for higher speeds and operational ceilings that would allow the manned bomber to penetrate foreseeable fighter defences. Concurrently, however, research at the frontiers of military science continued to point to the growing preponderance of defensive technologies - especially in enhanced radar technologies and air defence missiles - over the manned bomber.

That these two themes co-existed suggests that the direction of research was determined as much by contemporary military thinking as by the available scientific advice and potential. Thus although the place of science in post-war air policy was guaranteed by wartime achievements and post-war perceptions of them, it was at the same time accorded an ambiguous status when the connection between strategy and new weapons was being defined. Only in a few instances was science the primary factor in determining the future of weapons development, in most cases it was the servant of established doctrine. At all times, however, scientific opinion and evidence was important in the overall process of policy implementation because it had become a permanent part of the service establishment. Before discussing the history of the RAF post-war re-equipment programme, and the doctrines which informed it, it is therefore essential to describe the direction and operation of military science, and the major projects which were undertaken.

1. The Ministry of Supply

The Ministry of Supply was the pivot of air force science, being responsible for the research establishments and the agency which took the RAF's equipment requirements and managed the development and production process which ended with operational aircraft.

The Ministry was a large and complex organization, subdivided by departments and staffed largely by civil servants whose job was technical

and managerial. Sir Robert Cockburn, who was Controller (Guided Weapons) and then Chief Scientist at the Ministry of Supply during the second half of the 1950s remembered that

"When I moved to the Ministry of Supply it took me several years to find out how it worked, it was such a huge, complex business. The interlocking between weapons' design, aircraft aerodynamics, airfield policy, equipment policy etc., was incredibly complicated. One could be critical of the slowness with which all this information got regurgitated. I would have thought that as professionals they were very good, especially the people at the Royal Aircraft Establishment."

The Ministry was primarily concerned with air force and army equipment, devoting the bulk of its operation and financial vote to the air force. The navy retained its separate supply system for all of its ship and equipment needs except guided weapons and aircraft, for which it was obliged to work through the Ministry of Supply. The departments were organized functionally and run by controllers. Thus, for example, there was a Controller of Aircraft (usually, but not always, an Air Marshal, seconded from the Air Ministry²), and a Controller of Guided Weapons. Through their staffs at the Ministry of Supply, they had the executive task to run the research establishments and collaborate with industry, overseeing the whole of the development and manufacturing process of producing the equipment for which they were responsible. The navy was represented where its interests were involved; for example, there was a Rear-Admiral in the Controller of Aircraft's department, and strong naval representation in the guided weapons department. Naval guided weapons requirements were handled in exactly the same way as were those of the RAF. I have already drawn attention to the attempts made, through joint-committees, to standardize air force and naval equipment such as road transport and signals. At the Ministry of Supply efforts were made to co-ordinate the two services' requirements in radar and guided weapons. The fact remains, however, that the Ministry was overwhelmingly occupied with the RAF's equipment supply.

There was an established process for the procurement of military aircraft which may be taken as a model for the supply of all RAF equipment. The process would begin in the Operational Requirements (OR) Department of the Air Staff. The Assistant Chief of the Air Staff (Operational

1. Conversation between Sir Robert Cockburn and Mark Venables, 3rd September 1984, recorded on tape.

2. The Controllers of Aircraft were, chronologically, Air Marshal Sir Alec Coryton, Air Marshal Sir John Boothman, Air Chief Marshal Sir James Baker, George Gardiner (who had been Director RAE).

Requirements) was responsible for drawing up all Air Staff operational requirements including guided weapons. As well as aircraft and equipment requirements this included modifications to air frames, engines and equipment, and informing other branches of operational requirements trends. The OR Department was divided into directorates, the directors of which worked under the ACAS (OR). The Director of Operational Requirements (A)(DORA) dealt with aircraft and armaments, and the installation of armament and equipment in aircraft. The Director of Operational Requirements (B)(DORB) dealt with all other aircraft and flying related equipment, such as instruments and clothing. There was a separate section dealing with guided and homing weapons, under a deputy director (DDOR5), and subsections under (DORA) dealing with bombers and fighters. The various sections and subsections were run by a Group Captain, and the OR Department as a whole contained a marked preponderance of RAF officers compared with the permanent civil service staff.

The work of the OR Department was not of a technical nature. The requirements defined the roles that the aircraft were supposed to perform and the broad operational parameters that would make them of use in the future wars that the Air Staff had to prepare for. Thus the operational requirements represent quite a good guide to the Air Staff's perception of what shape wars might take. Sir Geoffrey Tuttle gives an example of the sort of factors which influenced his thinking while he was ACAS (OR). "The requirement for the V-bombers was dictated by two major factors (a) the size of the bomb, and (b) the geographical position of Moscow. This lead to many questions, one of the main ones being survival."¹ In tackling the question of the survival of a bomber force, one of whose future potential targets was obviously Moscow, the OR Department concentrated on the philosophical issue of whether this would be best assured by a high performance or substantial defensive armament². It is not surprising that high performance was chosen as the key to penetrating the Soviet/air defence system, and that it was decided that the V-bombers should carry no defensive armament. Hence, in addition to an emphasis on Radio Counter Measures (RCM) equipment and techniques the

1. Air Marshal/ Sir Geoffrey Tuttle, '50 years in flying', in The RAF Quarterly, Summer 1978, vol. 18, no. 2, page 147.

2. AIR 20/7111, Long Range Bomber: Air Staff Requirements. Number OR/230, and associated papers, June 1946 - August 1947.

operational requirement stressed the need for great speeds and a very high operational ceiling. How such factors were to be reconciled with payload and range requirements was not the concern of the Department.

The technical and scientific issues were the province of the Ministry of Supply. Of course, the OR Department took scientific advice about the technical feasibility of the requirement, but this was merely a consultative process. The positive influence of the scientists, where it was felt, operated largely through the Ministry of Supply when it sought to advise the Air Ministry on new technology. The consistent, primary concern of the OR Department was to translate Air Staff strategic doctrine into a broad military description of what aircraft were needed. Rather than possessing a technical or engineering background, it was more important that the ACAS (OR) and his senior staff were men of wide experience in the air force, with a good understanding of the Air Staff's established vision of what equipment the air force needed and of what the front line should be capable. Air Marshal Tuttle stressed this point¹ although he trained as an engineer in order to obtain a permanent commission in 1928 and spent most of the war with the Photographic Reconnaissance Unit.

If the OR staff were not technicians, neither were they especially innovators or experimenters in the post-war period. One should regard the OR Department as interpreters or even codifiers. From the senior members of the Air Staff there was an influence, a pressure from above, rather than direction, to sustain a clearly visualised type of force which was an independent strategic vehicle consisting essentially of manned bombers and fighters. One cannot say that all faces were set against missiles and rockets, long-range maritime reconnaissance and army support planes for example, but one can draw some indication of the broad line of approach by reflecting on the fact that the early operational requirements for missiles were designated 'unmanned fighter' and 'unmanned bomber'. It is therefore understandable that the OR Department largely worked on its own initiative, generating requirements internally and passing them up to the CAS and VCAS for eventual consideration by the Air Council. There was an Operational Requirements Committee which brought together any contending approaches about what the requirements should be, but there was no formal mechanism by which the department

1. In conversation between Sir Geoffrey Tuttle and Mark Venables, 16th July 1984.

was instructed on broad policy. In addition to established air force doctrine, past experience and individual perceptions of what would be needed, operational requirements were based also on what military intelligence foresaw as probable enemy developments. Finally, it should be noted that the OR Department consulted extensively within the Air Staff and with officers in the Commands, and frequently visited the experimental stations.

Once an Air Staff operational requirement was agreed it was sent to the Ministry of Supply to be worked up as a technical specification which could be used by industry as the basis for preparing blueprints and submitting tenders for contract. The evolution of a technical specification involved an interplay between the two Ministries with information and opinions flowing back and forth. The Ministry of Supply would comment on the technical and scientific implications and problems, estimate the cost of the aircraft and how long it would take to become operational, etc. It would often, in addition, have a view on the policy aspects of an operational requirement, and would submit operational papers in response to the original requirement, stating the Ministry view of the strategic implications. The fact that the Ministry of Supply had a view, and occasionally pressed it, suggests that the Air Staff was not the sole source of air power wisdom, and did not always get its own way. It is also evident that some friction could be created in this interplay. The Ministry of Supply could be thinking along entirely different lines. For example, Sir Geoffrey Tuttle related the case¹ (that was clearly bitter in his memory) early in the Korean War when the Ministry of Supply was determined to proceed with three types of V-bomber, while he, as ACAS (OR) believed and argued that only one bomber type was necessary, which would have allowed more to be produced more rapidly. He refers to this disagreement in his article in the RAF Quarterly.

"It is not easy to see why such a plethora of machinery was produced, but I believe the real reason was that the effect of the atom bomb on war had not yet got through to the Ministry of Supply, which wanted a big industry to fight another big and long war. Maybe they also wanted a big staff. Moreover, at this time Korea kept the ball

1. In conversation between Sir Geoffrey Tuttle and Mark Venables, 16th July 1984.

rolling, and Mr Attlee had a defence budget of four thousand seven hundred million pounds for three years. So all the projects went ahead."¹

The Ministry of Supply specification would then be sent, together with the operational requirement, to the COS Committee for approval, and would, at least in a formal sense, also get the Cabinet's agreement before it was issued to industry. These specifications represented the most basic technical expression of the Air Staff requirement for the next generation of aircraft, and would include components, equipment, instruments, armaments etc. Thus, in a very substantial sense, the specifications reflect the nature of the Air Staff's strategic thinking. This was by no means the end of the process because the specifications, at least in detail, were still subject to negotiation. Once industry had worked on the specifications, and produced preliminary designs, there would be a conference involving the Air Staff, the Ministry of Supply, and the manufacturers². Quite extensive modifications could arise from these conferences but none such as to alter radically the broad strategic conceptualization behind the aircraft. For example, the V-bomber specifications were adjusted during the design conferences. The maximum all-up weights had been originally set to take into account the strength and length of existing runways. The designers' argument that increasing the weight would significantly improve the operational ceiling was accepted³. Obviously, some aspects of the requirement, such as bomb load and range could not be altered.

Once this design stage was over, the Ministry of Supply would authorise development and the production of a small number of prototypes. These would be evaluated not only by the manufacturers, but also by RAF test pilots at the RAE. Further design changes might be made at this point -

1. Air Marshall/ Sir Geoffrey Tuttle, '50 years in flying', in The RAF Quarterly, Summer 1978, vol. 18, no. 2, page 147. It is perhaps wise to regard this anecdote with a little care as Sir Geoffrey is in a position to put a one-sided view. But the point I wish to illustrate - that the Ministry of Supply retained more than a merely technical view on future RAF aircraft is undeniable, and will be seen to be further emphasized when I discuss the Air Staff opinion of the value of the Ministry of Supply. There is no doubt that the relations between the two Ministries were sometimes poor.

2. Examples are: Chief of the Air Staff's Conference and Exercise 'Pandora' (Aircraft Designers' Conference with Air Ministry and Ministry of Supply), May-June 1948, AIR 8/1538; and, Conference with Aircraft Designers, March-August 1949, AIR 8/1561.

3. See Andrew Brooks, V-force, pages 21-24.

sometimes involving substantial redesign. If the prototype development was satisfactory, the MOS would order a production 'batch' - usually of 25 aircraft. Before being handed over to the Operational Conversion Units and front line squadrons, these first aircraft (sometimes also known as the development batch) would be used for an additional series of tests. The most important of these would be carried out at the Aeroplane and Armament Experimental Establishment at Boscombe Down on Salisbury Plain. This was a proving establishment where the aircraft were tested in the operational role. All aspects of the aircraft were evaluated to show that the production model met its specifications and was safe and effective for the Service to use operationally. Only when Boscombe Down was satisfied, would a CA Release (the Controller of Aircraft's release to the Services) be granted.

Even after the aircraft was in full production it was not unusual for further developments to be incorporated into the production line. Both the Vulcan and the Victor were first received by the RAF as MK I versions. While the line was running further developments were agreed, so that the later deliveries were designated as MK II versions of the same aircraft. The original MK Is were modified, becoming MK IA. This did not always happen (the Valiant existed only as a MK I) but was typical because it was declared policy to concentrate on a few types of aircraft, constantly improving them in the light of technical advances and operational experience. (For example, the Spitfire had run to 29 MKs and the Wellington Bomber to 12.)

A concurrent conceptualization of the appropriate size, depth and striking power of the eventual front line was obviously integral to the initial thinking about what was needed and how it should be worked up. The decisions on how many aircraft should be built and how the squadrons should be organized and deployed are, however, more pertinent to a consideration of the post-war expansion of the front line. At this stage it is important to note that the aircraft industry itself was capable of intervening in the decision making process about new aircraft, in addition to influencing Air Staff requirements after they had been generated within the Ministries. The description that I have given of the procurement process represents an ideal - the authorised and formal method by which new aircraft were brought into RAF service after the war. There are at least two examples of successful entrepreneurial involvement in the original formulation of operational requirements in this period.

One concerns the decision to acquire what has come to be known as a 'reinsurance' bomber. Initially only two firms were contracted to develop prototypes of the original specification: B35/46. These were Avro and Handley Page, the outcomes being the Vulcan and the Victor. The Vickers Company was, during 1947, able to persuade the Ministry of Supply to re-examine its decision and write a new specification, B9/48 issued in April 1948, around an independent Vickers design known as the 660, which eventually became the Valiant. The specification B35/46 was an extremely demanding one for the time, and the proposals made by Avro and Handley Page to meet it were futuristic and involved a range of technical and aerodynamic uncertainties. It was not certain that they could be realized as operational aircraft, and it was likely that it would require the full development time of five years before any judgement on their practicality could be made. The Vickers Company argued that these designs might fail, in which case the RAF would be without a new bomber in the early to mid-1950s, and thus in an extremely difficult position. The Company further argued that to guard against this possibility the Ministry of Supply should authorise the development of the 660, a more conventional design on which work was advanced and which could come into production well before the other two aircraft. The penalty was that it did not meet the B35/46 specification.

In accepting this argument, and agreeing to write a new specification (B9/48) based on the design capabilities of the 660, the Ministry of Supply (and by implication, the Air Ministry), succumbed to an appeal to caution and conservatism, and compromised the original philosophy that the next generation of bombers should have a performance at the extreme upper limits that contemporary theory envisaged possible. Even the original operational requirements were scaled down. However valid may be the contentions that the Ministry of Supply wished to assist the Vickers Company during a time of financial hardship, and that the pre-war experience of promoting three bombers (only one of which was really successful) influenced the thinking in the Ministries; the case of the Vickers Valiant demonstrates the ability of the industry to deflect the intentions of the Ministry. Whatever virtues and value may subsequently have been claimed for the Valiant, the fact is that it was an interim aircraft of limited strategic utility which had a relatively brief operational life. It received CA release in January 1955, and was withdrawn from service exactly ten years later.

The second example, that of the Canberra light bomber, demonstrates this influence even more clearly. After the war the Air Staff had no operational requirement for such an aircraft, but agreed to the issue of technical specification B3/45 taken directly from the design by Teddy Petter.¹ Petter and his design team, with whom Sir Frederick Page was associated, had completed the drawings for the aeroplane by the end of 1944, Rolls Royce were to develop a new engine for it, and the aircraft was to be built by the English Electric Company. Petter's chief interest was in keeping his wartime design team together; he envisaged the Canberra as a successor to the Mosquito bomber and was able to persuade the Air Staff of the excellence of his design and of their strategic requirement for such an aircraft. His intervention was successful both in the sense that the contract was won and that the aircraft proved to be a valuable addition to the RAF's order of battle. In the event it was to be Bomber Command's first post-war modern bomber, in service years before the V-bombers and able to fill a gap in the RAF's capabilities at a time when nothing else was available. The first prototype flew in May 1949, CA release was granted in May 1951, and the RAF eventually took delivery of 430 B2s and 129 B6s (these being the main marks). Altogether more than 1400 were built. Whatever post hoc justification may now exist for the Canberra, the fact is that the RAF acquired it on the basis of an operational requirement and specification that was sold to the service by industry. It cannot be validly argued that the Air Staff conceived of such a type in order to fill a vacuum that was feared would exist before the arrival of the Avro and Handley Page types. Although this was to some extent what actually happened, an aeroplane with a bomb load of 6000 lb, absolute ceiling of 48,000 ft and effective range of 1630 miles could never fulfil a strategic role with atomic weapons. It was the Short SA4 (Sperrin) (a design that was not taken beyond the prototype stage) that was supposed to fill the stopgap strategic role. The example of the Canberra demonstrates the influence of industry and perhaps suggests some uncertainties within the Air Staff over the future strategic bombing requirements.

1. English Electric Company Limited, Aircraft Division, Preston - High Altitude Bomber, specification B3/45, Bottomley Papers, file 71/2/48, 1st May 1946. The independent genesis of the Canberra bomber was drawn to my attention in a conversation with Sir Frederick Page on 7th February 1980 at the British Aerospace Offices, Kingston-upon-Thames, and with Mr Humphrey Wynn on 22nd November 1983 at the Air Historical Branch, Air Ministry.

In spite of the various external influences, notably the Ministry of Supply and the aircraft industry, it was the Air Staff itself that retained the vital say in what capabilities new aircraft should have. Financial and technical restraints were imposed by the Cabinet, the Chiefs of Staff Committee and the Ministry of Supply. But in judging the conceptual approach to the capabilities of the future front line, one has to conclude that the Ministry of Supply was a conduit - a technical clearing house and purchasing authority rather than a directing organization. Because the Ministry of Supply was the aircraft purchasing authority and controlled and funded the research establishments, an evaluation of its work in the period 1945-1952 should be undertaken in two parts: (i) with industry, and (ii) with research.

It would seem that the airman's opinion of the Ministry of Supply, in its function as purchasing authority and the executive arm which supervised the industrial process, was not high. The Ministry is criticised for being too devoted to maintaining a large aircraft industry, for having too large a staff which was excessively attentive to its own interests, and for consistently underestimating delivery dates and allowing development and production delays to occur. For example, Air Marshal Sir Gareth Clayton writes

"My views on the Ministry of Supply are unprintable. The politest thing that I can say is that the Ministry of Aircraft Production was needed when Beaverbrook started it up. The vast amorphous mass it became by the 60s was largely of use as a buffer between the users and the manufacturers. It seemed to be expressly designed to ensure that any Air Staff requirement was out of date by the time it was produced."¹

Air Chief Marshal Sir Kenneth Cross also draws attention to the delays which were blamed on the Ministry of Supply.

"The research policy I was interested in was new operational equipment. This was the direct responsibility of ACAS (Operational Requirements) and his staff. I monitored. There were many committees set up for specific equipments with representation from both Air Ministry and the Ministry of Supply. The latter mostly scientists. I think the system worked quite well. Production was another matter - often months or years behind forecast dates."²

I have already drawn attention to Sir Geoffrey Tuttle's disagreements with the Ministry of Supply and his resistance to its involvement in

1. Letter from Air Marshal Sir Gareth Clayton to Mark Venables, 8th August 1984.

2. Letter from Air Chief Marshal Sir Kenneth Cross to Mark Venables, 25th June 1984.

strategic and operational thinking. Sir Robert Cockburn agreed that the Ministry of Supply paid too much attention to the interests of the aircraft industry, and felt that the relationship between the Ministry and the Society of British Aircraft Constructors (in seeking to maintain a large healthy aircraft industry) developed in the years after the war such as to become a disproportionately important feature of the Ministry's outlook.¹ Sir William Cook, who was a civilian scientist at the Ministry of Supply until 1947 before transferring to the Admiralty, made the same point in a letter to me.

"As for the Ministry of Supply I was always doubtful about its role. It was not the ultimate customer and neither was it a supplier. It tended largely to orient itself to supporting the well-being of the industries which were the suppliers but was not well placed to effect the necessary compromises with service requirements except at second hand. Except for aircraft and their equipment the Admiralty in that period did I believe stand apart from the Ministry of Supply. The Ministry had no control over Admiralty research"²

The executive function of the technical civil servants of dealing with industry was accompanied by a responsibility for the research establishments. The Ministry exercised the bureaucratic control of scientific work for the RAF, taking charge of the expenditure and the various budgets. Finance for research was on the Ministry of Supply vote. The cost of aircraft was on the Air Ministry vote, the money being transferred to the Ministry of Supply for payment. In addition to

1. Conversation between Sir Robert Cockburn and Mark Venables, 3rd September 1984, recorded on tape. Sir Robert actually used the term 'scandalous' and said of the Ministry of Supply - 'they were far too much in the pockets of the industry'.

In a memorandum by the Minister of Supply on Size and Shape of the Aircraft Industry - Need for Planning to Preserve War Potential, the following question is addressed - "How with the reduced volume of work available, we can keep in being an essential nucleus of professional firms capable of designing and manufacturing aircraft superior in performance to those of our potential enemies, and maintain those firms at a level of activity sufficient to provide an adequate industrial base for expansion in emergency?" The memorandum considers only airframe firms and proposes that 13 "... should remain categorised as essential production units and should therefore be given prior opportunity to compete for new contracts." (In 1945 the number of firms so designated was 16.) The 13 firms were: Armstrong Whitworth Aircraft; Blackburn and General; Bristol Aeroplane; De Havilland Aircraft; English Electric; Fairey Aviation; Gloster Aircraft; Handley Page; Hawker Aircraft; A.V. Roe; Short Brothers and Harland; Vickers Armstrong; Westland Aircraft. Cabinet Defence Committee, DO(50)47, 28 June 1950. (PRO - CAB 131/9). See also, AVIA 15/1964, Post-war Industries, 1944-1952, Future of Aircraft Industry: Post-war Policy.

2. Letter from Sir William Cook to Mark Venables, 14th July 1984.

aircraft payments, the Air Ministry also used its equipment vote for the purchase of other items - how this was apportioned is detailed in the table in Appendix VIII. This relates only to purchase. The direction and quality of scientific research is a more complicated subject, depending largely but by no means solely on the work of the Ministry of Supply. In this function the Ministry was much more than a clearing house. An evaluation of its role in scientific research, to which I will now turn, will help to establish the substance of the post-war programme of military science.

2. The Research Establishments

It is best to regard the basic strategic thinking behind new aircraft types and the direction of military science as two distinct operations. The approach to new aircraft, and by implication, to the future of bombers and air power, was determined, essentially, within the Air Staff itself. The views of the Staff of the Operational Requirements Department, of the VCAS and CAS were the most important influences. Yet the two operations were unquestionably related, and it is in the Ministry of Supply that one finds the vital link between procurement policy and the development of scientific work. The recommendations of the Air Ministry's Scientific Advisor and his staff, the deliberations of the scientific committees such as the Defence Research Policy Committee, and the activities of the various research establishments were ultimately supposed to be coordinated and brought to a coherent form by the Ministry of Supply. Thus in attempting to answer the difficult questions about post-war military scientific policy, the work of the Ministry is a natural place to start.

At the end of the war there was a plethora of scientific establishments, some run by the Ministry of Aircraft Production, some by the Ministry of Supply and others working for and under the control of one of the Services. There were also numerous commercial companies which possessed research and development facilities. The government decided to rationalise its own effort under the control of the Ministry of Supply (which absorbed and superseded the Ministry of Aircraft Production in

1946).¹ The most important of the RAF's establishments was the Royal Aircraft Establishment (RAE), with its headquarters at Farnborough. The origins of RAE lay in the Royal Balloon Factory, started at Woolwich in 1892. This became the Royal Aircraft Factory, which at the turn of the century moved to Farnborough.

"To design and construct aircraft was in fact the principal *raison d'être* of the Factory. Aircraft manufacture, however, was in the course of becoming an enticing commercial proposition, and a disapproval of government participation in it soon began to be expressed. Many rods were used wherewith to beat the Factory. Among its functions, for instance, it included the testing of all aircraft submitted to it. The Factory standards, though low enough by modern standards, were considered too high by some manufacturers whose aircraft had consistently been failed. The fact that the testing authority was itself designing and manufacturing aircraft led to suggestions that private manufacturers of aircraft were deliberately failed because of jealousy."²

As a result of this agitation it was decided, during the First World War, that the Royal Aircraft Establishment (as it became known) should not be allowed to design or manufacture aircraft nor to compete with the industry in other aeronautical areas. The Establishment did, however, retain a close association with industry (to the present time) as a technical advisor to commercial designers, and expanded its own role in the design and testing of aircraft equipment.

Thus, from an early stage RAE was conceived of as a research and experimental station. Its terms of reference were established in 1924 by the Halahan Committee on the Organization of the Royal Aircraft Establishment, Farnborough.

"[The Committee] considered that its primary function should be the provision of a 'full scale aeronautical laboratory for the Air Ministry', its tasks being development work on experimental aeroplanes and engines, the testing of experimental instruments and accessories, the development of special flying instruments for which there was little commercial demand, and investigations of failures. The Royal Aircraft Establishment was divided into 14 departments, four of these being development departments, and the remaining ten which included the aerodynamic, physics and instruments, wireless and

1. The outline of the rationalization which follows deals only with the research and development functions of importance to air warfare. The rationalization of certain functions should not be taken to imply that the original locations were closed down, nor does it necessarily reflect on continuing work for the army and navy.

2. M.M. Postan, D. Hay and J.D. Scott, Design and Development of Weapons, pages 437-438.

photographic and metallurgical experimental departments, carrying out both scientific research and technical development."

During the Second World War RAE developed specialisations which remained the foundation of the Establishment's work after 1945. It became, in essence, the centre of aerodynamics and aircraft structures, of the development of engines, and of communications. As such the bias was towards engineering. At the same time, the radio department, which had, after 1934, perfected VHF radio communications, continued to research radio science and its applications, such as the use of radar to measure the performance of experimental aircraft, and the use of radio and radar for guiding missiles.² The research and testing of experimental instruments continued, as did work on the aerodynamics of bombs and the production of advanced bomb sights. The very close liaison with the aircraft industry also continued after the war - RAE assisted with research and technical supervision, built experimental machines and sub assemblies and tested commercially produced prototypes.³

RAE operated a number of outstations. One, at Bedford (which was ultimately called the National Aeronautical Establishment) was built after the war in accordance with Sir Stafford Cripps's 'location of industry' programme. Cripps envisaged moving the whole of the Farnborough organization to the Bedford site, but this was found to be too costly and Bedford became an outstation instead. The main value of Bedford lay in the high velocity wind tunnels that were built there - the building of the first supersonic wind tunnel was begun in August 1946. Prior to the completion of the tunnels⁴ the experimental investigation of

1. M.M. Postan, D. Hay and J.D. Scott, Design and Development of Weapons, page 446. See also: Laboratory of the Air - an account of the RAE HMSO 1948, and, C.F. Caunter, A historical summary of the Royal Aircraft Establishment 1918-1948 Ministry of Supply (AERO 2150A) November 1949 (cyclostyled).

2. Notwithstanding the diversity of work undertaken at RAE, 'it was really run by the Aerodynamics Department, which was the biggest'. (Conversation between Mr H A Popham and Mark Venables, 17th September 1984, recorded on tape). H A Popham was in the Radio Department, which after the war had much of its work determined for it by the Aerodynamics Department. During the war some of the work had been on RCM, although it was Farnborough which produced the navigational aid OBOE, and the airborne radar MONICA.

3. According to Laboratory of the Air RAE and industry 'worked as a team'.

4. "In addition, the large supersonic tunnel at Bedford will be of great value. This will be ready for use in 1955 and the cost will be £4 or £5 million." Defence Research and Development Priorities, Cabinet Defence Committee, DO(50)5, 5 July 1950. PRO - CAB 131/9.

structures and stress at speeds greater than that of sound had not been possible because the wind tunnel capabilities at Farnborough could not deal with speeds in excess of Mach 0.93.

The National Gas Turbine Establishment at Pystock is conterminous with Farnborough and its status of outstation is a somewhat academic one. This Establishment was formed when the government took over the Power Jets Company (which had been set up by Air Commodore Whittle to build his experimental jet propulsion engine) early in 1946.¹ It concentrated on jet engine research for the air force, and later did research in connection with rocket motors and the related problems of combustion.

Work on guided weapons presents a most confusing picture.

"At the end of the war, guided weapons were being developed by several separate organizations for each of the three Services. The Ministry of Aircraft Production was developing the precursor of the later 'Blue Sky' air-to-air guided weapon at RAE Farnborough, and the Ministry of Supply was developing a ground-to-air beam riding missile (LOPGAP) at GPE Westcott, ARDE Malvern, AGE Teddington and ADRDE Christchurch. These establishments had separate responsibilities for propulsion, guidance, control and telemetry systems to be used in this project. There were also plans at this time to turn Aberporth, which had up to now been an outstation of PDE Fort Halstead and Royal Arsenal Woolwich, into an outpost of GPE Westcott. The Ministries of Aircraft Production and Supply were amalgamated under Supply, and much debate ensued to decide how and where guided weapon development should continue. RAE guided weapon effort was based at Bramshot and Farnborough and headed by George Gardiner then, (succeeded by Ron Smelt, who was in turn succeeded by Morrien Morgan (later Sir Morrien)). H.A. Popham and others had built up a tracking organization in the Scilly Isles in relation to the Wallace Supersonic Model experiment, and Popham canvassed hard to develop a range there, later to be quietened by the offer to run Aberporth."²

During the war British missile efforts had been devoted to solid fuelled unguided projectiles epitomised by the 3" rocket used for ground attacks by fighter bombers. The work on these had been carried out by Sir Alwyn Crow of the Projectile Development Establishment (PDE), based first at Fort Halstead in Kent (a War Department armaments establishment), and, from 1940, at Aberporth in West Wales. The bulk of the rather primitive and largely ineffectual research into guided missiles was conducted by the Air Defence Research and Development Establishment (ADRDE).

1. For an account of this takeover see Postan, Hay and Scott, op cit., pages 228-233.

2. I.S. Dyer, An Outline of the History and Development of the Royal Aircraft Establishment Aberporth, TECH MEMO IR 137, May 1973, page 6 (cyclostyled).

In spite of the eventually successful application of unguided rockets to offensive purposes (in ground attack and against submarines for example) the primary impetus behind work on guided and unguided missiles was the search for better air defence. During the later period of the Blitz a large quantity of 2" and 3" unguided rockets were fired by anti-aircraft troops.¹ The air defence incentive remained the main one after the war.²

In 1947 it was decided to rationalize guided weapons research and development under the control of a guided weapons division at RAE, directed by R Smelt. Overall control was thus vested in the Ministry of Supply, which thenceforward co-ordinated the requirements of all the services. It was also decided that production would be undertaken by the

1. Walton on the Naze was the army's AA experimental range, operating under General Tim Pile's organization. It continued to operate after the War.

2. The air defence incentive was pronounced before the Russians exploded their first atomic bomb in August 1949; after that date, guided missile air defence came to be judged of such importance as to briefly challenge the overall priority given to Britain's atomic weapons programme.

In 1948, the Sub-committee for Air, Coast and Seaward Defences took the following view. "In the case where the enemy does not possess or does not use weapons of mass destruction, we are agreed that it is possible to inflict a casualty rate that will cause the enemy rapidly to abandon his attacks on this country, notwithstanding the technical advance in bomber performance. In the case where the enemy does use weapons of mass destruction, the technical advice at our disposal indicates that it would not be possible to prevent a portion of these weapons reaching targets in this country, but we are not able to assess this percentage either now or later when new air defence weapons became available. We are however strongly of the opinion that the active air defences will be essential to the survival of the country and that the losses inflicted will be sufficient to cause the enemy to abandon attacks if we can sustain the initial blows. (Report, COS(ACS) (48) 11, 6th April 1948. Chiefs of Staff Committee. PRO - DEFE 2/1650.)

At the end of 1949, the Ministry of Defence's arguments reflected the greater urgency. "Meanwhile developments which had taken place since the paper was written - the Russian atomic explosion, revelation of the urgent need for an air-to-air guided weapon, plus the fact that guided weapons seemed to offer the only prospect of successful defence against atomic weapons - only served to emphasize the need for pressing on in this field.

Sir Henry Tizard laid great stress on the need to solve first the fundamental problems of guiding a weapon through the air. Until these problems had been solved there could be little hope of progress with any form of fighting weapon. On the other hand, once they had been solved, past experience suggested that progress would be rapid. As to the need for guided weapons, in the view of his committee it was impossible to exaggerate their importance to the country." (Cabinet Defence Committee DO(49) 23rd meeting, 7 December 1949, Item 2. Guided Weapons' Research and Development. PRO - CAB 131/8.

aircraft industry. Although PDE continued to exist (having returned to Fort Halstead), working on the chemistry of rocket motor fuels; the chief guided weapons establishment was located at Westcott (thus another RAE outstation). This was known as the Guided Projectile Establishment (GPE), with Sir Alwyn Crow as its first director. The long established explosives establishment at Waltham Abbey was drawn into the work of GPE. Westcott was the trials establishment where the rocket motors were built and tested; development of solid and liquid rocket motor fuels was carried on in the chemical laboratories at Waltham Abbey.

Another outstation, which in 1948 was known as the Guided Weapons Trials Wing was at RAE Aberporth. The establishment was built up during the War by Alwyn Crow's PDE to handle all aspects of rocket research and development; after it was absorbed into the RAE organization from 1947 it concentrated increasingly on test firing, measurement and tracking, and the perfection of guidance mechanisms and techniques. However, at least in the period 1948-1956, a certain amount of development work was also undertaken. Also based at Aberporth was the Naval Trials site where missiles to naval specifications beginning with the Seaslug, were test fired.

These establishments, then, represented the sum of the post-war research and development stations working on air force requirements directly under the control of RAE. Their work was primarily in the areas of aerodynamics, engines and guided weapons. RAE was the largest and unquestionably the most important. There were, in addition, two other places which were of importance to the RAF - they were the Telecommunications Research Establishment (TRE) and the Aeroplane and Armament Experimental Establishment (AAEE) at Boscombe Down, both also part of the Ministry of Supply network.

TRE was the centre of radar and navigation research. Through much of the 1930s most radio research was carried on under Robert Watson-Watt at RAE, where he was Vice-Controller of Communication Equipment, but it was at TRE that the really innovative wartime work on offensive and defensive radar research and applications was done. After the War, TRE came to be recognized as a centre of excellence and at least approached RAE in importance. The investigation into all facets of 'beam' applications to warfare (which had included not only the home defence radar and fighter

interception network, but devices such as H2S, an aid to blind bombing, and a series of radio counter measures as well as navigational aids) continued, concentrating particularly on improvements in radar and developing 'command guidance' devices for missile guidance as an alternative to the 'beam riding' method of guidance. Such was the excellence of the post-war work at TRE, and so great were the achievements there in the fields of solid state devices, automatic radar, data extraction and processing, and computing; that it is fair to say that TRE alone transcended in importance all other stations because of the substance it was able to give to new concepts of defence in particular, and the approach to air warfare in general.

AAEE at Boscombe Down was a tri-service establishment, providing the final stage in weapons evaluation and proving before they entered service. It dealt with all aspects of the aircraft - equipment, structure and airworthiness, armaments, radio, navigational devices, and had a bombing range so that planes could be tested operationally. The Establishment was organized in five divisions - performance, engineering, armament, flying, and navigation and radio.

Some mention should be made of the facilities used for the development of the British atom bomb before the Atomic Weapons Research Establishment (AWRE) at Aldermaston was opened in 1950. " The manufacture of an atomic bomb of present design fell naturally into two parts: firstly the production of the active material and secondly the ordnance part, that is, the manufacture and assembly of the components causing the explosion of the active material. The second part of the work could be begun and completed without the need to use fissile material at any stage."¹ The Atomic Energy Research Establishment at Harwell was set up to organize the large scale production of fissile material (production in the period 1945-1952 necessitated the building of plant at Risley, Windscale and Capenhurst) - in May 1947 William Penney was authorised to proceed with the ordnance work on the atomic bomb. Work was then carried on at the Fort Halstead, Woolwich and Shoeburyness sites of the Armaments Research Development Establishment (ARDE - also referred to as the Armaments Research Department). In the post-war scientific effort, the atomic bomb

1. Margaret Gowing, Independence and Deterrence, vol. 1, page 180. See pages 179-183 for an account of William Penney's initiation into the British atom bomb programme.

programme stands in a class of its own, so high a priority was it accorded and so great were the resources devoted to it. The clarity of direction given to the programme and the vigour of the scientific effort put into it make it an exceptional case, and not a model for the rest of the post-war work. In terms of research facilities and resources, a case can be made for stating that all other programmes were liable to suffer shortages and restrictions if they competed with the atomic bomb programme.

"[At the beginning of 1948] ARDE had been using the [Aberporth] workshops as an annexe to Fort Halstead workshops, making components for the British atomic bomb - GPE had set up a small trials wing workshop, too. Popham's chief initial job was to prevent the Establishment being stripped bare by its previous owners; machine tools, instrument stores and even complete huts were disappearing on convoys of lorries to Woolwich and Fort Halstead. Some of the staff were destined to go also to these places and were naturally interested in getting equipment they wanted to their future places of work."

3. The post-war realignment of the scientific effort

Inevitably, the research establishments and their scientific staffs had to take a share of the post-war reductions, in spite of the government's declared policy that military priority be given to scientific research and development into modern weapons of war. In fact only the atomic bomb project actually enjoyed more or less unlimited access to resources, a priority which was enforced at the expense of other projects. To a substantial extent, the according of such a high priority was based on

1. I.S. Dyer, An Outline of the History and Development of the Royal Aircraft Establishment Aberporth, TECH MEMO IR 137, May 1973, page 8 (cyclostyled).

According to a 1952 report by the Sub-committee for Air, Coast and Seaward Defences, the sites at which atomic energy activity was being carried on were:

FACTORY	FUNCTION
Windscale	Fissile production
Springfields	Uranium extraction
Fort Halstead & Woolwich Common	HER design (due to move to Aldermaston by 1952)
Woolwich Common	Electronic production
Aldermaston	HER design, assembly, etc.
Chorley	HER, HE production) completed by
Risley	HQ and design for fissile production) 1952
Cardiff	HER mould production
Harwell	Research
RAE	Electronic design (major design task finished by 1952)

(Policy for the Anti-Aircraft and Seaward Defences of Atomic Energy Establishments, Chiefs of Staff Committee, COS(52)416, 7 August 1952.

PRO - DEFE 5/40.

strategic considerations. Both the Cabinet and the Chiefs of Staff regarded it as a weapon of supreme importance which Britain had to acquire as rapidly as possible.

"Quite recently, [prior to February 1949] at a conference of Service and Supply Ministries, Tizard's point had got across: a great and increasing proportion of the country's research effort was being devoted to the atomic project and this could only be done at the expense of other vital projects such as aircraft, radar and guided missiles. Yet there was no machinery for looking at all of them together. The Minister of Supply himself had agreed that it was open to question whether atomic energy should continue to have overriding priority. The Defence Research Policy Committee prepared a strong memorandum for the Minister of Defence. They had long maintained, they said, that it would be futile to attempt to be strong everywhere and that it was essential to determine which were the important projects vital to survival and then concentrate on them. In the non-atomic field the effort available for even these selected projects was wholly inadequate, and there was no hope of all the projects in the highest category of importance being completed by the time they were needed to implement the accepted defence policy. The Committee felt it their duty to point out the facts about this non-atomic research and development - facts which had not been given to Ministers when they made their recent priority ruling. It was clear that Britain might well have atomic weapons before she had either the aircraft to carry them or the aids to ensure that the aircraft could reach their target and drop the weapons accurately. Air defence was imperilled because the guided weapons programme was inadequate. There were still vital problems unsolved about the defence of sea communications. Chemical and biological warfare must not be neglected, because of their offensive potentialities and because they might be used against Britain."

Given the inevitability that research and development would suffer some reduction after the War, the way in which the cuts were apportioned and the scientific priorities set also provides a clue to the development of strategic thinking. The most indicative relationship is the one which connects four factors - (i) the level of resources devoted to various scientific projects; (ii) the overall direction of scientific research and development; (iii) the weapons and equipment requirements established by the Air Staff and the Ministry of Supply; and (iv) the rate and quality of the development and production work on the various programmes. The pre-eminence accorded to the atomic bomb programme suggests that the bomb alone dominated post-war political and strategic thinking. This suggestion is reinforced by the contemporary recognition that Britain could not afford to advance in an unrestricted manner on all scientific fronts, and that some important projects would suffer shortages as a result of the atom bomb project. As Sir Robert Cockburn pointed out, the most awkward stage occurred between development and

1. Margaret Gowing, Independence and Deterrence, vol. 1, pages 225-226. She cites: MOD, file Def 2 (e) (1) and MOD, DRP (49) 15.

production where capital was frequently insufficient to exploit scientific achievements properly. Among the areas of work, other than that on atomic bombs, the priorities set demonstrate a rather confusing and uneven pattern, but a hierarchy can be discerned. This hierarchy reflects a mixture of firm strategic perception and vigorous scientific activity wrapped up within a process of policy direction which displays an irritating lack of overall coherence.

There are four ways of approaching the determination of priorities for non-atomic work. A crude one is to consider how the Air Staff chose to allocate its equipment purchasing powers - this is shown in the table in Appendix VIII. Not surprisingly, the bulk of the money went on aircraft purchase. Any dedication to guided weapons will not be evident from this Table as they were all then at the research and development stage and thus funded by the Ministry of Supply. A second approach is to consider how the Ministry of Supply maintained the establishments, how high the staffing levels were kept and what priority was given to the provision of supplies and facilities. A third is to examine the extent to which scientists were drawn into the policy making fora and the degree to which note was taken of them. This should be contrasted to how sensitive the direction of scientific effort was to the strategic input of the military chiefs. A final evaluation of the priorities can be drawn from the outcomes in the shape of completed weapons deliveries.

The fate of the research establishments mirrors that of the post-war military budget. There was, from 1945, a sharp reduction of resources and effort followed by a short pause, and then a resumption of urgent work in certain areas with reduced staff and facilities. By the summer of 1948 the two related areas of guided weapons and advanced radar and radio guidance were being pursued with considerable energy.

The post-war rundown was notable for the intellectual vacuum that existed, acute staff shortages and low morale amongst the scientists that remained. There was evidently a lack of higher direction, and the work that continued concentrated on wartime projects such as the primitive investigation of supersonic flight using the Wallace Supersonic Model and absorbing the results of German rocket technology, particularly in

relation to rocket engines.¹ Like the personnel shortages in the RAF, scientific staff reductions stemmed from the intention of the government to reduce the budgets, and the desire of many staff to return to their peacetime occupations. The greatest drain was back to the universities. Many of Farnborough's engineers had come from the Electricity Boards and the Post Office, and industry in general reclaimed its workers. Both RAE and TRE suffered an acute staffing shortage. Dr W.B. Lewis (at that time in charge of TRE) in a letter to Sir Henry Tizard emphasized the threat to the organization, then employing about 700 people, which Lewis expected to be cut to about 200. In the letter he stresses the shortage of money, government policy on releasing scientists and serving officers, and the hostility of the Admiralty towards TRE.² In a letter forming part of a continuing correspondence between Lewis and Tizard on the reduction of scientific staffs, Tizard writes:

"I am very puzzled about the government policy of reduction of scientific staff. Some reduction is certainly necessary and desirable, but in my ignorance things seem to be out of balance. I say in my ignorance because I know so little of what is going on now that I do not even know what person, body, or committee is responsible for advising ministers on such important matters of policy. One of my last official acts was to recommend, some months ago, the setting up of an appropriate advisory body; but nothing has been done yet."³

C.F. Caunter describes a similar process at Farnborough after the War.

"The change over to new policies, such as turbine aeroengines and rocket aircraft and guided weapons, caused a period of policy reorientation. The peak total wartime personnel of about 6000 was

1. At the end of the war H.A. Popham was working with R. Smelt at Farnborough on experiments using the 'drop body' to measure supersonic drag. Because manned supersonic flight was at that time officially decreed too risky, the Wallace Model (aeroplane, a remotely controlled hydrogen peroxide driven vehicle made by Vickers) was employed to replace the clumsy 'drop body' in a series of tests carried out on the Isles of Scilly in 1946. Popham was a member of the tracking team on the Isles of Scilly. (From conversation between H.A. Popham and Mark Venables, 17th September, 1984, recorded on tape). W.G.A. Perring in 'A critical review of German long range rocket development' in The Journal of the Royal Aeronautical Society, June 1946, gives an account of British work on German rocket motors, and indeed, all aspects of the German rocket programme.

2. Letter, Dr W.B. Lewis to Sir Henry Tizard, 16th December 1945, in Tizard Papers, file HTT 463. "Commercial and economic advantage of the UK has replaced winning the war as our goal." This file also contains a memorandum by Lewis The role of TRE in the national scientific effort, discussing in detail current and future projects, general scientific policy, outlining TRE's achievements during the war and work that could be undertaken after the war by a full team.

3. Letter, Sir Henry Tizard to Dr W.B. Lewis, 11th March 1946, in Tizard Papers, file HTT 463.

reduced to about half that number in the interests of economy and the redirecting of a proportion back to civilian industries."

It would appear that the staffing reductions formed the crux of the difficulties faced by the research establishments. Any shortage of finance was secondary, except in the limitations this imposed on large capital projects, such as the construction of the supersonic wind tunnels at Bedford. The great requirement for capital expenditure on the atomic bomb project exacerbated the difficulties, but it was in the area of highly qualified scientists that the atom programme's needs were most felt in other areas of work. "There was no serious clash with atomic energy in demands for labour and raw materials: the real problem was in the competition for very scarce high grade scientists, especially in electronics where atomic energy made particularly heavy demands."² This competition was felt, not only in staff shortages, but also in an intellectual hiatus which put a brake on innovative thinking and research which is the basis of advanced technology. "For the next couple of years TRE was as dead as a door nail. Everyone was suffering from intellectual exhaustion. Work continued on wartime things, but there was really no new thinking until 1948/49. If all the best people leave suddenly, the whole place collapses. All the facilities were there, but to be fair, there was no incentive, the war was over."³ This recollection of Sir Robert Cockburn is echoed by A.P. Rowe, a scientist at TRE, in a letter to Sir Henry Tizard.

"My first intention was to write a TRE paper giving our joint views but the note to superintendents calling for ideas brought practically nothing and the truth of the matter is that, after a long war, they are, unlike myself, not much interested in the next one. This strengthens my view that the main task is to get awareness of the problems in the scientific world rather than to improve our weapons quickly. It is a little too early to worry people about this but it ought not to be left long after the German war."⁴

C.F. Caunter also makes reference to a period of stagnation at Farnborough after the war, but goes on to note that the decline did not last long.

"The end of the war inevitably created a considerable reduction in current commitments and this sharp cessation of intensive war effort brought about a phase of stagnation during which the policies of the future were evolved and eventually implemented.

1. C.F. Caunter, A historical summary of the Royal Aircraft Establishment 1918-1948, page 150. .

2. Margaret Gowing, Independence and Deterrence, vol 1. page 226.

3. Conversation between Sir Robert Cockburn and Mark Venables, 3rd September, 1984, recorded on tape.

4. Letter A.P. Rowe to Sir Henry Tizard, 6th March 1945, in Tizard Papers, file HTT 401. The joint views Rowe wished to put were on the future development in weapons and methods of war, for Tizard's 'ad hoc' committee, which was then about to begin its deliberations.

The passive phase quickly passed (because of growing European tension) and, with depleted staffs intensive work on new and progressive policies designed to defend the country in the event of a third world war developed rapidly, so that by 1947 the departments were again occupied to capacity. ... (among other priority projects were) research upon transonic and supersonic flight, the combined aerodynamic, thermal and instrumentation problem of guided weapons."¹

During the post-war period of reduced activity the mechanisms for co-ordinating and directing the scientific effort were also in flux, and undergoing a measure of reorganization. The debate on scientific control, initiated by Sir Henry Tizard and his 'ad hoc' Committee had one consequence in the formation of the Defence Research Policy Committee. At the same time, the roles of the Scientific Adviser to the Air Ministry, the Ministry of Supply and the Chiefs of Staff Committee and its sub-committees in the direction of scientific effort were being evolved. An appreciation of this evolution forms an essential introduction to a study of the priorities that were set and the course of RAF re-equipment that was undertaken.

4. The direction of the scientific effort

During the War the military and scientific establishments had been groping towards a workable mechanism which would facilitate the higher coordination of defence research and the stating of priorities. The necessity for such a mechanism gradually became apparent from the mid 30s, largely consequent upon the successful work of the Committee for the Scientific Study of Air Defence. The chairman of that Committee was Sir Henry Tizard, a devoted advocate of efficient scientific collaboration and coordination of scientific and military thinking and activity. He was to play a vital role in the development of post-war cooperation, but his wartime experience was largely one of frustration.²

Most of the scientific activity had been dictated by the pressures of the War. As the requirement arose it could usually be readily defined and existing establishments were expanded to take on the work, or new ones created. The scientists collaborated on an ad hoc basis with the

1. C.F. Caunter, A historial summary of the Royal Aircraft Establishment, 1918-1948, pages 163 and 167.

2. See Ronald Clark, Tizard, pages 316-317 for a discussion of the difficulties Sir Henry faced in trying to bring about better control of military science during the war.

relevant service to produce an acceptable solution, which was pressed into service as rapidly as possible. This was the pattern of work on such scientific achievements as the counter to the magnetic mine, devices to aid in the struggle against German submarines, and the devices to assist with bombing accuracy. The most obvious example of a project that was properly organized was the Tube Alloys project, the British end of the atomic bomb programme - and of course the Manhattan Project itself.

Largely through the efforts of individuals such as Tizard a system of higher coordination and direction began to take shape. A Joint Committee on Research and Development Priorities was set up by the Chiefs of Staff at the end of 1943. This was later superseded by a special Deputy Chiefs of Staff Committee formed to oversee scientific questions of service interest. At the end of the War it was doubted whether this Committee would adequately meet the post-war requirements, and Sir Henry Tizard was asked for his advice. This he gave in a paper entitled Central direction of scientific effort.

"We in this country, on the other hand, have ended with war with the fullest service realization of the vital role of science in defence, but without any adequate machinery for real central direction of scientific effort. It is true that the DCOS Committee was formed in the fifth year of the war to meet this need; but it arbitrates between the departments rather than exerting an effective direction of scientific strategy, and none of its members are sufficiently free of executive duties to assume responsibility for the overall picture. .. The body of British science is healthy enough, and its physiology is quite appropriate, including the many local motor centres. But it has no head to control its overall rate of activity and growth, to guide its efforts in the right direction, and to enable it to act as a fully informed and articulate advisor to the government on the technical-scientific aspects of major political issues - in a word, to formulate our scientific strategy. I was personally quite convinced that far more time and continuous thought by scientists of considerable authority in the heart of the government machine, would alone ensure that the Chiefs of Staff get scientific advice reliable enough to guide their strategic decisions and in particular the decisions on the character of the armed forces. The revolutionary impact of atomic energy upon these and other fundamental policy issues exemplifies even more vividly the necessity for continuous, high powered, fully informed and central consideration of the manifold implications of all new scientific developments."

1. Sir Henry Tizard, Central direction of scientific effort, 12 October 1945. COS(45)611, in COS(45) memos nos 543-630, vol. VIII, (PRO - CAB 80/97), (also AIR 8/1450). The minutes of the meeting at which the paper was discussed are in COS (45) 229 meeting minute 1. These arguments had been prefigured in the report of the 'ad hoc' Committee - "All the foregoing leads us to the conclusion that it is necessary to retain, either under the Minister of Defence or within the Committee of Imperial Defence, a suitable organization to link military with scientific thought." (Report by Sir Henry Tizard's 'Ad hoc' Committee on Future development in weapons and methods of war, paragraph 24, page 9; to the Chiefs of Staff Committee, 16th June 1945. COS(45)402 (PRO - CAB 80/94).

The debate on the question of how to achieve central direction, which was widely regarded as necessary, continued for more than a year before a new committee was established. Sir Henry Tizard remained closely involved, and increasingly concerned that the wartime lessons might be lost.

"It took another World War to demonstrate finally and without any question or doubt that the real tactical needs of the Services in war can only be well defined with the help of scientists; that professional scientists like professional sailors, soldiers and airmen, have their own special virtues as well as their own special faults; that if they cooperate wholeheartedly at all levels the virtues are additive, while the faults tend to cancel out; and that if the needs are properly defined, there is skill and genius in the country to meet them. In the course of the late war some scientists began, with great effect, to study strategy, that is to say, they began to investigate what was most important to do, as well as how best to do it. Here too it was found that they had their own special contribution to make. What disturbs me is the thought that this lesson, only partially learnt, will be lost; that no competent scientists will be left to pursue it; and that the Services and the Government will be content with the thought that they can always rely on the unpaid services on committees, when they think it necessary, of scientific men who are striving to earn a modest living at the same time that they are advancing knowledge. The retention of scientific advisers on the staffs of all three Service Departments is a step in the right direction, but it is not enough in itself. What is needed is a scientific staff attached to the central Chiefs of Staff organization that will have no executive duties, nor be overburdened by administration, but will devote its whole time to the study of the influence of advancing scientific knowledge on the problems of defence."¹

The final outcome was the Defence Research Policy Committee (DRPC), set up in January 1947 as part of the new Ministry of Defence (MOD) with Sir Henry Tizard (who also became Scientific Adviser to the MOD) in the chair. Its terms of reference were to study war from the scientific aspect and in relation to the general lines of defence strategy which the Chiefs of Staff have recommended and which the Defence Committee has adopted. The Committee was attended by the scientific advisers to the three services, representatives of the three services (in the RAF's case, an officer on the Defence Research Policy Staff (Air) which was part of the ACAS(OR) Department of the Air Staff, responsible to the VCAS) and a number of representatives from the Ministry of Supply including the Chief Scientist. It reported, via the MOD directly to the COS committee, and responded to the needs and questions of the Chiefs of Staff. Because it was interservice and based within the new MOD it was supposed to be

1. Sir Henry Tizard, 'Science and the Services' in The Journal of the Royal United Service Institution, August 1946, vol. 91, no. 563, page 343.

able to balance the priorities for defence research - thus not only reflecting service desires but also setting the direction of scientific advance and helping the services define their requirements. The Committee had its own technical staff.

This senior Committee, then, existed to reconcile the three services' requirements as a coherent technical strategy - to integrate the facilities and the technology and assign resources on the basis of relative value.¹ However, it remained essentially without executive powers to enable it to translate higher direction into action (Tizard had in fact argued for a body unencumbered by executive duties). Thus, although the Committee did question some of the services' operational requirements, and produced speculative papers investigating scientific developments, it had limited impact on the particular projects of the individual services. On the whole they remained committed to the lines of analysis generated from within the Service Ministries. Furthermore, the Committee was bound to work to the terms of governmental higher directives, and was not allowed to interfere with the Chiefs of Staff prerogative to define strategy. Perhaps the most absurd limitation lay in the fact that the Committee was precluded from considering the military implications of atomic weapons. This restriction was modified in time, but in the period 1947-1952, not sufficiently to allow it any serious recommendations. Finally, to a substantial extent, the Committee was a success because of the personality of Tizard, who had a great reputation and was respected by most who worked with him. He resigned as chairman at the end of 1949. When Sir John Cockroft became chairman of the DRPC the change in personality had a disproportionately weakening effect. (He resigned in April 1954, and had filled the post in a part-time capacity from March 1952, from which time Sir Frederick Brundrett effectively ran the Committee). Cockroft's experience with the Committee was not a happy one and he undoubtedly attempted to give it a more powerful role than was originally intended. This explains his attitude,

1. I have drawn this outline of DRPC functions and achievements from my conversation with Sir Robert Cockburn (3rd September 1984, recorded on tape) who was a member of the Committee for nearly ten years, firstly as Scientific Advisor to the Air Ministry, then as Controller of Guided Weapons at the Ministry of Supply, and finally as Chief Scientist, Ministry of Supply. In spite of the Committee's shortcomings, Sir Robert felt that it worked quite well, especially under Tizard, as a means to discuss the larger questions of science and war and to establish some common areas of thinking between the services.

but does not detract from the value of his opinion that:

"The main difficulty in running the DRPC was that it had no executive powers; it was not loved by the senior members of the Ministry of Supply responsible for weapon production, and the service representatives were concerned primarily to represent the views of their own department."

Although Sir Robert Cockburn believed the Committee to have served a valuable function in getting the services and scientists together for overall discussions, his criticism of its effectiveness supports the view taken by Cockcroft.

"The Chiefs of Staff laid down the policy and it was not easy to keep them informed of changes in their original assumption. Moreover, each Service was responsible for drafting its operational requirements and this led to overlapping specifications and duplications in projects. Financial control was vested elsewhere, and it was difficult to identify the total cost of a new weapon system and to relate it to the policy decision which had led to its development."

There were at least three other inter-service committees (apart from the highly secret committees set up to run the atomic bomb project) that dealt with scientific matters. Access to the papers of the Joint Technical Warfare Committee (JTWC), (a sub committee of the COS Committee) is restricted³ but there is evidence that the Committee made detailed studies of future weapons and force requirements. (For example - Mr Wynn at the Air Historical Board told me that the JTWC rewrote the report of the Tizard 'ad hoc' Committee (July 1945), attempting to take account of the new circumstances thrown up by the explosion of the A bombs in August 1945 - of which Tizard and his fellows had only sketchy conception). The Air Force List of October 1946 gives details of the memberships of the Aeronautical Research Council and the Radio Research Board - both drawn from across the spectrum of the military and scientific establishments. The Ministry of Defence itself was set up at the end of 1946, but its centralising influence was still in its infancy and it was not able to overcome the tradition of inter-service rivalry and independent approach that persisted after the War. However, the DRPC

1. From a review of Ronald Clark's Tizard.

2. Sir Robert Cockburn, Science, Defence and Society, the Truman Wood Lecture to the Royal Society of Arts 15 March 1967. Both of these quotes are taken from the unpublished manuscript of Cockcroft and the Atom by Guy Hartcup, which Mr Hartcup was kind enough to let me read while he was preparing it for the publishers.

3. At the Public Record Office the 1945 JTWC papers are listed as being contained in CAB 81/23 - 81/26. The Secretary's files for 1943-1948 are listed as being contained in CAB 137 (retained in the Department of Origin in terms of the Act). It can be assumed that the Joint Intelligence Committee (JIC) also considered scientific matters - the JIC papers are not consolidated in the PRO.

was an important mechanism in giving the MOD some grip on the three Services, as Sir William Cook makes clear in his letter to me.

"You ask about the working of the Defence Research Policy Committee. In the period in question, with the three Services separate entities, this Committee was the only forum for collective discussion of future equipment. I formed the opinion that it formed an essential purpose in that the separate Ministry of Defence could use it to question the value of Service proposals; in effecting this the Chairman played a vital role, the Services for obvious reasons being reluctant to criticise each other's proposals."

A further influence on the direction of scientific effort existed in the Scientific Advisors to the Service Ministries. The Scientific Advisor to the Air Ministry worked in the Air Staff (responsible to the VCAS) and had his own staff of about 20 scientists based at the Air Ministry. He inherited the Operational Research Sections that were retained (at reduced establishment) in the Commands after the War. They were largely autonomous, the Scientific Advisor was a suzerain rather than a manager.² Sir Robert Cockburn described the job of Scientific Advisor in the following manner:

"My essential job was to act as a link between the forward thinking of the research establishments and what I absorbed, almost by osmosis, as to what the forward thinking of the Air Force was, and bring the two together. I used to go to all their conferences, listen in and take part in the discussions. They were extraordinarily kind to me, took me as one of themselves. They never doubted that my loyalty was to the RAF, as it was. I used to travel round the aerodromes and listen to people, so that I got very au fait with the general thinking of the RAF, therefore was more able to marry this with the advanced thinking of the establishments - the scientists - which was a different world."³

Sir Robert believed that the Air Force was very serious about science and made great efforts to stay up to date with developments. The relationship with scientists was good, and fruitful, but was conducted at

1. Letter from Sir William Cook to Mark Venables, 14th July 1984. Sir William was an Admiralty member of the DRPC from 1947-1954.

2. Sir George Thompson had been scientific adviser from 1941-1944; the post-war advisers were:

H R Hulme 1945 - 1947

R Cockburn 1948 - 1954

H Davies 1955

S Scott Hall 1956 -

The table in Appendix V gives the numbers of scientific officers on the Air Staff and at the Commands for the years 1946-1952.

3. Conversation between Sir Robert Cockburn and Mark Venables, 3rd September 1984, recorded on tape. Air Chief Marshal Sir Alfred Earle did not recall the scientists having a great influence, and although they were frequently questioned, he criticised the papers they circulated as being in general useless. He remembered Cockburn, however, as a 'live wire' who always made his opinions felt.

a personal level. There was no proper committee structure in the Air Staff to deal with science (outside the obvious interests of the Operational Requirements Department) and the Scientific Advisor's job was therefore to infuse newer thinking into the traditional outlook by personal contacts and winning the confidence of the serving officers. Air Chief Marshal Sir Kenneth Cross confirms the influence of the Scientific Advisor - "I was Director of Weapons, Director of Air Defence in CAS Department (Slessor and Dickson) from September 1952 until January 1956. The Scientific Advisor was very prominent in the Department and attended most meetings at director level and above. I can only speak from my relatively low level in the Department."¹

However, Air Marshal Sir Gareth Clayton, while nodding to the role of the Scientific Advisor on the Air Staff, is far less charitable about the MOD and MOS scientists.

"I can't possibly remember the various Departments which dealt with scientific direction. Obviously ACAS (POL) ACAS (OR) and ACAS (OPS) would be interested, and discussions with the Chief Scientist (RAF) would be held on future projects. Scientific research at Command level was well organized and productive. At MOD and Ministry of Supply level I am not all that sure. I, personally, had the feeling that the Scientific Advisor to the Government, at least in my time, seemed to be asked for his views on a wide range of subjects which were, perhaps, beyond his experience and qualifications. He could influence greatly the final decision on whether, say, a future VTOL aircraft proposal was to be accepted, even though his specialization and background might have been totally remote from aircraft and aviation hardware. As a result, a sound proposal put forward after work by teams of practical aviators, and aircraft designers, could be turned down if the Chief Scientist was not sold on it, because his views carried a lot of weight with the Minister of Defence or Prime Minister."²

The fact that the Ministry of Supply directly controlled the research establishments made it another important influence on scientific direction - I have already discussed a number of ways in which this was exercised. In addition to them, research directives were imposed on the establishments by the Ministry. According to Sir Robert Cockburn, roughly 70% of the work of the establishments was on Ministry specified projects, trials etc. The remainder was devoted to long term research determined by the local directors. In the case of long established stations, such as RAE, the channels of communication and control were

1. Letter to Mark Venables from Air Chief Marshal Sir Kenneth Cross, 25th June 1984.

2. Letter from Air Marshal Sir Gareth Clayton to Mark Venables, 8th August 1984. Clayton's views almost certainly derive largely from a period after 1952, when the RAF was being forced, in the face of its bitter opposition, to develop a ground support role and deploy the VTOL Harrier in the manner demanded by the MOD.

formalised, and the flow of information a regularised procedure. At the other stations there was more flexibility; especially at a place like TRE where the importance of innovative science was greater, and the emphasis on experimental work more pronounced. In all cases, an alternative channel of communication was the direct contact between scientists and the serving officers and Ministry staff. In strictly formal terms then, the Ministry of Supply made the decisions on what direction work should take at the research establishments, and these depended on how the Ministry and the Air Staff judged the strategic priorities and the urgency of bringing new technologies to operational form. There were, in addition, as I have indicated, a range of formal and informal controls on scientific direction, and the directors of the establishments had substantial latitude to push forward work in which their departments specialised or which they and their staffs wished to pursue. Finally, the progress of research in the aircraft industry exerted an indirect influence. Especially at RAE, because of the close relationship with industry, there was an incentive to accommodate the emphasis that industry had set, because, in attempting to meet the Ministry of Supply requirements, the Establishment had to respond to what industry was doing with those same requirements. An example of such an emphasis lies in the development of jet aeroengines, in which industry made the running and RAE provided important technical support. It must be noted that industry's influence was extremely sectional - in the case of guided weapons for example, it was the government which decided that it was necessary to stimulate the interest of industry.¹

1. The role of industry should not be over stressed because it is difficult to document cases but the influence was undoubtedly there. Perhaps this was a rather exaggerated view, but Mr H.A. Popham is convinced the priorities were, in truth, actually 'worked up' from within the industry. He rejected the notion that anything half coherent came out of the Ministries! When I asked him who ordered him to do what, how the strategies were set and the technical programmes defined by the higher authorities, he was incredulous - "Doesn't work that way - surely you don't believe that. It works the other way round. Enthusiasts like Morien Morgan would say 'Well, the RAF wants guided weapons, we'll make this thing called Red Duster [which became Bloodhound, a ground to air defence missile]. I know a good chap called David Farrer in Bristol.' So they drew this thing up on the back of an old envelope, outline it, get a rough idea of how it could work. The job of Morgan was to go and convince the London HQ that this thing was saleable to the RAF, and get some money for it. He sold that to the Controller, Guided Weapons, who sold it to the Air Staff, and Bristol got £4 million for Bloodhound. That was peanuts. I think the conceptual ideas came from within the industry, and within the establishments, and then had to be sold to get some funding. The trick was to sell it so hard that politicians couldn't get out of it. Concorde was the arch trick of this sort." (Conversation between H.A. Popham and Mark Venables, 17 September 1984, recorded on tape.)

The atomic bomb project was the striking exception to this somewhat loose system of setting and directing priorities and the work to meet them. It was closely directed by a few secret committees set up for that purpose, and by a number of dedicated individuals whose task had been closely defined for them. Three major stations came into existence for the prosecution of the work (Harwell run by John Cockroft; Risley, run by Christopher Hinton; and Aldermaston, run by William Penney). The object was clearly stated and the resources made available as speedily as possible.

In summing up the attempts to give central direction to military science it can be said that the DRPC was a success within a restricted compass, although working in a rather different way to that envisaged by Sir Henry Tizard when he proposed such a committee. At least it was the basis for the Ministry of Defence's efforts to draw the services under unified control. The Ministry of Supply was essentially an executive and technical organization, but it attempted (not entirely without success) to influence the broader process of setting priorities. The Air Ministry's Scientific Advisor and his staff were an important and integral part of the Air Staff, but the role was advisory and whatever influence on policy they did have was of a long term and single issue nature. We must conclude therefore, that scientific implications of policy followed rather than preceded, that centralised direction of military science was weak, and priorities evolved from strategic decisions made at the Cabinet Defence Committee and Chiefs of Staff Committee level, and from preconceptions of strategic and operational requirements existing within and shaped by the Air Staff and the Admiralty. (The influence of the Army in this period appears to have been minimal.) There were strong doctrinal and material imperatives for the persistence of a powerful tradition of independence in setting force priorities and of competing for resources. Naval research was a strong independent factor with a long history epitomised by the Admiralty Research Laboratory. The Navy's wishes influenced the path of missile development after the war, and the naval laboratories pursued separate Admiralty work although development and procurement of missiles and aircraft were centralised in the Ministry of Supply.

I believe therefore, that an examination of the priorities is a good guide to the cast of strategic thinking of the period, and that work was pushed forward, not on the basis of rationally evaluated scientific potential, but because a corpus of strategic theory determined what would be required.

5. Research and development priorities and the supply of military aircraft

The priority accorded to the production of atomic bombs was quite distinct from that given to any other type of weapon. In the atomic field there was little hesitation, much coordinated work even before a small Cabinet sub-committee took the formal decision to proceed, and, from 1947 onwards, the programme was pushed forward with great dedication. Yet in spite of this high level priority the project encountered delays and supply bottlenecks.

"The priority for atomic energy was overriding in Prime Ministerial intent from 1947 onwards, though latterly it was joined by guided missiles and some other defence items. But it was muffled in effect and was disliked by some of the Ministers and departments, who tried to diminish it whenever the chance arose. It was a confusing riddle: when is an overriding priority not an overriding priority?"¹

The context of the priority given to the atomic energy programme should be kept in mind when considering the progress of the other military priorities. Production of the atomic bomb was one of the supreme goals of the post-war scientific effort, only sporadically were other projects accorded such status. Such projects were guided weapons, radio and radar applications, and military aircraft.

There was one notable period when the atomic weapons priority was challenged by the Chiefs of Staff. Initially, the challenge originated from Tizard's Defence Research Policy Committee and was based on Tizard's view that other important projects such as aircraft, radar and guided weapons were suffering because so many scientists and other resources were tied up in the atomic weapons programme. I have quoted from Margaret Gowing's summary of Tizard's arguments on page 152 above. In the Cabinet Defence Committee the outcome of the DRPC intervention was to focus concern on the slow rate of progress in the field of guided

1. Margaret Gowing, Independence and Deterrence, vol. II, page 43. The Prime Ministerial intent was given substance in a top secret minute by Attlee of February 1947 - "I regard the development of our atomic energy project as a matter of the highest urgency and I am anxious that it should proceed as rapidly as possible. I should be glad therefore if you would issue instructions to your officers that everything possible should be done to avoid delay in meeting the needs of the atomic energy programme. If any conflict arises with other high priority programmes which cannot be resolved within the limits of this directive, I should be glad if it might be reported to me." (op. cit. page 39, citing UKAEA (LO) file 330/4/6/1 pt. II)

weapons. Before the spring of 1950 a solution was sought in re-organizing the guided weapons section in the Ministry of Supply, and by providing for closer collaboration between the scientists working in atomic energy and guided weapons.¹

The Chiefs of Staffs' anxiety over progress on guided weapons derived from more than Sir Henry Tizard's increasing scepticism about the value of atomic weapons for Britain - indeed they did not share it to any significant degree. Rather, they were troubled by the state of British air defences and counted on guided weapons to augment the fighter defences, particularly in the period before Britain possessed its own atomic bomb.² At first there was no suggestion from the Chiefs of Staff that the atomic weapons programme should suffer by accelerating the guided weapons programme, but in 1950 they proposed lowering the atomic bomb priority, though not by such an extent as to destroy the programme altogether. I believe the reason for this change lay in the explosion by

1. "The Committee had before them a memorandum by the Minister of Supply (DO(49)8) which had been prepared as a result of a request from the Defence Research Policy Committee to advise on the special priority measures which were required to enable adequate progress to be made in the field of guided weapons research and development. The Minister of Supply said that his department fully recognized the importance that was attached by all concerned to research and development in the guided weapons field. B. Several Ministers felt that research and development in so important a field ought to be the responsibility of a single individual, whose sole business it would be to see that progress was made at maximum speed. The Minister of Supply doubted whether such an arrangement would, in fact, lead to any improvement in the present position, but undertook to bring before the committee a paper describing his existing organization so that the suggestion could be further considered." (Cabinet Defence Committee, DO(49) 5th meeting, 18 February 1949, Item 5. Guided Weapons Research and Development. PRO - CAB 131/8. The Ministry of Supply was not quick to respond to these anxieties, arguing that everything possible was being done in the guided weapons field, which already enjoyed a priority second only to atomic weapons. The debate continued throughout 1949. (See: Cabinet Defence Committee, DO(49) 23rd meeting, 7 December 1949, PRO - CAB 131/8, item 2). "The Minister of Supply doubted whether there was any real cause for anxiety in the progress that was being made on guided weapons and did not believe that any delay there may be was attributable to faulty organization within his department. As far as organization within the Ministry of Supply was concerned, he had been into the matter fully and was quite convinced that tinkering with the machine would produce no better results. Moreover, he doubted whether it would be possible to speed things up by giving the guided weapons field a higher priority in the general scheme of things, as it was already second only to atomic energy." (Cabinet Defence Committee, DO(49) 13th meeting, 13 May 1949. Item 6. Organization and Progress of Guided Missiles in the Ministry of Supply. PRO - CAB 131/8.

2. See Cabinet Defence Committee, DO(49) 14th meeting, 17 May 1949. Confidential Annex: Air Defence of the United Kingdom PRO - CAB 131/8.

the Russians of an atomic bomb. At that point, the case for active defence, if attainable, momentarily seemed much more attractive than reliance on defence through deterrence at some future date.

"We have been considering, in the light of recent events, the priorities at present accorded to our major defence research and development projects.

2. We are advised that the evidence on which to base an estimate of the the extent of Russian development of atomic energy is very slender, but that the information which the Russians have received from Dr Nunn May and Dr Fuchs, coupled with the explosion which occurred last August, all point to the conclusion that their programme is much further advanced than we had thought and that they have embarked upon the production of plutonium bombs of the Nagasaki type which they are likely to possess before us.

3. In this changed situation we have been reviewing our general strategy and defence policy and have re-examined the case, on strategic grounds, for continuing to give the highest priority to the development of our own atomic weapons programme in the light of the present state and rate of progress of development of other projects which would be vital to the security of this country on the outbreak of a war. These projects are - a. guided missiles of all types. b. Any other methods of increasing the lethality of fighters and the accuracy of bombers. c. The provision of an effective controlling and reporting system. d. All measures of defence against submarine attack. e. Defence against mining. f. Anti-tank defence. g. Defence against low flying aircraft.

4. Where, and to the extent in which the claims of these projects for scientific and other effort, compete with those of the atomic weapons programme, we recommend that the former should have priority over the latter.

5. At the same time we still think it essential that we should continue to produce atomic weapons. Indeed we are advised that, if we were now to show a tendency to abandon any substantial element in our atomic programme, the prospects of our ever getting an agreement with the Americans would fade as they came to see that we had less and less to contribute. The American stock of atomic bombs, however, is, we believe, so big, and our contribution to the common pool will be relatively so small, that we think it illogical that our own atomic weapons programme should continue to be given priority over the projects showed in paragraph 3. above."¹

The Ministry of Supply vigorously resisted the proposal and traded memoranda with the Ministry of Defence in the Defence Committee for the rest of 1950.² The priority was not changed (at most,

1. Report by the Chiefs of Staff on Defence Research and Development Priorities, Cabinet Defence Committee, DO(50)35, 28 April 1950, PRO-CAB 131/9.

2. The Minister of Supply quite reasonably pointed out that the Chiefs of Staff priority list was very wide and could hardly all supersede atomic weapons research. The Chiefs of Staff would have to be more clear on the really important alternative priorities. (DO(50)39, 19 May 1950, PRO - CAB 131/9. The Chiefs then made it clear that "The project about which [they] were most seriously concerned was the guided weapon. For us this was a really vital weapon - the only one that offered a prospect of defence against the atomic weapon. While the Chiefs of Staff had no desire to wreck the atomic weapons programme they were quite clear that more rapid progress on the guided weapon was imperative." (DO(50) 10th meeting, 25 May 1950. PRO - CAB 131/8.)

guided weapons were given 'equal' priority with the atom programme, though this did not much alter the true allocation of resources), and the issue became less acute when Mr Attlee announced a vastly increased defence budget in his rearmament statement of January 1951.

(i) Guided weapons¹

Immediately after the War it was the German advances in missile and rocket technology, rather than Britain's own rather more primitive wartime work in the same field, that attracted the attention of British scientists and military commanders. There was much to be learnt from the German technology, and the strategic implications for air defence of what success the Germans had been able to achieve was obvious for those who cared to think about them.

1. Guided weapons is a generic term, initially referred to in the documents as 'unrotated projectiles'. I think there is some virtue in distinguishing between missiles and rockets although in some respects they are similar and work in one area is of benefit to the other. The terms are often used interchangeably and my distinction is by no means officially recognized. However - I use missiles to mean short range projectiles for surface-to-air and air-to-air defence against aircraft, and air-to-surface and surface-to-surface offensive use employing aircraft for close range strikes on surface targets, and, for example, replacing the naval gun in ship-to-ship combat. Another characteristic of missiles is that they are usually guided to target for a large part of their flight, whereas rockets (at least of this period) depended for accuracy on a predetermined ballistic trajectory, corrected by pre-set on-board inertial (gyroscopic) navigation. The rocket, ideally, would be a long-range surface-to-surface projectile carrying a payload sufficiently powerful to enable economic bombardment of distant enemy targets. The range involved would be at least in excess of extreme artillery ranges, and there is some point in thinking of rockets as an extension of artillery ordnance as well as an expression of air power. Long range rockets with a warhead of, say, 3 or 4 tons, are obviously a potential alternative to bombers. At shorter ranges this was probably always true of artillery anyway. For example, Alistair Horne in The Price of Glory - Verdun 1916, page 99, claims that 10,000 tons of artillery shells were fired at one sector of the French line (the Bois de Caures) over a 48 hour period in February 1916. Of course, range was a critical factor in favour of air power in the late 1940s - the V2 (which was the first true rocket in the sense I mean it here) had an average range of 207 miles. The earliest air defence missiles were frequently referred to as LOPGAP (liquid oxygen and petrol guided anti-aircraft projectiles). They were generally 'beam riders' - that is: they flew up a searchlight or radio beam pointed at the target. Homing weapons lock onto emissions (such as infra-red from the engine exhausts or radio transmissions from onboard radar or ECM) from the target, and command guidance weapons are steered by a controller who tracks the position of weapon and target on radar and transmits flight corrections to keep the rocket on the correct course. More successful later GAP used computer controlled command guidance.

"They [The Germans] also adapted their rocket technology to defensive missiles like 'Wasserfall', a ground-to-air missile, and the X-4 air-to-air wire-guided missile. We had already seen two of their missiles in operation, the HS 293 rocket-propelled glider bomb and the Fritz X guided ballistic bomb. With these developments, coupled with their advances in infra-red technique, the Germans could not substantially affect the outcome of World War II, but they initiated a new phase of warfare."

British wartime work had concentrated on air defence guided weapons. In 1942 work was proceeding on 'Brakemine' (ground launched, radar beam rider GAP), and in 1943 on 'Ben' (ground launched, searchlight beam rider GAP). In the same year, 'Longshot', an air-launched radar beam rider GAP was being developed by Lees and Aspinall at TRE, in association with Benson at RAE. Crow and Cook worked on techniques of proximity fusing at the Projectile Development Establishment. Brakemine, Ben and Longshot came to nothing and, by the autumn of 1944, research was concentrated on a naval GAP for use against the kamikazes. Work had emphasized beam riding for guidance as opposed to command guidance or homing. At the end of the War British theory was behind that of the Germans in such areas as motors and fuels, and aerodynamic stability, and, at least in some aspects considerable use was made of what the Germans had achieved.

"It is interesting to note that the original teams studying the requirements for LOPGAP during the war assessed all three methods of propellant - ramjet, bifuel liquid propellant and solid propellant. They thought that ramjet propulsion held the most promise, although the development timescale could be long; the bifuel liquid propellant motor was thought to be the most likely to be successful in the early development to the standard of performance required. It can be seen, in retrospect, that a mistake was made, so far as the general guided weapon requirement is concerned at least, in not undertaking the development of large solid propellant sustainer motors from the outset. One must realize however, the background against which this mistake was made. We had, at the end of the war, produced only small solid propellant motors with a low specific impulse, while the Germans had demonstrated only too effectively the capability of a liquid bifuel system in the V2 rockets."

The evidence that German activity provided for the significance of missiles for air defence was too great to be neglected and work in this area was to become a major feature of British developments. Although the search for a more and more effective air defence of Great Britain in the

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1. R.V. Jones, Most Secret War, page 583.
 2. T.L. Smith 'Twenty Years of Guided Weapons' in The Journal of the Royal Aeronautical Society, May 1966, vol. 70, no. 665, p. 589. The only British rocket that ever came near to realization was the two stage liquid fuelled Blue Streak. It was abandoned because it was liquid fuelled at a time when strategic theory demanded instant readiness and thus a solid propellant.

period 1945-1952 had the practical effect of producing a steadily stronger jet fighter force, it should not be assumed that defensive missiles were neglected. At least by the late 1940s some of the prototypes based on the early operational requirement for an anti-aircraft missile were ready to be tested. However, in this period that anomaly (to which I have referred above) between the progress in air defence and orthodox thinking about air offence can be observed clearly.

The balance between air offence and defence, always finely set in spite of the activities and achievements of Bomber Command and the Eighth Air Force, did not unequivocally favour the offence at the end of the campaign. The possibilities that the Germans opened up at least set the realistic parameters for post-war bomber design. This was recognized by Sir Henry Tizard's 'ad hoc' Committee in the middle of 1945.¹ The German efforts in the last nine months of the war could have been much more intelligently interpreted, by the authors of the new generation of Britain's strategic bombers, for they in fact forecast the vulnerability of the bomber quite as explicitly as the shooting down of an American U2 aircraft at extreme altitude by a Soviet air defence missile in 1960.

"Had the war gone on much longer, the Messerschmidt 262 (as Adolf Galland and his select band of pilots in Jagd-Verband 44 showed in the closing stages of the war) might well have swung the balance against the Americans and ourselves; and guided missiles, both from the air and from the ground, would have come into service, for in this respect - pressed by the need for new forms of defence - the Germans were well ahead of us all."²

The value of air defence missiles, either ground or air launched, lies in the speed of reaction which they allow. The climb rate of the German 'Natter' missile was 40,000 feet in three minutes. Not only does this allow a more or less instant defensive reaction as bombers approach their target, it in fact profoundly deepens the defence as the bomber stream will be open to continuous and deliberate attack throughout the flight over enemy territory. As research into guidance techniques progressed there was held out the promise of high accuracy - if a hit could be

1. "There are other defensive measures which can be greatly developed. A-A fire can most certainly be greatly improved in lethal effect. Guided or homing missiles may add substantially to defensive strength." (Para. 57, page 16). It should be noted however, that at that stage the Committee believed manned fighters would be more important than guided weapons (para. 9, page 6), and was "Not sanguine that guided A-A projectiles will be sufficiently effective against a numerous attacking force whether by land or sea." (c), page 2. Report by Sir Henry Tizard's 'ad hoc' Committee on Future development on weapons and methods of war, to the Chiefs of Staff Committee, 16th June 1945. COS (45) 402 (O) (PRO - CAB 80/94).

2. R.V. Jones, Most Secret War, page 591.

guaranteed the warhead could be quite small and the ratio of shots to kills would make the air defence missile an economical weapon. In the first place it was the navy, rather than the RAF, which showed most interest in the potential of guided weapons. This may have been on account of Admiralty concern about vulnerability about capital ships to air attack. A Ministry of Supply memorandum on guided missile development¹ lists service requirements. None came from the RAF, and the memo proposed that all research should be concentrated on a naval long-range anti-aircraft missile and a landbased anti-aircraft missile, both with a maximum range of 16,000 yards.

As I have pointed out, any early RAF tendency to neglect guided weapons was negated by their potential as air defence weapons. As this came to be appreciated, a major effort was made to build up an industrial base for their production.

".... more specific assessments related to an air to air weapon and a surface to air weapon for the navy - these being the weapons systems for which there had been most enthusiasm towards the end of the war. Industry at this time was anxious to reform itself to meet the expected greatly increased demand for consumer goods and generally had no desire to dissipate resources on the long-term development of guided weapons. By the late 40s however, the threat to the UK of attack by large numbers of heavy bombers began to be appreciated. Two policy decisions then set the pattern for some time (1) we should continue to concentrate on defensive guided weapons (2) we should build up resources in industry to produce weapons in sufficient quantity to meet the multiple bomber threat."²

1. Ministry of Supply memorandum to COS, Guided missile development programme, 19th September 1945. COS (45) 578 (O) (PRO - CAB 80/97). The memo sets forth a range of requirements, detailing requests from Admiralty and General Staff ranging from long range sea-to-air, to 'strategical' (300 miles) surface to surface. "All work is at present being actively concentrated on items 1 and 5 - naval long-range anti-aircraft and land long-range anti-aircraft, both with height up to 50,000 ft, speed up to 700 mph, and range up to 16,000 yds." I formed the impression that the navy's interest was rather more sustained throughout the period 1945-1952 than the RAF's. Sir Robert Cockburn, on reflection, thought this was quite likely the case, especially in the close defence role. "There was this distaste of the Air Force having their manned role displaced, so they were a bit slower. Guided weapons did not interfere with Navy's role as an ocean going force, merely armed it better." Mr H.A. Popham was much less sure of this assertion, but he did agree that the Navy was more relaxed in its approach as guided weapons were only replacing the gun. (Conversations between Sir Robert Cockburn and Mark Venables, 3rd September 1984; and Mr H.A. Popham and Mark Venables, 17th September 1984.)

2. T.L. Smith 'Twenty years of guided weapons' in The Journal of the Royal Aeronautical Society, May 1966, vol. 70, no. 665, page 587.

Post-war industry naturally concentrated on jet engines and aircraft. There was, indeed, not much knowledge in the industry of guided weapons technology - for example a RAeS member from the De Havilland Aircraft Company commented after a lecture at the Society that "reliable published data on rocket propulsion had been so scarce that some uncertainty regarding even fundamental points must exist in the minds of many people in the industry".¹

It became the task of the Controller (Guided Weapons) at the Ministry of Supply to create a guided weapons industry in the late 1940s. There was a substantial transfer of information from TRE and RAE to industrial teams in an attempt to further this objective.² The outcome of these efforts was a guided weapons programme which by 1948 had produced the first successful test flight of a true guided missile, the RTV 1 (rocket test vehicle) guided by a type 584 radar system. In the same year, at Aberporth, the first firings were made of the Seaslug, a naval surface-to-air missile. From 1946 work on a radar beam rider GAP using a liquid propellant motor was under way at GPE Westcott. TRE worked on homing techniques and a department of RAE under George Gardiner concentrated on air launched guided weapons. The development of the LOPGAP which became the RTV 1 was also progressing at Aberporth by 1946. In 1949 the National Gas Turbine Establishment's RAMJET test vehicle was in use at Aberporth.

According to T.L. Smith, "the first urgent operational requirement to arrive in the later 1940s was for an air-to-air weapon to outrange the guns of enemy bombers".³ The successful product became known as

1. Discussion following paper by W.G.A. Perring 'A critical review of German long range rocket development' in The Journal of the Royal Aeronautical Society, June 1946.

2. "Whereas in the past commercial firms had been reluctant to switch their research staff over to defence projects unless they could be assured of receiving orders, the atmosphere throughout the whole country was now changing ..." (DO(50) 23rd meeting, 21.12.1950. PRO-CAB 131/8.) "There was a tremendous argument about the technology of the guided weapon - whether they should be semi-active, active, passive, long-range, short-range - it went on and on. It was mainly at the DRPC that the answer was decided; soon after I got onto the Committee (as Scientific Advisor to the Air Ministry) Tizard put his foot down. We were now going to concentrate on two ground-to-air weapons and one fighter weapon. Then Mitchell, my predecessor (as Controller of Guided Weapons) at the Ministry of Supply, set out, by placing contracts anywhere he could in the industry, to build up a guided weapons industry. My job in 1955 was to cancel about half of them as absolutely useless." (Conversation between Sir Robert Cockburn and Mark Venables, 3rd September 1984.)

3. T.L. Smith 'Twenty years of guided weapons' in The Journal of the Royal Aeronautical Society, May 1966, vol. 70, no. 665, page 587.

Firestreak (originally called Blue Jay), the first British air-to-air infrared homing weapon. Production work began in 1952, the first successful launch was in October 1954. The Fairey Company developed a competitor to Firestreak, a beam riding air-to-air missile called Fireflash (formerly known as Blue Sky). Fairey sought to sell this weapon to both the navy and the RAF.¹ Other systems which reached at least the development stage included the Bristol Aircraft Company's XTV (Bloodhound), English Electric's Red Shoes, and an embryo television guided bomb called Blue Boar². The two most intractable problems were the control of an aerodynamically unstable object in flight and the regulation of liquid fuel burn in the rocket motors that then existed. During the extensive testing of beam riding vehicles conducted between 1951 and 1953 the developers were plagued by motor explosions after launch, and these trials must have influenced the tendency to switch to a solid propellant system. These problems had been resolved sufficiently by 1954 to enable the RAE trials wing at Aberporth to shoot down their first target aircraft, using RTV 1. (Earlier test firings, from 1949, had been aimed at static spherical targets (aluminium spheres) suspended from barrage balloons.)

During this period there was effectively no long range ballistic rocket programme, and it is of great interest to try to understand why this aspect of the new technology was so neglected. The contention that Britain had no knowledge of this field can be immediately dismissed, for German science provided what could have been a decisive addition to British knowledge. Although the Americans and the Russians acquired all the completed rockets left after the war, and were able to obtain the services of most of the German scientists, it is not true that Britain was entirely deprived of information and assistance. From Perring's account,³ it is clear that the British had gained

1. "That awful firm Faireys made it, and made an awful mess of it." (Conversation between Mr H.A. Popham and Mark Venables, 17th September 1984.)

2. I have reproduced, as Appendix IX, a memorandum by the Ministry of Supply on Acceleration of the Guided Weapons Programme, 18 November 1950. This provides a useful statement of the measures taken to advance the guided weapons programme following the demands made in the Defence Committee to accord guided weapons a higher priority than the atomic bomb. The memorandum also gives an excellent summary of the content of the guided weapons programme, of the action taken to speed it up and the expected dates of completion of the five central projects, and of the main establishments engaged on guided weapons work.

3. W.G.A. Perring, 'A critical review of German long range rocket development' in The Journal of the Royal Aeronautical Society, June 1946.

extensive theoretical knowledge of German rockets (especially the A4, A9 and A10). For example, he gives details of the technique used by the Germans to measure the temperature of the weapon's skin while in flight, data on trajectory patterns, thrust requirements and flight characteristics. It is not possible to believe that all this was acquired solely by reconstructing the A4 that crashed and broke up in Sweden in 1944, especially as some of Perring's data related to the A9 and A10. So British scientists not only had the services of some German scientists,¹ but must also have had access to original German documents. That this is the case, and that they also had access to complete rockets is confirmed by Sir Alwyn Crow (then Director General of Projectiles at the MOS) in his comments on Perring's lecture.

"Since the war they (the British) had reconstructed some of the V2 rockets at Cuxhaven and had fired them. There had been experiments by a combined team of soldiers and British technicians and some of the German technicians had told them what they knew. Undoubtedly something of the sort described would have to be expected and plans were in hand in this country with a view to exploring future long-range projectiles on a fairly large scale. It was a necessary parallel to the atomic bomb development"²

I.S. Dyer, in his history of RAE Aberporth, refers to 'awkward leftovers in the form of old German rocketry' which had been collected during tours of Germany after the War by British parties which had "picked out anything they thought strange or interesting and had sent these items to Aberporth for future investigation"³. The material, 500 tons in all, was destroyed. He also mentions some early research on rockets at Aberporth.

"Towards the end of the War some research had been done into long range ballistic missiles and data had been prepared to produce a ramjet missile called 'Athodyd'. This was first fired from North Battery by a man called Palmer and was not a particularly successful vehicle. One early firing made a violent shift in course, resulting in a land impact near the coastal village of Llangrannog."⁴

The argument that Britain eschewed rocket development because its scientists were denied access to the extant body of knowledge in the field thus cannot be valid, but three other reasons can be advanced with more certainty. The first relates to what W.G.A. Perring calls the "unknown problem of control". The Germans had been plagued by their

1. "German scientists were making a significant contribution to the work on guided weapons. The Minister of Supply was considering the position which would arise, very shortly, when it would no longer be possible to retain the services of these Germans unless special steps were taken." Cabinet Defence Committee DO(49) 5th meeting, 18 February 1949, item 5. PRO - CAB 131/8. See also, C.F. Caunter, A historical summary of the Royal Aircraft Establishment 1918-1948, Ministry of Supply, AERO 2150 A.

2. Commenting on W.G.A. Perring's lecture to the RAeS, in op cit.

3. I.S. Dyer, An outline of the history and development of the Royal Aircraft Establishment Aberporth, TECH MEMO IR 137, May 1973, page 8.

4. op cit pages 6 and 7.

rockets flying out of control and Perring believed that this would be an even greater problem when attempting to use a booster to achieve greater speed and range. So, although Perring thought that some of the technology lay within the scope of present knowledge, and undoubtedly work on short range guided missiles would have relevance for longer range rockets, the difficulties associated with building a two stage rocket capable of the height and velocity to achieve a 1500 - 3000 mile range and of lifting a large payload into the upper atmosphere must have seemed sufficiently daunting to discourage a full scale rocket programme.

The second reason follows from this, and stems from the lack of an industrial background in this field. It can be argued that there was no rocket 'tradition' in British science or industry, while there was a strong basis of aircraft technology, and thus there was a 'natural' incentive to concentrate on aircraft rather than on rockets. It would have been excessively costly to create the technology from scratch and there must inevitably have been a disincentive to pursue rocket research at a time when resources were so stretched. Thirdly therefore, we can see that financial implications exercised an influence on the low priority given to rockets. Choices had to be made, and in the guided weapons field it was decided to devote resources to short range defensive missiles. It will be evident that this decision was a conscious and coherent one, air defence was fixed as a far higher strategic priority, and as early as the report of the Tizard 'ad hoc' Committee it was argued that long range rockets were weapons of the far distant future and surrounded by too many uncertainties to warrant a priority above the other projects that I have discussed. In deciding between the merits of long range rockets and strategic bombers as the offensive system for the next decade and beyond, bombers were chosen because the industrial base and expertise was ready to hand while a decision to choose rockets appeared to promise, in the medium run, an almost imponderable gap in Britain's strategic offensive capability. It was inevitable that the British establishment would have to choose to neglect some of the advanced weapons options, the fact that the pace of long range rocket development by the Soviet Union and by the United States was so swift (and by 1957 with the launch of Sputnik I had made obsolescent the bulk of British military equipment first conceived in the late 1940s) does not prove that those decisions were irrational or irresponsible. Perhaps they were short sighted, probably they were excessively grounded on the technologies of the time and the techniques that had been successful

during the War - what is certain is that the country's resources demanded that some options be neglected. The strategic choice of bombers before rockets was made a much easier one by the determined preference of the Air Staff for bombers. Not only did the bomber represent proven technology and offer the prospect of an unbroken offensive capability, in addition, although the Air Staff did issue an operational requirement for an 'unmanned bomber', the RAF as a whole believed in the future of the bomber and fervently wished to assure the future of manned aircraft for all missions. The pressure of the 'bomber school' was so persuasive as to guarantee the future of the bomber if a choice had to be made between bombers and long range rockets.

(ii) Radio and Radar

The impetus for developments in this field were chiefly the defensive possibilities that seemed likely in the areas of control of guided weapons, and early warning of air attack and the control of fighter defences. The physics of radar is closely allied to some aspects of the physics needed in an atomic energy programme. The production of coherent transmission sources at Harwell, for particle acceleration, paved the way for the development of coherent radar at TRE, which gained access to the technology in 1948. From then on the electronics of defence, based on these new radar powers, was able to make impressive progress. An example of the impact that this advanced radar, in conjunction with enhanced data processing, had on the tactics of fighter defence lies in the changed method of interception. Using wartime radar, fighters had been directed to their targets on a pursuit course: with coherent radar it became possible to intercept on a collision course, greatly increasing the speed of reaction and probability of interception. In the field of guided weapons, radar physics was equally important. It became possible to track high speed missiles and guide them to target with great accuracy. It was clearly going to be possible to deal with multiple targets and to process and use large quantities of data for air defence. The conjuncture of these radar developments, early electronic computers and radar guided missiles revolutionized air defence capabilities against manned aircraft, even those capable of flying faster than Mach 1. And of course, the great progress made in the field enormously enhanced the research and testing of new aircraft and missiles. It became possible to evaluate accurately aerodynamic characteristics, stability and performance. In addition to the measurement of phenomena during scientific testing, aircraft instrumentation also benefitted.

Work on the application of radio and radar for offensive air power - both in the fields of radio counter measures (RCM) and of navigation - was also carried on, but it was largely an organic development of the World War II work and did not have the revolutionary implications of defensive electronics. The decision had been made that the V-bombers should carry no defensive armament, and would rely on height, speed, evasive routing and RCM to penetrate the enemy defences. It was recognized that raids might have to be made in daylight - because of this RCM assumed increasing importance as it became the bomber's chief defence against successful fighter interception. The V-bombers each carried much of the electronic equipment that in the war had been unique to the airborne RCM aircraft. One of the crew members had as his sole occupation the operation of radio measures to deceive and confuse the enemy defences. H2S remained an important airborne aid. At the end of the war the advanced mark was the 4a, in 1957 the first Vulcans were fitted with the mark 9.

(iii) RAF Aircraft

I have already touched on various aspects of the post-war supply of military aircraft. I wish now to deal with the production programme and the priorities which underpinned it, and to discuss the performance characteristics which the Air Staff sought in the next generation of front line aircraft. There is no doubt that from such a discussion one can reasonably draw inferences about the Air Staff's conception of a future air war, and about how they and the government viewed the developing strategic situation. The capacity of the economy to produce weapons such as heavy bombers was steadily reduced after the war. At the same time, aircraft design was at a watershed - beyond the horizon lay performances and requirements that presented a range of technological uncertainties and confusions. Thus although the Air Staff knew what capabilities it wanted, it is likely that the scientific implications and the necessary time scale were not fully appreciated.

In organizing the post-war supply of bombers, the Air Staff faced three considerations: (a) the supply and employment of existing types and current production, (b) the preparation of an operational requirement for whatever force would replace the existing fleet, (c) the preparation of an aircraft production programme that would meet the minimum needs of the Air Force and be acceptable to the government.

At the end of the war Bomber Command was equipped with the Lancaster as its front line bomber. This was powered by four petrol-driven piston engines, producing (in the standard 1945 mark) a top speed of 287 mph, a ceiling of 25,000 feet and a range of 1660 miles with maximum bomb load of 14,000 lbs. (The Lancasters which carried ten ton bombs were special versions.) The Lincoln was a direct derivative of the Lancaster, which it was to replace. Development flights had begun in June 1944, and the first squadron to be equipped with Lincolns received them in August 1945. Lincolns remained in service with Bomber Command until December 1955, and saw 'action' over Malaya. This aeroplane was capable of 295 mph, a ceiling of 35,000 feet and a range of 1470 miles with maximum bomb load of 14,000 lbs. It carried defensive armament. The Lancaster had been regarded as the pre-eminent British bomber of World War II; yet the Lincoln was obsolete as a strategic bomber within a remarkably short time. Even by the time of the international tension surrounding the first Berlin blockade in 1948 there can have been no prospect of deploying the Lincoln force against the Soviet Union. The next generation of British bombers eventually entered service in the 1950s - the Canberra bomber in May 1951, the Valiant bomber in January 1955.

The production programme for these bombers was the subject of negotiation and bargaining similar to that already described for manpower. Stage II of the aircraft production programme was the plan for RAF equipment after the war in Europe, and took account of the requirements for the war in the Pacific. The programme envisaged some continued production of existing marks, plus output of Lincolns and jet fighters, and was to have been fulfilled within one year after VE day. This programme was regarded as grossly excessive by other ministries. The Minister of Labour and National Service makes the following points in a letter to the Prime Minister on 8 May 1945.

"I would urge that immediate steps be taken to reduce the labour force in the aircraft industry. In my view the amount of work that is being carried on for stage II is far too great and will hold up for a considerable time any chance to develop our civilian production At the present time there are large numbers of aircraft available to fight Japan, but as I understand it, the programme launched for stage II - modern aircraft - is very high indeed, and in any case much of it could not be brought into operation against the Japanese a directive should be issued to the Air Ministry and Ministry of Aircraft Production that they must base their programme on an industrial force of not more than 600 000 and that that should be reached over the next three or four months."

1. COS (45) (0) (325) in memorandum numbers 287-403, vol. V. (PRO - CAB 80/94)

Major General L.C. Hollis (then Senior Asst. Sec. to Office of War Cabinet) was disturbed by this argument and wrote a note to the Prime Minister putting the RAF case.

" the Chiefs of Staff consider that our means of meeting our future strategy might be endangered if arbitrary cuts are at present attempted in our aircraft industry. In particular, if we place ourselves in a position where our air services are widely equipped with aircraft that are inferior to those of other nations, our influence in the world will be greatly reduced."

Whatever arguments might be put up, after the defeat of Japan production targets were steadily revised downwards. In a Ministry of Aircraft Production paper of 20 August 1945 there is the following statement on financial allocation.

"I am afraid that we cannot assume that the Treasury will agree to a post-war estimate of about M£100 for aircraft production and research. The Cabinet will have to determine the proper allocation of the national income, and the Treasury have warned me that our share may well be under this figure. The rough idea which has prevailed is that of 70% to production and 30% to research and development, but you (that is Minister of Aircraft Production) were inclined when we discussed the matter recently to the view that the proportion should be nearer 50-50."²

The projected output of aircraft that resulted from this round of Cabinet discussions is given in a memo by the Secretary of State for Air of 22 October 1945.

"In his minute of the second of October 1945, the Prime Minister has directed that the service and supply departments should submit production programmes to the end of 1946 reviewed on the assumption that the labour force at the disposal of the supply directorates has been cut by a further 300 000 men and women by the end of 1945. The joint war production staff have proposed that the M.A.P. labour force working for the RAF should bear 100 000 of this cut. On this basis I submit the attached schedules containing the information in respect of the RAF for which the Prime Minister has asked."³

1. Note by L.C. Hollis on The aircraft industry - stage II, 23rd May 1945, COS (45) (0) (355) in memorandum numbers 287-403, vol. V. (PRO - CAB 80/94)

2. Ministry of Aircraft Production, War potential in relation to aircraft production, 66313. (PRO - AVIA/15/2247)

3. Memorandum by the Secretary of State for Air, Production programme for the RAF, 22nd October 1945, for the Cabinet. DO (45) 21 (PRO - CAB 69/7)

Aircraft in RAF service, production of which to cease by end of 1945.¹

Heavy Bombers	704 at 31.12.45 472 at 30.6.46 452 at 31.12.46
Light Bombers	124 at 31.12.45 nil at 30.6.46 and 31.12.46
Non-jet Fighters	1138 at 31.12.45 680 at 30.6.46 488 at 31.12.46
Jet Fighters	none (obviously!)

Aircraft in RAF service, production of which to continue during 1946.

Heavy Bombers	80 at 31.12.45 144 at 30.6.46 176 at 31.12.46
Light Bombers	436 at 31.12.45 496 at 30.6.46 and 496 at 31.12.46
Non-jet Fighters	134 at 31.12.45 344 at 30.6.46 440 at 31.12.46
Jet Fighters	90 at 31.12.45 176 at 30.6.46 256 at 31.12.46

RAF heavy bomber equipment by type (British production only listed)

Halifax	32 to be produced by end 1945, none thereafter
Lancaster	111 to be produced by end of 1945, none thereafter
Lincoln	172 to be produced by end 1945, with an
additional	115 to be produced January-June 1946, and an
additional	86 to be produced July-December 1946

Clearly, this was a production programme which, at least in respect of bombers, was not going to be met. In its entire production life span, which lasted into the early 1950s, a total of 528 Lincolns were built. Perhaps the only thing these figures demonstrate (apart from a measure of wishful thinking) is the Air Staff's early propensity to continue thinking in terms of a mass bomber fleet. The approach was soon to be adjusted by force of economic and strategic circumstances. In any case, this sort of programme for bombers rapidly became an academic exercise as the Air Staff began to consider what the next bombers should be able to do.

1. Details from DO(45)21, reference at footnote 3, page 179.

The conceptual gap between the Lincoln and the bombers that were specified in OR 229 is enormous, the time span in conception was less than one year. In a lecture to the RAeS in 1980, Air Vice Marshall/Craig outlined the intention behind OR 229.

"Speaking in October 1953 on the subject of preventing war, Lord Tedder, developed lines of thought which must have been influencing our Air Staffs in the mid 1940s. During the last conflict it was the war in the air, he emphasized, unforeseen by many and still not understood by some - which was largely responsible for altering the shape of the war. It became a war of areas, and it might well be that if there were a war in the future it would be one of continents. The experiences of Napoleon and Hitler had illustrated the folly of attempting a land invasion of a vast country like Russia. Only from the air would Russia lie open to retaliatory attack. It was also absolutely essential to remember, Lord Tedder stressed, that purely defensive air forces, with no offensive element, were no defence at all to a country.

Other thoughts were in the Air Staff's mind. By early 1947 they had come to the conclusion that flight refuelling on future types of aircraft was not a paying proposition: instead they proposed to rely on aircraft carrying enough fuel for the ranges required. Experience with the Mosquito had served to underline the view that speed and height even more than self defence armament were the keys to successful bomber operations. Jet engines were a sine qua non and so was the atom bomb. The specification for the new medium bomber included the need to carry such a bomb in a weapons bay designed to accommodate its expected dimensions. These views (and the concurrent government decision to authorise research and development of atomic weapons) reflected the combined military, scientific and political assessments about the actions required to ensure the United Kingdom's security in the post-war world. Such general thoughts and principles led quickly to the decisions to develop and produce the Vulcan B1 and the other V-bomber types (Valiant and Victor) of the medium bomber force."

These lines of thought on the required performance of a future bomber, and the fighting potential of such a bomber against fighters, had been articulated as early as August 1946.

"CAS asked if a long range fighter was envisaged. It was bound to be asked for as it had been in the past. ACAS (TR) replied that when bombers are able to fly at 600 mph the problem of fighter interception will be almost insoluble and there will be no need for long range fighters to protect the bomber. Meanwhile, however, a long range fighter was in fact being developed in Canada.

As the final point of the second day's conference, it was mentioned that the Air Staff requirements for the future long range bomber

1. Air Vice Marshal D.B. Craig, 'History of the Vulcan in RAF service', the Chadwick Memorial Lecture to RAeS Manchester, 19th March 1980, from manuscript copy loaned to Mark Venables by Mr Humphrey Wynn, Air Historical Branch, pages 4-5.

called for a still air range of 5000 miles with the ability to operate at 50 000 ft, at a cruising speed of between 500 and 570 mph. It was likely that this specification would be met and also, in view of the enormous power required to obtain this performance, that the take off run would be shorter than that of the present overloaded heavy bomber. It was possible that the take off run would be in the region of 900 yards. In addition, the landing speed would be correspondingly low."¹

This belief that as speeds approached Mach 1 the margin of superiority of the fighter over the bomber would shrink to insignificance partially accounts for the willingness of the Air Staff to issue a requirement for an aeroplane that would not be able to exceed the speed of sound. At this time the fighter was still regarded as the most dangerous threat to the bomber. The essential requirement that the aeroplane have a service ceiling of at least 50,000 ft was set in the belief that this would allow the overflight of all likely ground defences. Certainly, conventional anti-aircraft guns could not reach such heights, and the full potential of ground launched guided weapons was not appreciated. Concurrent British missile specifications envisaged a maximum range of 50,000 ft, at which height it was assumed that accuracy would be poor. The hope of outrunning fighter defences even if armed with air-to-air guided weapons was also based on the belief that the sound barrier would present an obstacle for some time into the future.² At one stage supersonic flight was thought to present unknown dangers to human pilots, and although this must have been rapidly discounted, the fact remains that research into supersonic flight was not pursued as a priority; indeed, it became policy to limit work to tests on models and theoretical analysis. In addition to the strategic reasons I have suggested above, the development of supersonic flight languished in Britain because of the shortage of testing facilities, because industry was given no incentive to undertake the demanding research required, and regarded the problems as enormous. Thus, like long range rockets, supersonic flight came to be accorded a low priority, to the detriment of British air power capability. The English Electric Lightning was the first British supersonic fighter - it entered service in December 1959. No supersonic bomber ever became operational. The according of such a low priority to supersonic flight was even to be acknowledged officially as an error.

1. Aircraft re-equipment programme, from 'Conference with Commanders-in-Chief, 6th August 1946, AIR 8: file 1532, paragraphs 75 and 77.

2. In view of the fact that the sound barrier was crossed in level flight in October 1947 in the United States of America, the persistence on planning based on this belief is odd.

"The decision was also taken in 1946 that, in the light of the limited knowledge then available, the risks of attempting supersonic flight in manned aircraft were unacceptably great and that our research into the problems involved should be conducted in the first place by means of air launched models. It is easy to be wise after the event, but it is clear now that this decision seriously delayed the progress of aeronautical research in the UK. The general economic and financial situation of the country was a limiting factor; in particular following devaluation in 1949 various other research aircraft for experiments in flight, at speeds near that of sound were cancelled for reasons of economy."

In spite of the rather optimistic forecast that the advanced high speed and high altitude bombers would have previously unobtainable advantages in relation to future air defence fighters, it was recognized that the bomber's task would become increasingly difficult. Even if the design and production programmes for the bombers went ahead on schedule, the new front line would not be in place before the early 1950s, by which time air defence would also be more powerful. British requirements for air defence demanded that its fighters 'mature' gradually, advancing as the technology itself advanced by pushing basic designs to their limits. The first British jet fighters - the Meteors and Venoms - were structurally and aerodynamically jet powered versions of World War II fighters, capable of about 550 mph and a ceiling of 45,000 ft. However, not only for economic and scientific reasons could a similar creeping process not be employed for bomber development. Certainly, to maintain a bomber fleet on that basis would have been prohibitively costly. But the crucial consideration was that a 'great leap' had to be taken to allow the force to keep ahead of foreseen defences during its gestation period.² Furthermore, as it became increasingly understood that a future mass bomber fleet was out of the question, it also became very important for the RAF to have a survivable force of bombers. Hence the premium that was placed on achieving the most advanced technology and performance for the new bombers.

This extracted a great penalty. Although the Lincolns and the loaned American B 29s theoretically kept Bomber Command alive as a strategic

1. The supply of military aircraft, February 1955, Command 9388.
2. The Air Staff papers contain an interesting discussion on the relationship between future air offense and defence potentialities. This record is also a valuable indication of the role and influence of the Scientific Adviser to the Air Ministry. See File ID/52/1/52 (PRO - AIR 20/6937), 18 November 1947 - 19 March 1948. Research Priorities and Staff Requirements - Policy: paper written by H R Hulme, with Air Staff responses and ensuing correspondence.

bombing force, this was officially recognized to be the facade that it was.¹ The pursuit of the most advanced technology in fact created a gap in strategic capability that was all of a decade long. It has been argued that the Air Staff anticipated this gap - that they understood what a lengthy process V-bomber production would be and accepted it in order to ensure the future of the manned bomber.² It is difficult to give credence to this argument, simply because the Air Staff, from the first, thought in terms of an interim bomber, and later accepted the notion of an 'insurance' bomber (the Vickers 660) on the grounds that there was little doubt that it would actually fly, and that Vickers guaranteed delivery of production models by the end of 1953. Furthermore, by the end of 1949 the Staff was so anguished by their 'bomber gap' that the B 29, and the Canberra light bomber were welcomed

1. The most acute period of Bomber Command's inadequacy was felt during the strategic planning which occurred upon the outbreak of the Korean War. In May 1949, the Chief of the Air Staff had said, during a discussion on the air defence of the United Kingdom: ".... the plan in (DO(49)38) dealt only with the defence of the United Kingdom in the narrow sense. In achieving a proper balance of forces, provision would also have to be made for the offensive effort (e.g., against flying bomb and rocket installations) which had played a large part in the defence of the country in the last war and might well have to play an even greater part in the next when the defence is likely to be confronted with even greater difficulties (e.g. against the high level, high speed bomber, and against low level attack)." (DO(49) 14th meeting, 17 May 1949, PRO - CAB 131/8). In the July 1950 Ability of the Armed Forces to meet an Emergency, Report by the Chiefs of Staff to the Cabinet Defence Committee, all aspiration to a strategic air offensive was dropped, of necessity, for the time being: "The essential basic tasks of the RAF in war in 1951 in order of priority on the assumption that the Continent will be overrun, will be as follows: a. The defence of the United Kingdom against air attack. b. The protection of our vital sea communications in conjunction with the Royal Navy and with our allies. c. The defence of the Middle East base including support of the land forces in that theatre." (DO(50)58, 21st July 1950, PRO - CAB 131/9) By 1952, after the completion of the important report on Defence Policy and Global Strategy (D(52)26) the strategic role of Bomber Command was reinstated in the war plan. "46. The Chiefs of Staff stated in their review of global strategy that in addition to the aid that the RAF can lend to the sea and land campaigns, air power has a special part to play as a deterrent to war and as a means of upholding our influence in world affairs. 1. To provide a deterrent to war and a powerful striking force if war comes; 2. defend the UK and its ports and sea approaches 3. Play their part in the allied air forces in connection with operations at sea and in the land campaign." (D(52)41), 29 September 1952 PRO - CAB 131/12.

2. "To sum up the position before the Korean War broke out, requirements had been stated by the Services for very advanced aircraft expected about 1957." The supply of military aircraft, February 1955, Command 9388.

as valuable additions to the strategic bomber force. The original Ministry of Supply specification B35/46, which gave rise to the Vulcan and the Victor, was issued in January 1947 and based on OR229. In August of the same year a new specification, B14/46 was issued, also based on the OR229 but calling for much reduced performance. The outcome, the Short SA4, of which two prototypes flew, could achieve only 42,000 ft and a speed of 460 mph. The first prototype flight took place in August 1951, by which time this 'Lancaster with jets' was so clearly obsolescent that it was cancelled. This plane was intended as the interim bomber and the Air Staff accepted its low performance in order to have a new aircraft in service as soon as possible. When its inadequacy became apparent the Vickers 660 was accepted and a new specification B9/48, was issued in July 1948 based on the aircraft's design performance. This sequence suggests therefore that the RAF was troubled by the implications of seeking an advanced bomber and did attempt to provide for an intermediate capability. The Air Staff was defeated in their efforts by the pace of technological progress, a fact which they at least recognized in the short term, although, by remaining fixed in their drive to secure a modern bomber fleet they ultimately fell prey to their own preconceptions.

The logic of post-war developments, we can conclude, imposed on the Air Staff a set of priorities which conflicted with their own efforts to achieve their central priority, the preservation of a viable strategic offensive force. Both science and the strategic situation pulled in the direction of air defence. In the end, only the prospect of the atomic bomb allowed the conception of British strategic air power to remain a valid one. Thus, while official policy repeatedly emphasized the growth of air defence¹, the Air Staff could pin its hopes on the time when the

1. "The Air Ministry programme provides for the continuation of the progressive rearmament of the RAF with the most modern types of jet propelled fighter aircraft" (1)

"The plan for doubling the jet fighter strength of fighter command will be completed and the power of Bomber Command will be increased by forming squadrons of B29 aircraft as a result of American aid." (2)

"The front line strength of the RAF increased considerably during the last year, notably in fighter command and the British Air Forces of Occupation In Fighter Command, the doubling of the front line of the regular day fighter squadrons has been completed" (3)

(1) Statement relating to defence, Command 7042, February 1947.

(2) Statement on defence, Command 7895, March 1950.

(3) Memorandum to accompany Air Estimates, Command 8162, February 1951.

new bombers, armed with atomic bombs, would give reality to a renewed British strategic capability in the hands of the RAF. It was this vision, as long as it remained an assured one, which allowed the Air Staff to accept other priorities ahead of the bomber.

1. It did remain an assured vision. For although the atomic bomb, guided weapons and jet fighters had a higher priority than the V bombers, the certainty that the V bombers would actually be built was only once in doubt, briefly, in 1949/1950. Otherwise the bombers themselves always enjoyed a special priority. "[Handley Page, A V Roe and Vickers (Weybridge) are] engaged in a bomber project to meet a requirement classified as of supreme importance." [In the case of Handley Page and A V Roe the specification number B35/46 is attached.] Quoted from the reasons give for retention of the firms on the Ministry of Supply approved list in memorandum by the Minister of Supply on Size and Shape of the Aircraft Industry - Need for Planning to Preserve War Potential, the Cabinet Defence Committee, DO(50)47, 28 June 1950. (PRO - CAB 131/9).

Chapter 6

British strategy, 1945-1952

In many respects the British position after the War was determined by a decline in power which had its origins earlier in the Twentieth Century. This decline has been measured both in absolute terms, and in relation to the strengths of the other great states. The Second World War itself, however, was a major contributory factor in shaking Britain's hold on global power, as it was in respect of the might of France and Germany. Although Britain had been on the victorious side, it seemed likely that the cost of that victory would be too great for the country to be able to sustain its old position of supremacy. British statesmen and military leaders of the later 1940s were aware of this penalty, especially so when they were obliged to take the United States of America as a reference point, and when they took account of the increasingly hostile power of the Soviet Union. It is essential to incorporate this sense of weakness into an evaluation of British post-war military policy, but it is also vital to understand those aspects of the British situation and outlook which seemed, at the time, to promise a continuing place within the triumvirate of the great powers. The fact is that the character of British decline and the post-war quality of British potential was profoundly ambiguous, and it is inevitably true that the leaders of the time were not able completely to grasp the internal logic of the shifts in global power that were occurring. British leaders, in fact, tended to behave as if Britain was still, in essence, a great power, and to plan a future on that basis. They did so not only because of the traditions and perceptions they shared with British leaders of the past, but also because of the superiority that derived from the defeat of the Axis Powers.

"It has become a commonplace to observe that the unusual and transient circumstances of 1945 conspired to delay British recognition of the processes at work. The achievement of victory as the not wholly unequal partner of Russia and America, the temporary eclipse of France, Japan and Germany, the fingerhold on nuclear weapons that even Russia did not possess and, perhaps above all, the residual, indeed as yet scarcely diminished, responsibilities of empire, both imposed military obligations on the old global scale and at the same time fed the illusion that they could be discharged. Even the early economic crisis that compelled abandonment of Greece and Turkey to the United States in 1947 could be attributed to the passing strains of post-war reconstruction."

As with so many other features of British post-war policy, strategy was dominated by the economic and financial legacy of the War. The sale of foreign assets and the creation of an enormous foreign debt to pay for the War produced a balance of payments crisis which influenced policy throughout this period.

"The structural weakness of the economy after the Second World War was the most significant indicator of Britain's new situation. Britain in 1945 was in many respects far poorer than in 1938. The heavy damage to her productive plants from bombardment and to the merchant fleet from torpedoes was considerable. More importantly, wealth which had been accumulated over decades had been rapidly consumed. Gold and dollar reserves had dropped from £864 million to £453 million; over a quarter of the overseas investments which had long played a role in balancing Britain's international account had been sold to pay for war supplies; external liabilities in the form of debts had risen from £760 million to £3,353 million; exports had gone down 30%."

A solution was sought in import restrictions and a vigorous export effort. The government strove to restore industries damaged in the war, and to direct as much as possible of the labour force and industrial capacity to the production of civilian goods for export. Thus the incentive was to limit military expenditure to the lowest possible level, and to rationalise strategy along the lines of the economic imperatives. I have already discussed how this financial stringency influenced the course of military adjustment to peacetime conditions - the point I wish to emphasize here is the extent to which the economic crises and financial shortages formed one pole of the post-war sense of weakness. Of course, no military system can deploy unlimited resources, and all have to make strategic choices based on economic reality - in Britain at this time economic reality was one of the cardinal limitations on strategic planning².

Granted, then, the influence of economic weakness after the War, what were the strategic factors that dominated British planning? The most acute concern was for the Air Defence of Great Britain.³ The unique sense of vulnerability the British Chiefs felt largely arose from the

1. Andrew Pierre, Nuclear Politics, page 69.

2. The direct relationship between economic constraints and strategic planning is discussed in Richard Rosecrantz, Defence of the Realm, chapters 2 and 3: and, various authors, Perspectives upon British Defence Policy 1945-1970, chapters 5, 8 and 9.

3. "As to the priority accorded to the air defence of the United Kingdom in the general scheme of national security, it already very properly enjoyed a high priority as it obviously constituted the first line of defence to the base on which all else depended." (Cabinet Defence Committee, DO(49) 14th meeting, 17 May 1949 Item 2. Air Defence of the United Kingdom, PRO - CAB 131/8.

influence which the V2 campaign (and, to a lesser extent, the V1) had on their outlook. About 1000 of these short-range rockets fell on Britain in 1944 and 1945, and the only defence against them had been the destruction of the fabricating and launching sites. If the threat from this type of weapon seemed both impervious to measures of conventional air defence, and of an especially horrifying character, at least it was also judged to be a remote one after 1945, provided enemy launching sites could be kept far away from British shores. Range, payload and accuracy of the rockets of the near future seemed to promise some remission of the threat for the time being. The wider implications of aerial bombardment were, however, placed on the top of the agenda by the German rockets and the course of the air war late in the conflict. The Allied strategic bombing of Germany demonstrated what might be achieved in a future European war. Post-war analysis of the threat emphasized three points. First; the smallness of Britain, its proximity to Continental Europe, and the densely concentrated nature of its industry and centres of population, located in a few vulnerable conurbations, made air attack seem the most likely option for any aggressor seeking to rapidly 'knock out' the country.¹ Thus, the features of the inter-war fear of the bomber reappeared in an intensified shape in the strategic thinking after 1945. Second; as the Soviet Union began to be viewed as the most likely enemy, it was feared that Russia would seek to attack Britain early in any future war, from the air. Third; the threat of atomic bombardment seemed to present the most devastating challenge to the survival of Britain. Prior to the general deployment of advanced rockets, perhaps armed with atomic warheads, the build-up of the ADGB took on the aspect of the most pressing strategic requirement.

1. The following are typical statements: "Since we enjoy the doubtful privilege of inhabiting the most vulnerable target in the world, its general characteristics should be of more than passing interest." (Air Marshal Sir Roderick Hill, 'The Air Defence of Great Britain' in Journal of the Royal United Service Institution, May 1946, Vol. 91, no. 562, pp. 161/2.

"The United Kingdom is in a particularly isolated and vulnerable position in relation to any enemy which is in control of the whole or of a major part of the mainland of Europe. [The atom bomb] is a factor that we must consider in all our defence problems, and its effect is to increase the vulnerability of our own population and industrial resources." Viscount Trenchard, 'Air Power and National Security', in Air Power: Three Papers, Air Ministry Pamphlet 229, December 1946, page 34.

The second great strategic problem was to resolve the future of British global power, which entailed an examination of the role of the navy.¹ The forces underlying the post-war transformation of British naval power are complex, but it is possible to say that, in the broad outline, three factors had the greatest impact. During the War the capital ship had been eclipsed by air power. The sinking of the *Repulse* and the *Prince of Wales* in the Gulf of Siam had been a traumatic shock to the British establishment. The naval operations off the island of Crete in May and June 1941 had suggested a similar lesson in the vulnerability of ships to air strikes. The experience of the United States Navy in actions against the Imperial Japanese Navy provided an even more convincing series of demonstrations of the ascendancy of air power over naval forces. The only major occasion on which the two navies had engaged in a gunfire duel was at the Battle of Leyte Gulf, all other significant encounters had been decided by carrier-borne aircraft. The evidence pointed to an inevitable decline in the value of fleets based on capital ships deploying as their main armament high calibre guns - principally battleships and heavy cruisers - precisely the force that had been the backbone of pre-war British power.

The second factor related to one of the principal roles of the British fleet; that of imperial guardian. After 1945 it became increasingly clear that the Nineteenth Century approach to the British Empire was finished, and that the Empire would have to be given up, or at best evolved into a new form. The so-called 'imperial retreat' was a long and uneven process, but it was part of the political conception of Mr Attlee's government from the start and the first practical consequences occurred in 1947 with the independence of India, Burma and Ceylon. It was still likely that commercial routes to Britain would need to be covered, but what would not be necessary would be fleet action to defend the Empire against traditional imperial rivals such as France and Germany, nor would it be necessary, in the long term, to maintain fleet bases such as Singapore and Trincomalee. Furthermore, as the retreat from empire would mean a steady reduction in overseas army garrisons and the need for land actions in defence of territorial possessions, so the

1. "From that [the rise of air power] followed two main consequences. The first, which involves, for Great Britain, a revolution in policy - a clean break with the traditions of centuries of sea power - is that our old ability, conferred upon us by sea power, to 'take as much or as little of the war as we will' (in Bacon's words), is as dead as mutton since the fleet ceased to be our sure shield." (Sir John Slessor, 'Air Power in War', March 1950, in The Great Deterrent, page 102.

value of strategic mobility based on sea power would decline. Therefore the rationale for the global role of the British fleet was beginning to disappear at the same time as the military basis of its strength, the gun armed capital ship, was being undermined.

Finally, the importance of the fleet in the defence of the home islands - against an opposing fleet attempting to secure the Channel for an invading army; and in the exercise of naval blockade, would become far less significant in circumstances where the traditional European rivals were shattered and in which the Soviet Union, possessing neither a powerful ocean going navy nor a critical dependence on seaborne supplies, loomed as the most likely threat to British security.

The Navy was not, of course, finished, and the Admiralty was able to make a number of strategic arguments in support of the endurance of a large fleet, some of which were readily accepted by the government and the Chiefs of Staff. But there was a clear recognition that the basis of British power (on which the strategic vitality of the Navy had rested) and the overall global balance of power, had shifted fundamentally. There would thus have to be an accompanying change in the composition of Britain's strategic forces.

The emergence of the Soviet Union and the United States as new superpowers which would exercise a growing dominance in global strategy, and the underlying intentions of both of them (but perhaps especially of the former) towards Britain, was a third strategic factor that came to dominate British planning. The British reaction to this development took both offensive and defensive forms. One defensive approach was to seek to consolidate a system of alliances in western Europe, which matured in the Dunkirk and Brussels Treaties. Concurrently, Britain began to rearm the forces of her European allies with war surplus weapons. The impulse to create a West German state and eventually, to fashion within it a new military power, was part of the same approach. Less successful was the attempt to define military agreements with the self governing nations of the Old Empire, such as Australia and New Zealand.

Towards the United States there was less freedom for manoeuvre, because Washington obviously had great scope for determining what its future policy would be towards Britain and Europe. Within the Labour Party there was a section which argued for a policy of complete independence of the

United States, but this line had little support in the Cabinet, which regarded the United States as a 'natural' ally and even the guarantor of the Western position.

However, the Cabinet's position was not one of slavishly accepting American leadership at any cost provided the defence of Europe was ensured. In any case, at least initially, the American position was too uncertain for such a policy to be realistic. Rather, the Cabinet aimed at the twin goals of establishing the basis of a viable independence of United States's policy while at the same time drawing America into the defence of Western Europe on the foundation of a 'special relationship' with Britain. Progress towards these goals occurred on numerous fronts. The British government sought independent purchase on American intentions by building up an advanced weapons industry and by modernising its armed forces (most notably, in deciding to build a British atomic bomb and preparing an independent strategic bombing force); by taking, in Western Europe, the initiative of creating a regional security organization dominated by Britain; and by following an independent line towards the Soviet Union. Such events as Anglo-American cooperation in occupied Germany (leading to the creation of Bizonia in 1947), the favourable American response to a British appeal for assistance in Greece and Turkey, the creation of the Marshall Aid Plan, and the formation of the North Atlantic Treaty Organization (NATO) all signified growing American willingness to be involved in the defence of Western Europe. The British government welcomed these developments because it did not perceive them as stages in the dominance by the United States of West European affairs, but rather the fulfilment of the aim to enlist the United States in the stabilization of the post-war European status quo. This status quo was not perfect from the point of view of an ideal vision of British interest in Europe, but its preservation was the best that could be hoped for.

Of course, these events owed their real origin to the perception in Washington of what the United States's best interests were, and therefore cannot be said to be the product of British policy. They did accord with that policy, however, and thus were not resisted by the British government.

Towards the Soviet Union there existed strong elements of traditional anti-Bolshevik sentiment, especially among the Chiefs of Staff and

amongst some members of the Labour Government. For example, "When Shinwell moved to the War Office (outside the Cabinet) in October 1947 he became increasingly right wing in his assumptions, especially on foreign and colonial questions: during the Korean War, he was a leading sabre-rattler and a close intimate of Field Marshal Montgomery."¹ According to Rothwell² the Foreign Office withdrew from the Post-hostilities Planning Committee (which was dominated by the Chiefs of Staff) because of its anti-Soviet attitude. British policy was not initially antagonistic towards the Soviet Union - the government strove to reach an accommodation if possible. It pinned hope on the United Nations Organization (UNO) as a means to involve the Soviet Union in post-war cooperation and, at least in the earlier Foreign Ministers' meetings sought to develop those areas of agreement that existed. So it is wrong to regard the British government as automatically hostile towards the Soviet Union, in spite of the urgings of the military Chiefs. For a time Attlee and Bevin, and sections of the Foreign Office, believed that post-war cooperation was both possible and desirable. "Mr Attlee himself was converted to a tougher line, [against sharing atomic secrets with the Russians] although he was not prepared to go too far along it. He amended officials' drafts of an aide memoire for his Washington trip [in November 1945] to exclude references to the Russian threat."³ Margaret Gowing draws attention to a similar reluctance two years later: "Ministers were certainly not yet prepared to accept that Russia was in effect an enemy, albeit undeclared. The Chiefs of Staff in an aide memoire on future defence policy in January 1947, had assumed there was at present only one foreseeable enemy, but the Prime Minister had struck out this assumption. Again in June 1947 the Chiefs of Staff proposed that defence policy should be based on the possibility of war with Russia. Attlee and Bevin thought this was dangerous: ... "⁴

Between the breakdown of the Foreign Ministers Conference in Paris in the summer of 1947 and the start of the Berlin Blockade one year later, the government's policy rapidly hardened into one of resistance to the Soviet Union, and the decision to confront the Russians, if necessary, was taken. Even if there was then insufficient military strength in Europe to achieve this confrontation with force of arms (as was momentarily

1. Kenneth Morgan, Labour in Power 1945-1951, page 57.

2. Victor Rothwell, Britain and the Cold War 1941-1947, page 120.

3. Margaret Gowing, Independence and Deterrence, vol. 1, page 69.

4. *ibid.* vol. 1, page 186, citing COS (47) 5 (0); COS (47) 9th meeting; COS (47) 74th meeting.

considered in July 1948) or possibly to hold a defensive line in Western Germany, yet Britain was prepared to take an aggressive diplomatic position.

"He [Bevin] tells me [Harold Nicolson] that yesterday he had had a real heart to heart talk with Molotov in his (Bevin's) flat. He spoke as follows: 'Now Mr Molotov, what is it that you want? What are you after? Do you want to get Austria behind your Iron Curtain? You can't do that. Do you want Turkey and the Straits? You can't have them. Do you want Korea? You can't have that. You are putting your neck out too far, and one day you will have it chopped off. We know much more about you than you imagine. We know that you cannot stand a war. But you are behaving in such a way that one day there will be a showdown. And you will have to give way in the end and lose your credit with your own people. You cannot look on me as an enemy of Russia. Why, when our government was trying to stamp out your revolution, who was it that stopped it? It was I, Ernest Bevin. I called out the transport workers and they refused to load the ships. I wanted you to have your revolution in your own way and without interference. Now again I am speaking as a friend. You are playing a very dangerous game. And I can't make out why. You don't really believe that any American wants to go to war with you - or, at least, no responsible American. We most certainly do not want to. But you are playing with fire, Mr Molotov, and one day you will be badly burnt. And I don't see the object of it all. If war comes between you and America in the east, then we may be able to remain neutral. But if war comes between you and America in the west, then we shall be on America's side. Make no mistake about that. That would be the end of Russia and of your revolution. So please stop sticking out your neck in this way and tell me what you are after. What do you want?' 'I want a unified Germany', said Molotov."

In spite of the existence of obvious indicators of weakness and vulnerability, Britain continued to behave as a great power, and pursue its traditional interests globally, but especially in Europe, as if it had the means and authority to do so. The extent to which this aggressive policy was successful is remarkable. For when policy had to be supported by military action, Britain was only able to act at great cost to its surviving strength. The results were mixed. In Greece, in Palestine, and in Northern Persia the practice of great power intervention gave rise to domestic crises and international embarrassment. The struggle in Malaya against local Chinese communists, though ultimately successful, was a long and difficult one, involving 26 battalions of British troops at its height. Undoubtedly the most onerous burden on British resources was the requirement, strategically and diplomatically crucial, to keep an army and an air force of occupation in

1. Reputed conversation between Bevin and Molotov, recounted by Bevin to Harold Nicolson and recorded in Nicolson's diary entry of 3rd December 1947 - in Nigel Nicolson ed., Harold Nicolson, Diaries and Letters 1945-1962, pages 115-116. This was the time of the breakdown of the last Foreign Ministers Conference.

the British Zone of Germany. Yet the commitment to the occupation of the Zone was kept up and it is well to recognize the extent to which the country was able to act successfully with military forces - primarily evidenced in the British effort during the Berlin Air Lift and its contribution to the Korean War. The Statement on Defence of February 1949 draws attention to renewed naval activity of the 'flag showing' variety.

"In the autumn of 1948 the reconstituted Home Fleet carried out a cruise to the West Indies. The appearance in those waters of HMS Duke of York with cruisers and destroyers in company was an encouraging sign of the recovery of our naval strength."

The confidence of the government derived not only from the tradition of exercising international power, but also at least in part, from a belief that the main protagonist (that is the Soviet Union) was also enormously weakened by the war and would not embark on another in the face of sufficient resolve. Thus, although the Soviet Union grew to be regarded as a threat, at least until 1949 and 1950 this threat was thought of as a long-term prospect and capable of being countered within the long term. In addition to this reassuring analysis there were also some positive features of the British position which allowed the government greater assurance in its assertion of power. I have touched upon the first, which lay in the steady restoration of relations with the United States. Ernest Bevin's policy was, by 1947, to underpin Britain's security with permanent alliances, the crowning achievement of which was NATO. As a western military bloc began to take shape, with Britain and the United States acting as primes inter pares, many of the imponderables about the post-war settlement in Europe, and Britain's place in that settlement, began to be resolved to the Cabinet's satisfaction. The Army in Germany reinforced Britain's position in the alliance. Although it was a burden, it therefore also had its advantages. At first this Army had materially guaranteed British influence over the fate of Germany, as a defeated nation. Thereafter, it became an instrument whereby Britain could demonstrate to the Soviet Union that the division of Germany, set out at Potsdam in 1945, was to be permanent, and also indicate to the United States the intention to defend this least unfavourable status quo. This commitment to a standing Continental army transformed Britain's traditional European role, but what was a necessity in order to have a voice in the future of Europe was turned into a strategic virtue by its utility in adding to the balance of Western forces facing the Russian army.

Perhaps the greatest asset of all was judged to lie in Britain's access to the secrets of atomic energy. The atomic bomb was a powerful symbol of technological prowess and a potent source of military strength. With the weapon, and the means to deliver it, Britain would be neither dependent on the United States for possession of the most modern weaponry, nor obliged to face the Soviet Union with conventional forces alone. This at least was the long term perspective of the government, because Britain could not hope to produce the bomb before the 1950s. The need for a long view was not necessarily a disadvantage when the atomic bomb was judged essentially as a weapon for the next generation of the British forces, rather than, say, a diplomatic tool, or a practical means of influencing American military policy. Taken as an independent British weapon, which I will argue was its principal rationale, there seemed no need to fear a capability gap because the strategic planning on which it rested was also necessarily long term.

1. The strategic role of the atomic bomb

British strategy after 1945 is frequently discussed largely in territorial terms¹ - for example: the restoration of European control in the Far East and the re-establishment of British colonial power in places such as Malaya and Borneo; the retention of the Middle Eastern base, grounded on the Suez Canal and the preservation of British influence in the Eastern Mediterranean (hence the involvement in Greece); and the management of territorial legacies of the War such as Berlin, Trieste and Palestine. This is all very well, but I believe such an approach deals in the manifestations of a short term process of reorganization necessitated by the division of Germany and the inability of the 'Big Three' to agree an ordered shape to the post-war world. Comparing the peace settlement of 1945 with the Congress of Vienna in 1815 will demonstrate what I mean. In 1815, the defeated power, France, existed as a viable state with interests to articulate and an obvious role to play in the new European order. In 1815 the French state had to be accommodated in some way. In 1945 Germany did not exist in the same sense, and the conflicting interests of the victors guaranteed that any

1. Such an approach is to be found in, amongst others, J. Baylis, British Defence Policy in a Changing World; C.J. Bartlett, The Long Retreat: A Short History of British Defence Policy 1945-1970; W. Medlicott, British Foreign Policy Since Versailles 1919-1963.

accommodation would be made with different Germanies defined separately and differently by them. The creation of Bizonia in 1947 was the first step in the division of Europe that was to become permanent. The European states system was destroyed and the divided continent fell under the influence of two extra-continental powers.

In 1815 the major powers, including France, also settled on a new global order; that is, they agreed to a world-wide division of spheres of influence. However well this agreement worked, and whatever its long term implications were, it was settled by the powers and formed the basis of a European stability that lasted (with minor interruptions) until 1914. It can also be argued that it laid the foundations of the second British Empire. Taken as a model of peacemaking then, the Congress of Vienna helps to explain Churchill's attempts to agree with Stalin a new division of the world into spheres of influence. The agreement did not prosper, and between 1945 and 1948 no basis for European or global cooperation was established between the Big Three. In essence there was no peace treaty.

Instead, the three powers attempted to impose a settlement which was most beneficial to their own interests and intentions, in a struggle called the Cold War. For Britain, the imperial 'mopping up' and territorial 'tidying', the highlights of which were Indian independence in 1947 and the Suez Canal action in 1956, were in all ways secondary to the European course of the Cold War.¹ This was inevitable because the factors at stake in the Cold War were vital to British power and influence. For although Britain had been a great imperial nation, its most fundamental interests had always depended on events within the European state system, of which Britain was unavoidably a part. This fact, after all, was at the root of the famous balance of power system which had been integral to

1. If there is an exception to this, it is the Middle East. A firm hold on the British base there was, for the Chiefs of Staff second only, in strategic importance, to the defence of the United Kingdom. "The [Defence] Committee well knew that the Chiefs of Staff attached vital importance to this area [the Middle East] from the military point of view, but in fact the United Kingdom armed forces in this area were fulfilling a far wider function. Not only did they bring a similar sense of stability into an area which was of vital economic consequence to us, but they held a position that was at the centre of the Commonwealth and the centre of the Moslem world, withdrawal from which could hardly fail to lead to the disintegration of the Commonwealth and the eventual fall of Africa to the Communists." (Cabinet Defence Committee, DO(49) 20th meeting, 15 November 1949. PRO - CAB 131/8)

British foreign policy since at least the time of Marlborough's continental campaigns. As the concept of the European balance of power had been rendered permanently redundant by the events of 1945-1948, then Britain had as its primary strategic goal, to construct a replacement system which would guarantee its security in relation to events in Europe. This necessarily transcended any of the overseas considerations; they could not form the basis of British global power whilst the position of Britain as a European power was uncertain.

By 1948 it was believed by the British government that the most immediate threat to a new order in Europe consistent with long term British security was the Soviet Union. It is reasonable to conclude that this belief was not an illogical one. At the same time however, the intentions of the United States, in a number of areas, could not be ignored. On the one hand, American designs on the Empire, especially in Asia, presented a threat to the retention of the Far Eastern possessions. The American condition for the loan of \$3.75 million, negotiated at the end of 1945, that Britain begin to dismantle the system of imperial trading preferences, and the anti-imperial tone of sections of American official and public opinion suggested that American policy was hostile to the British Empire in its totality.¹

In other ways American behaviour was unfriendly towards Britain. Lend-lease was unilaterally cut off in August 1945, and the passage of the McMahon Act one year later put an end to Anglo-American atomic cooperation and formalised the refusal to give Britain American atomic energy information which had been in force since the end of the war in the East. At least until the Foreign Ministers meeting in Paris in the summer of 1947, the United States government had often appeared to sympathise with the position of the Soviet Union on the settlement of Europe, rather than follow the increasingly belligerent British line expounded by Ernest Bevin. There were occasions between 1945 and 1948 when it appeared to the British government that the United States might be willing to leave Europe to settle its own security arrangements and territorial future, dealing with the Soviet Union as best it could. This was never a likely eventuality - on 12th March 1947 the President

1. For an excellent treatment of American attitudes to the Empire, especially in Asia, see Christopher Thorne, Allies of a Kind.

enunciated his so-called 'Truman Doctrine' and ushered in the era of containment.¹ But the fact is that in the face of the threatened Soviet attempt to dominate the post-war structure of Europe in a fashion inimical to British power in the system (at least, this threat was perceived by the British government), and in the light of apparent American indifference to this outcome, and even hostility to Britain, the British government had no choice but to regard the European situation as the most important of its strategic considerations.

It is in terms of this analysis that the government regarded the atomic bomb as of such overriding importance. There are a number of features inherent in the atomic bomb that gave it this importance. The most obvious is its destructive power, which might afford a nation like Britain the strength to attack so powerful a nation as the Soviet Union. With such a weapon, Britain fighting alone could strike a telling blow at the Soviet Union, whereas, unless fighting with allies, no other measure of force available to Britain could be expected to avail against the Soviet Union in a war. At the same time, possession of atomic bombs and the means to deliver them would provide the means of threatening the Soviet Union, with unacceptable destruction, in periods prior to the outbreak of conflict.

These were, however, in the first instance, strictly military considerations and they were resisted by the Cabinet until 1948. The reason for resistance was that, although atomic energy was a source for

1. Andrew Pierre writes: "In 1946 the burden of the developing tensions between the Western nations and the Soviet government was borne by the British." (Nuclear Politics, page 68.)

Avi Shlaim, in an article on the Berlin Blockade, convincingly demonstrates "... that Britain under the leadership of Ernest Bevin played a much more significant and decisive role in organizing the Western world for the post-war struggle for power in Europe than is commonly believed" and that "Britain played a significant role in forging the overall Western policy of firmness in dealing with the Soviet challenge " (page 1.) He argues that "During these few crucial days, [at the start of the blockade in June 1948] London moved with greater speed and decisiveness [than Washington] in making its basic strategic choice to stay in Berlin, in announcing this decision and in prompting the American government to follow suit. Led by its staunchly anti-Communist Foreign Secretary, the British Cabinet quickly resolved to do everything to supply Berlin by air and to concert a common policy in this matter with the governments of the United States and France. Much of the inspiration and initiative for the air lift came in fact from the British side" (page 5.). ('Britain, the Berlin Blockade and the Cold War', in International Affairs, winter 1983/4)

weapons, the government was not anxious to think of the Soviet Union as an enemy and was therefore only prepared to think about the bomb in general rather than in specific strategic terms. In January 1947 the General 163 Cabinet Committee decided to proceed with production of an atomic bomb. Before that date the Staffs had discussed the matter and begun to formulate a general line of strategy. The Air Staff had prepared a requirement for the first British bomb. At least from the start of 1946, British military planners had believed that Britain should produce atomic bombs, only during 1947 was this military appreciation given its official strategic purpose - use against the Soviet Union.

I do not wish to argue that without the intransigence of the Soviet Union the bomb would not have been introduced into the British arsenal, nor that the central motivation came from the military staffs who pressed the case on the Cabinet. The point I wish to make is that the decision to proceed with a British bomb was based on the strategic need to influence the course of events in Europe and this came about as the result of a political evaluation of the vital interests of Britain. The supreme importance of the bomb to Britain was that it was judged to offer the nation the concrete ability to act in a genuinely strategic manner at a time when there seemed no other weapon available which could provide this capability - and when such a capability seemed crucial to Britain's future global status.

However, it will be evident from the drift of the argument that I attach great importance to the perception of the Soviet Union as dangerously hostile to British interests. This perception, and the start of the Cold War ensured that military policy and expenditure on equipment would be high on the political agenda, and created a strategic milieu not far removed from what had existed during the Second World War.

The strategic case for the atomic bomb was not the only one. It came to represent a proficiency in military technology and engineering that in itself stood as evidence of the power of Britain. Especially judged against the Soviet Union, but also in respect of other great nations, British technical excellence was regarded as a vital element of security. This was applied across the range of weaponry, but took on a special significance in the atomic bomb programme. This consideration was not merely a symbolic one. Because it was believed that Russia was behind

the United States and Britain in military science, it was therefore held that this superiority was an important balancing factor in the preparation for any conflict that might arise. Out of this reasoning (although in many respects it was subsequently proved false) grew the urge to maintain a technological lead, as a strategic factor in itself.

The variety of other reasons that have been evinced for the British bomb can be dealt with briefly. It may be true that possession of the bomb promised to confer enhanced international status, and it may have been held that any great power should have such a weapon. These assertions seem to me inseparable from the actual strategic considerations. No doubt Andrew Pierre is correct in saying that "Among many of the scientists there had always been the expectation that when it became feasible a bomb would be manufactured. The Tube Alloys technical committee had made this assumption in advising Sir John Anderson in 1944. Britain had been a pioneer in atomic energy from the start. Not to have continued its development would have seemed almost unnatural."¹ Certainly, also, commercial and economic motivations contributed to the desire to press ahead with a nuclear energy programme, in any case integral to the production of bombs. Finally, the British bomb was seen as a means of proving to the United States that Britain should be readmitted to the secrets of America's own programme, and was in a position to be trusted as a full atomic partner in the future.

Of all these reasons, the only one that seems to me to have much bearing on the working out of post-war strategy is the last. Britain wished to cement a firm alliance with the United States, and one of the desired features of this alliance was an atomic partnership that would give Britain a special influence on American strategic planning and access to American technology. The result of such an alliance, it was anticipated, would be to guarantee a major role in the reorganization of the European balance.

More important than this, I contend, was the central place of the atomic bomb in the British strategy for dealing with the Soviet Union in the European context. The belief that Russian intentions in Europe had to be countered as the major object of British strategy gave the British atomic bomb programme its underlying rationale. The British doctrine of strategic air power provided the military framework of the strategy.

1. Andrew Pierre, Nuclear Politics, page 74.

2. Air strategy

The bomber was the only vehicle that could deliver the atomic device. This fact alone brought into focus the strategic lessons of the Second World War, and enabled the advocates of British air power orthodoxy to argue that the bomber had achieved its ultimate fulfilment. The essence of this argument came increasingly to involve the ability of the bomber to strike at distant targets - that is its offensive capability. Other considerations such as independent strategic operation, the over flight of enemy surface forces and the emphasis on economic destruction were still important, but after 1945 they became secondary to the cardinal strategy of the offensive.

"Offensive action is the necessary forerunner of victory. Until the initiative is seized and the offensive taken, victory is impossible.

An air force cannot hold. Tactically, its operations can only be offensive. Even when the aim is defensive, such as that of fighter escorts to bomber formations, the protection of shipping against submarine attack, or the defence of the United Kingdom, it will almost invariably achieved best by audacious offensive tactics. In the early stages of any war the Royal Air Force is almost certain to find itself upon the strategic defensive. But the aim must be at the earliest possible moment to wrest the initiative from the enemy, and to this end an offensive policy is essential, even when the means are apparently still inadequate."

The formulation of this concept as the centrepiece of British post-war strategy depended on three closely allied factors. It had been proved, to the satisfaction of the Royal Air Force, that during the Second World War the bomber offensive was the only means available to Britain to take the war to the enemy. This was not merely a gesture, but a method by which the course of the war with Germany had been decisively swung in the favour of the allies. Air power doctrine was not dogmatically opposed to the use of air forces in supportive or home defence roles (Lord Tedder makes this clear in his lectures Air Power in War) but it was emphatic that these were secondary roles in any major war. The emergence, so soon after the defeat of Germany, of the Soviet Union as the enemy against which it was necessary to prepare war plans, reinforced the validity of the air offensive concept because there was no other way then thought feasible to reach a decision against that country. For example, Sir John Slessor, in a paper he sent to Basil Liddell Hart at the end of 1947, (at

1. Royal Air Force War Manual, part 1 Operations. Air Ministry AP1300, January 1950. Paragraphs 13, 14: page 15.

which time Sir John had just become Commandant of the Imperial Defence College) wrote:

"It is inconceivable on any realistic basis of strategy that a Field Army on traditional lines could possibly be used against Russia. Does anyone seriously imagine that we are going to defeat Russian armies in Western Europe, or invade Russia, with 3 or 13 or 30 corps of the Territorial Army?"¹

Sir John goes on to draw the inevitable Air Force conclusion to the problem of dealing with a power like Russia.

"But until that day comes [replacement of the manned aircraft by the robot weapon and the push button] our primary aim must be the Air Force which alone can produce the counter offensive capable of overcoming Russia's inaccessibility and the only form of visible strength which is the least likely to deter Russia from aggression; and which must be the main agent of our survival in the event of war."²

The emphasis in British air power doctrine, from its origins, had been the power of the offensive based on the bomber. With the practical experience of the campaign over Germany to support this emphasis after 1945 it is likely that it would have remained a cardinal feature in theory in any event. But the emergence of a strategic target such as Russia, thousands of miles distant from British bases and containing a vastly spread network of vital centres, imposed harsh conditions on any offensive plan even though it gave the air offensive concept a new operational validity. The atomic bomb was the solution to the dilemma posed by the problem of how to concentrate force against Russia.

Thus air power and atomic power was a 'natural' synthesis, in the circumstances Britain faced from 1947. The only available delivery system for atomic weapons was the bomber, and the chief means by which the bomber could succeed in an offensive against such a target as Russia was by deploying the atomic bomb.

The importance of the atomic bomb for the practice of British bomber doctrine after the war went beyond this strategic implication however. The creation of a mass bomber fleet, which in 1941 had been stated as a prerequisite for a successful offensive, became a redundant requirement with the enormously enhanced power of concentration afforded by atomic

1. Sir John Slessor, Paper entitled What would you do if you were appointed Supreme Commander British Armed Forces with the directive (a) to prevent war with Russia and (b) to be prepared to fight it if it comes in five to ten years time?, 6th September 1947, paragraph 7 (b). In Liddell Hart papers, Slessor correspondence file 1/644/unnumbered.
2. *ibid.* paragraph 7 (d).

weapons. This was most propitious, because the construction and operation of even 1000 bombers of the modern post-war type was clearly beyond the resources of Britain. The opportunity to prepare for a campaign using atomic bombs enabled the Air Staff to state a requirement of a bomber fleet of only 240 modern aircraft and yet retain a rational framework for strategic policy.

"The main characteristic of this [atomic] bomb is of course its great concentration of explosive power for small weight. This means that a small number of aircraft - provided always that they can get through to the target will be able to produce the equivalent effect of a very large number of our conventional H.E. bombers. Superficially it might be argued that if we are to depend primarily on the effects of atomic bombing, we need provide only a small specialised strategic bombing force."

This line of reasoning did create an underlying penalty. It would mean that Bomber Command in future was committed to a single all pervasive strategic task, the delivery of atomic bombs during a major war. In the short run this did not present a serious difficulty because such a task represented the ultimate strategic mission but in the long run it imposed an inflexibility on the force, and on the concept of a bomber offensive which depended on the capability of bombers to survive the early stages of a war. The lack of reserves, and the requirement of the force to maintain a readiness for a single all important role was in fact eventually to limit its value to British strategy. But after the War this disadvantage was not perceived. The Air Staff was committed to the preservation of the manned bomber and now was given the opportunity to make a sound case for its future.

Belief in the bomber went deeper: it represented the deepest orthodoxy of the air force and formed the basis of what can be described as a 'Bomber School'. There was thus a crucial influence at the heart of British strategy that, although it drew strength from the factors discussed above, depended as well on the outlook of the airmen themselves. Air Chief Marshal Sir Kenneth Cross puts the position succinctly:

"My recollection is that every airman as soon as he began to think about the application of air power, came to the conclusion that attacking the enemy at source was by far the most sensible way of doing things. In that sense the whole thinking air force was a 'bomber school'."

1. Air Chief Marshal Sir Norman Bottomley, Lecture to the Army Staff College Camberley, no date (but 1946 or 1947, while he was still Commander-in-Chief, Bomber Command) Bottomley Papers AC71/2/78.

2. Air Chief Marshal Sir Kenneth Cross, letter to Mark Venables, 18th June 1984.

This approach to air power, the pivot of British post-war strategy makes the question of air defence appear to be a secondary one, although as we have seen the political and scientific emphasis given to air defence at least suggests the existence of a contradiction. In fact the basis of British security was never allowed to rest solely on the strategic air offensive during this early period.

"The decisive expression of air power is the long range atomic bomber. The bomber offensive is the primary agent of air mastery. It is a vital element in the air defence of this country. We must have our fighters for close defensive. But more than ever, in any future war we must also reduce the scale of attack at its source."

In one sense then, the notion that the RAF was Britain's 'first line of defence' depended on the established concept that the strategic offensive would defeat the enemy's own offensive initiatives and force him back onto the defensive in the air by attacking his home base. But for the government faced by the prospect of atomic bombardment of Britain, this was not enough. Concurrently with the articulation of an offensive air strategy employing atomic bombs, the strategy of air defence was actively pushed forward. The development of air defence against Russia was credible while the threat came solely from bombers, even if armed with atomic weapons. Until such time as long range rockets became viable, the notion that there could be no air defence would not be recognized by the government. The expansion of fighter squadrons during the Berlin crisis of 1948 and at the start of the Korean War (thought to be a prelude to Russian invasion of Western Europe) demonstrates the measure of the government's determination to maintain an alternative air strategy.

Arising from the pressures for feasible offensive and defensive strategies, the notion of deterrence based on atomic bombers rapidly took shape. British strategic planning in this period did not shrink from the intention to use atomic weapons in a conflict, primarily with the purpose of delivering a devastating attack on the Soviet Union before it could exploit British vulnerability, but also in the expectation that Russia's offensive forces would be unable to survive both a strategic attack and the attempt to penetrate British air defences. But an additional level of defence was envisaged in the ability to threaten a bomber strike. Thus the strategic offensive assumed a dual role; in which that of deterrence was to become paramount.

1. Marshal of the Royal Air Force Sir John Slessor, The Place of the Bomber in British Strategy, paragraphs 4 and 6, Air Ministry pamphlet 317, 31st December 1952.

3. The atomic bomber fleet and global influence through deterrence

The primary rationale for the V-bombers was the intention that they be used in a European war against the Soviet Union. As the problem of the air defence of Great Britain became more acute they came to be seen as a force of defence through deterrence. In post-war strategy this was a dual capability which did not contradict the Air Staff's basic vision of the bomber offensive, but as the centrality of the deterrent function began to be emphasized, so it became tempting to think that the V-bombers might be able to exercise a wider global influence by virtue of their deployment. The need to create a permanent fleet-in-being, and the incentive to invest in it wider implications, overlapped with the strategic role of the navy, which was anyway subject to a re-evaluation.

Naval power had been exercised at three levels: (a) protection of the lines of sea communication, both for the seaborne supply of materials to Britain and for imperial security; (b) the direct protection of the British Isles from invasion and; (c) the deterrent effect of the gun armed battleship. In September 1939 the chief strategic concept guiding the British government in its plans for war was naval power based on these three functions. Their first act was to mobilise the Home Fleet, alert the Mediterranean and Far Eastern Fleets and prepare to strengthen the Home Fleet at the expense of the others if necessary. The change in the relationship of power between the air force and the navy that occurred between 1939 and 1945 meant that air power usurped the place of sea power at the centre of British strategy. Sir John Slessor was not being entirely partisan when he said: "For a century before 1914 the Pax Britannica rested squarely on the British Fleet. Then came 35 years of grey twilight when there was nothing to take the place of our sea power. Today I believe the Pax Atlantica depends as surely and probably more permanently on Anglo-American air power, of which the decisive expression is the long range atomic bomber."¹

The most important reason for this change lay in the decline of the deterrent power of the battleship fleet. Deterrence exercised by the fleet took two forms of denial; (1) The exercise of blockade and (2) the denial of the free use of sea power to the enemy. Blockade is a

1. Sir John Slessor 'The place of the bomber in British policy'. Address to The Royal Institute of International Affairs, March 1953, printed in The Great Deterrent, page 123.

traditional expression of sea power and can be an effective form of deterrent to a power dependent on supply by sea. However, against a Continental power such as Germany, it would only take effect slowly, and, given Hitler's Continental conception of expansion, could not in practice be an effective deterrent. Furthermore, blockade could be exercised by a variety of naval (or even air) forces - the German submarine campaign is an obvious example. In fact, the British blockade depended on a picket force of small ships, to patrol, intercept and search - battleships had no part in the mechanics of blockade although, as enforcers, they were vital to it.

Far more significant than blockade was ability to prevent the enemy making any positive use of the sea in pursuit of his global military objectives. It is this feature which must be regarded as essential to the deterrent effect of the battleship. Thus, except in enclosed waters, Germany could never move troops or supplies by sea, initiate strategic maritime movements, or influence third parties with which it did not have a common land frontier. These effects were achieved by the existence of the British battle fleets, principally the Home Fleet based on Scapa Flow, which depended on battleships for its power to sink the surface vessels of the enemy. The credible fleet-in-being was enough to achieve this deterrent outcome, although of course the fleet had to be prepared at all times to enforce the deterrent threat by being willing to engage in the climactic battleship action which was the highest aim of naval strategy.

During the war, both of these means of sea power deterrence were overtaken by the exercise of air power. The parallel between naval blockade and strategic bombing as approaches to economic destruction of the enemy is obvious. Air power theorists could point to a number of advantages - a more direct application and a more discriminating technique of 'closing down' sections of the enemy economy; and a far more speedy method of producing results. In addition, the battleship was shown to be a vulnerable target to air strikes, and could no longer perform the second deterrent function with any degree of security. Finally, in considering Russia as an enemy, that country seemed immune to naval pressure of the kind that Britain had exercised - perhaps any kind of naval pressure.

"7.(a) The Navy:- Must be absolutely confined to those forces which would be necessary to counter Russian naval action against our vital

sea communications - and that means anti-submarine forces alone - it by no means follows that the result would be a smaller navy; Russia does not care a damn about the sea. She is completely independent of sea-borne trade (or will be in five years); she cannot be attacked by sea or embarrassed by naval blockade; and she would be as unimpressed in peace by a show of naval power as an African elephant would be by a whale. So we must confine ourselves to ensuring that Russia cannot strangle us by cutting our sea supply."¹

The adjustment of naval roles went through two phases between 1945 and 1952. During the first phase, lasting until about 1950, naval war planning concentrated on the defence of sea communications and commerce protection.

"The planned strength of the war fleet for 1957 is based upon the estimated threat to the control of our sea communications at that date. The major threat comes from submarines, mines and aircraft, but surface raiders cannot be entirely discounted. In 1951 the nature of the threat will be similar to that estimated in 1957, but it differs in quantity and quality."²

A network of bases was retained to maintain a policing and support role by squadrons of light vessels of wartime vintage. Only six battleships were kept on the active list, and only one of these, the Vanguard, was modernised.

1. Sir John Slessor, Paper entitled What would you do if you were appointed Supreme Commander British Armed Forces with the directive (a) to prevent war with Russia and (b) to be prepared to fight it if it comes in five to ten years time?, 6th September 1947, paragraph 7 (a). In Liddell Hart papers, Slessor correspondence file 1/644/unnumbered.

"The primary function of the navy is the control of sea communications. This means:- (a) the safe movement by sea of our trade and munitions of war and of our armed forces and their supplies; this involves the destruction of such enemy naval or air forces as may threaten our sea routes. (b) Denying the use of the sea to the enemy by sinking his merchant shipping and troop transport at sea, and destroying the naval and air forces that escort or cover them. The first of these is vital. The importance of the second will vary with the nature of the enemy, and, in a war against a great self-contained land power, is unlikely to be significant." (Royal Air Force War Manual, part 1 Operations. Air Ministry AP1300, January 1950. Paragraph 7: pages 7-8.)

2. Report by the Chiefs of Staff on Ability of the Armed Forces to Meet an Emergency, paragraph 4. Cabinet Defence Committee, DO(50)58, 21 July 1950. PRO - CAB 131/9. The mention of surface raiders is a reference to the construction by the Russians of the Sverdlov class of cruisers, the first of which was launched in 1951. (These cruisers did not operate on the high seas until 1954.)

"It is known that all [Russian] major ships are fully manned and none are in reserve. It is also known that five new heavy cruisers have been completed in the course of the last 18 months, and there is evidence that the expansion in destroyers and submarines has been on a similar scale." (Ibid. paragraph 10)

"The First Lord of the Admiralty said that the naval construction programme was primarily directed against the underwater menace. It would be wasteful to stop at this stage the construction of two aircraft carriers and six destroyers and it was impossible to contemplate a cruiser strength of less than the 18 proposed." (The Provision for Naval Equipment, Cabinet Defence Committee, DO(49) 22nd meeting, 25 November 1949. PRO - CAB 131/2.

"'During the actual building of the Vanguard a new conception of the use of capital ships had come into being. No longer was the idea of a battleship fighting in line of battle considered to be its primary task But their primary duty now was as heavy anti-aircraft vessels, carrying a formidable armament for use against enemy aircraft attacking the carriers It was this conception which resulted in the 9th Vanguard becoming the most powerful anti-aircraft ship afloat.' Post-war the Vanguard, like the older battleships, never carried out any active service duties and all were regarded as obsolete."¹

The aircraft carrier was a key component in the Admiralty's post-war planning. It was supposed to contribute to the defence of sea communications and commerce protection by using its aircraft in an anti-submarine role, and by providing air cover for convoys and their escorting fleets. But the carrier was also conceived of as a replacement for the battleship, thus becoming the new generation of capital vessels. While the Navy confined the conception of its post-war air function to the operation of light carriers for the air defence of surface forces, convoys and for anti-submarine operations, there could not be and were no objections from the RAF on strategic grounds. However, the question of the strategic role of the Navy was not closed - in 1950 the Navy began to press for a renewed strategic mission deploying strike aircraft from the heavy, armoured fleet carriers. In 1946 the Royal Navy was operating six Illustrious class armoured fleet carriers and five Colossus class light fleet carriers. Although the Illustrious class carriers could be used in anti-submarine and air defence roles, the Navy wished to modernise them so that they could continue to fulfil their designed purpose of flying bomber strikes against enemy surface vessels, and targets on enemy territory.

"This led to a major dispute within the Chiefs of Staff Committee, as the other services were sceptical of the utility and effectiveness of large fleet carriers in a future war and saw little point in either expensive modernisation or new construction. Inherent in the Chiefs of Staff dispute was the discrepancy which seemed to exist between the characteristics of the Navy's existing carriers and the argument which was being used to justify their continued existence. The Admiralty are alleged to have regarded the large carrier as the successor to the battleship in the role of the capital ship of the fleet, and to have been unable to conceive of a fleet that was not built around large capital ships."²

1. John Simpson and Frank Gregory, 'The Evolution of British Naval Equipment, 1945-1970' in Gregory F. et al, Perspectives Upon British Defence Policy 1945-1970, page 244. The internal quote is from Kemp P.K. Nine Vanguards, Hutchinson, 1951, page 197.

2. Ibid. page 220.

The Air Staff's antagonism towards heavy fleet carriers owed much to the share of the defence budget that they would take up. But the central reason lay in the claim for a strategic air power role for the Navy which heavy carriers underpinned. This claim was pursued by the Admiralty when the RAF's own strategic capability was at its weakest, challenging not only the prospects for the RAF's sole possession of a strategic bombing force, and the continuation of the V-bomber programme, but also rekindling the pre-war arguments about the divided control of air power.¹ In the 1950 report on the Ability of the Armed Forces to Meet an Emergency the Navy is actually assigned a strategic air role. "C. To provide seaborne tactical air support when shore-based air support is not available or adequate. D. To assist the RAF with strategic air offensive if so required."² In a report on the Defence Programme in 1952 naval aviation is expected to attack strategic land targets. "15 E. Attack the maritime threat at its source, i.e.: the enemy mine-laying forces, U-Boats, and surface forces in their harbours and bases, where this is best performed by naval forces, including submarines and naval aircraft."³

1. "The philosophical controversy had a more general significance, mirroring fundamental differences in the way that Britain's strategic problems were perceived and dealt with. Obscure debates, such as that over the bomb and the battleship, were significant not just for their immediate practical consequences, but also because they were the chief expression of the struggle for priority between the air force and the navy in the defence of Britain and her empire. The allocation of defence resources depended directly on the outcome of the struggle." (Geoffrey Till, Air Power and the Royal Navy, 1914-1945, page 195.)

2. DO(50)58, 21 July 1950. PRO - CAB 131/9.

3. Chiefs of Staff to the Cabinet Defence Committee, D(52)41, 29 September 1952. PRO - CAB 131/12.

See also: Use of Aircraft Carriers in Strategic Air Offensive; Chief of the Air Staff Papers, AIR8/1792. 1948-1949.

Sir John Slessor's argument against the aircraft carrier is a forceful summary of the RAF's view - "If further economies must be found in defence expenditure, it is impossible to resist the conclusion that they must and can be found in the sea service. We merely confuse the issue by ex cathedra pronouncements like 'it is important that at all time a carrier striking force, well equipped and fully worked up, should be available to the British home fleet'. Why? What would that striking force be required for in war? We must ask ourselves first whether the impact of the aircraft carrier upon our only imaginable enemies in a future great war is likely to justify the cost involved and whether there is any vital interest of our own that can only be secured by the aircraft carrier." (Sir John Slessor, Strategy for the West, page 86.)

Between 1950 and 1956 the Admiralty aspired to a nuclear strike role in a general war. Whatever the realistic strategic merits of such an aspiration, the Navy was not able to acquire an adequate carrier force nor suitable types of carrier aircraft to carry out the role. The theory of a 'broken-backed' war, in which the role of a naval strike force would be of strategic importance, did not replace the air force view that the opening phase of a major war would be decisive. Thus, in the end, the Navy's rearguard carrier case did not recapture a share in Bomber Command's strategic mission. However, whether this meant that the long-range land-based bomber actually did inherit the global role of the British battle fleet is at best amenable to a theoretical answer because, by 1957, the notion of truly global dimensions to British military power had become hypothetical. Clearly, the case for this translation was put by the RAF, and countered by the Royal Navy. Judged by the allocation of defence resources, the RAF won the argument. But the global influence of the British nuclear deterrent force was not to be tested in the way that the British battle fleet was, and it has to be concluded that the fullest extent of the influence of British nuclear deterrence lay within the European orbit.

Chapter 7

Nuclear deterrence

The theory of nuclear deterrence, although founded on a small set of seemingly immutable principles, has become a remarkably complicated system of theoretical abstraction and practical preparations¹. From the earliest articulation of this radical theory of military strategy, theoretical analysis and hypothetical 'scenarios' have often leapt ahead of the concrete capabilities for the simple reason that the strategy has always had, as its first premise, the notion that the highest aim of strategy is to prevent, to deter, the outbreak of war involving the use of atomic and hydrogen weapons. According to Margaret Gowing,

"It had become [by the summer of 1947] a major tenet of faith among the Chiefs-of-Staff and Ministers alike that the United Kingdom was particularly vulnerable to attack with atomic bombs, rocket and biological weapons, that a third major war would be utterly disastrous, and that the supreme object of British policy must be to prevent war, in particular by deterring aggression which might lead to war."²

It is because of this central premise that the creation and deployment of nuclear forces took on as much significance as the employment of those forces in a conflict - for the existence of a force-in-being is the basis on which the threat of attack is made explicit to a potential enemy. The theory then inevitably looks forward to the elaboration of deterrent techniques, as well as considering current strategies of use and threatened use. It is true that willingness to employ the deterrent forces, and the expectation that they might have to be used in hostilities - involving questions of how early in a conflict they should be used, and in response to what degree of provocation, are also matters integral to deterrence strategy. The assumption that deterrent forces would have a high utility during hostilities as well as before them was implicit in early British thinking on the matter.

1. I consider the best treatment of it to be by Patrick M. Morgan in Deterrence: A Conceptual Analysis. But see also: Philip Green, Deadly Logic: The Theory of Nuclear Deterrence; Thomas C. Schelling, The Strategy of Conflict; Andre Beaufre, Deterrence and Strategy; William W. Kaufmann, The McNamara Strategy; J. David Singer, Deterrence, Arms Control and Disarmament; Glenn Snyder, Deterrence and Defence: Towards a Theory of National Security; Herman Kahn, On Thermonuclear War.

2. Margaret Gowing Independence and Deterrence Vol. 1, page 187.

"I think the aims of British strategic policy can be defined thus - in conjunction with the United States and other like-minded people, to prevent war with Russia, if that is possible, without sacrificing our honour and vital interests; and, if war cannot be prevented, to win it as quickly as possible. That perhaps is rather obvious and over-simplified. I must say a little more on the point about preventing war. It is largely a political problem But in this respect - as always - political policy has a very direct bearing on strategic policy, and the British Government has laid down a priority between the services which, while designed to give us the sort of forces we should need if war were forced upon us, is fortunately also the most appropriate to our policy of preventing war. Our policy is to give first priority to that form of force which affords the most obvious deterrent to attack by Russia."¹

Because of the central premise, the development of nuclear deterrence is as much a philosophical and intellectual exercise as it is a preparation of actual military capability. In fact, these two strands constantly interact to form an uneven and complex historical progression. On the one hand, an intellectual process is carried on in which an existing or future force structure is conceived so as to present the most convincing threat, and to allow of the most effective attack on the enemy should war begin. On the other hand the quality of scientific advance, bureaucratic procedure and military strategy is influenced by a wide range of factors outside the theoretical orbit. Thus the premium on preparation, that is, on the deployment of the deterrent forces, has compelled a huge and impressive intellectual effort, not only in devising the original system, but also in expanding and updating it. The strategic reasoning and the mechanisms which support the resultant system, have given rise to an increasingly impenetrable web of theory and practice.

The first point, then, to emphasize about the genesis of nuclear deterrence, is its theoretical nature, which at times has borne only tenuous connection with the reality of the forces available. An analysis of the elaboration of nuclear deterrence theory in Britain has to be pieced together from a variety of sources - the theory did not emerge fully formed, neither was there an intellectual vacuum during which all clarity of thought was absent. Not only was the central premise quickly articulated - there were a number of determining influences which shaped the scale of the problem in men's minds. The significance of recognizing

1. Sir John Slessor, 'Some British Strategic Problems', Lecture at the United States National War College, Washington, April 1948; reprinted in The Great Deterrent page 76.

The Statement Relating to Defence, February 1947, Command 7042, says - 'The supreme object of British policy must be to prevent war. The role of our forces must therefore be to deter aggression while at the same time safeguarding British interests against attack.'

the theoretical and speculative origins of the strategy based on the concept of aiming primarily to prevent war lies in the perspective that this gives to the period between the conceptualization of the approach and its realization in the form of the V-bomber force. The first British atomic bomb was detonated on board HMS Plym, anchored amongst the Monte Bello Islands 50 miles north west of the state of Western Australia, on the 3rd October 1952. The exercise was known as 'Operation Hurricane'. Bomber Command's first operational V-bomber squadron, flying Valiants (no. 138 at RAF Wittering, with six aircraft) came into service in July 1955, but was not then armed with atomic bombs. The first British operational atomic bomb was tested by air dropping at Maralinga in the Great Victoria Desert of South Australia on 11th October 1956. This exercise was known as 'Operation Buffalo'. The date of the British acquisition of a credible deterrent force can therefore be put at 1957.

This gap of a decade between the issuing of the operational requirements (in the summer of 1946) for new bombers and the atomic bomb should not therefore be viewed as a bar to the coherent development of theory nor as a period of vacuous speculative exposition. Not only did considerable effort go into post-war planning, there were also a number of pressing defence requirements which seemed to invoke the inevitability of a deterrent system. Margaret Gowing identifies at least six Chiefs-of-Staff's reviews of strategy (between 1945-1952) in which the theory of, and requirements for, nuclear deterrence were evolved.¹ Thus although

1. Margaret Gowing Independence and Deterrence, vol. 1.

"In October [1945] the Chiefs-of-Staff said emphatically that the best method of defence against the new weapons was likely to be the deterrent effect that the possession of the means of retaliation would have on a potential aggressor" (page 164).

New Year's Day 1946 (page 169); July 1946 (page 174); January and June 1947 (page 186); end of 1947: "Moreover the Chiefs-of-Staff apparatus had begun to think in more detailed terms about why they wanted atomic bombs and how many they wanted. Towards the end of 1947 it had been recognized that the atomic programme must now be related to specific and quantitative requirements from the Chiefs-of-Staff rather than to a general belief in deterrence. 'We believe' the Chiefs-of-Staff had said, 'the knowledge that we possessed weapons of mass destruction and were prepared to use them would be the most effective deterrent to war itself.'" (pages 214 and 215).

Early 1950 (page 231) (This reference is to Plan Galloper, DO(50)34, March 1950; retained in the Department under Sec. 3(4) of the Act. The memorandum on Ability of the Armed Forces to Meet an Emergency, DO(50)58, July 1950 is based on Plan Galloper and gives a clear indication of that Plan's contents.); 1951 'Report on Military Aspects of Atomic Energy' (page 437); Summer 1952, Chiefs-of-Staff Global Strategy Paper (page 440). She quite naturally concentrates on the aspects of these reviews pertaining to the numbers of atomic bombs the Chiefs required, and at what date they wanted them available for military operations.

there is an understandable temptation, based on reasonable analytical grounds, to regard the Global Strategy Paper of 1952¹ and Dulles's Massive Retaliation formulation of 1954 as the mainsprings of nuclear deterrence theory, such an approach runs the risk of giving undue emphasis to the later strategic and technical considerations and neglecting the earlier influence of doctrine and military imperatives that were a vital part of the British conception. This type of error is to be found in Andrew Pierre's evaluation.

"The concept of the independent British nuclear deterrent was born in the early 1950s and was to remain at the centre of the defence policies of successive governments for over a decade. Its genesis was due to a number of economic and strategic considerations in 1951-1954 which led the Churchill government to increase its reliance on nuclear weapons. Out of the Korean rearmament experience, the conclusion was drawn that the continuation of large, balanced, and well-equipped conventional forces was not compatible with the requirements of a healthy economy, a sound trade position, and the maintenance of an adequate level of social welfare in the British Isles. Furthermore, it was not certain that in the evolving patterns of warfare the West needed to match the Communist's bloc in every category of military armaments. Churchill became convinced of the need for a 'new assessment'. He directed the three British Chiefs-of-Staff in the spring of 1952 to make a fundamental strategic review taking into account the state of the economy, the role of nuclear weapons and the NATO force goals of 96 divisions which had been unrealistically set that February at the Lisbon meeting."²

While it is probably true that nuclear deterrence came to represent, for a country like Britain, an economical (that is: cheap) alternative to large conventional forces, the atomic bomb programme was not, in the

1. This famous Chiefs of Staff paper is Report on Defence Policy and Global Strategy, Cabinet Defence Committee, D(52)26, 17 June 1952. PRO - CAB 131/12. This copy is closed until 2003. Another copy is in the Chiefs of Staff Memoranda, 1947-1952, COS(52)362, 15 July 1952. PRO - DEFE 5(40). This copy has been retained in the MOD under Sec. 3(4) of the Act. Reference to the Report is contained in The Defence Programme D(52)41, 29 September 1952. PRO - CAB 131/12. D(52)41 gives some indication of the thinking contained in the Report on Defence Policy and Global Strategy.

2. Andrew Pierre Nuclear Politics, pages 86 and 87. This is not to say that Pierre's argument is entirely fallacious. There is evidence in the Cabinet Defence Committee papers on the Shape and Size of the Armed Forces, and in the Chiefs of Staff Committee papers that from 1952 the wish to economise on the £4700 million programme of January 1951 led to an increasing emphasis on nuclear deterrence. It is incorrect, however, to situate the genesis of the concept of the independent British nuclear deterrent at that time. Furthermore, the suggestion that the Defence Policy and Global Strategy Report of June 1952 contained a sharp departure from earlier thinking seems to me to be misleading. Rather it was an important consolidation of earlier themes. Richard Gott (International Affairs, April 1963) makes an earlier statement of Pierre's view.

1940s, accorded the priority that it was in order to economise on military spending. On the contrary, the eventual costs were dimly perceived, and the decision to deny resources for other weapons and to limit the services' budgets in order to produce atomic weapons were taken (always accepting the principal policy requirement to cut post-war military spending) for strategic reasons. The first of these revolved around a different type of economy - the economy of force promised by atomic weapons. From the Air Staff's point of view, if the conception of strategic air power that in the Second World War had generated the requirement for a 4000 strong bomber force was to be translated into a post-war reality, the concentration of force that would be permitted by the atomic bomb was an essential strategic requirement. It was on the basis of an appreciation of the destructive power of atomic weapons (demonstrated at Hiroshima and Nagasaki), and the expectation that Britain would acquire these weapons, that the Air Staff stated its requirements in 1946.

The according of such a high priority, in resources and production span, to atomic weapons derived also from the view that the army and the navy had become secondary to the air force as guarantors of British security in the face of a power such as the Soviet Union. This was acknowledged policy by 1948 at the latest. It was by then believed that only Bomber Command could effectively influence the course of a war with the Soviet Union, and was therefore the primary arm of British strategy. This belief was due not only to the influence of air power doctrine after the war, but also to the inaccessibility of Russia to other arms, and the preponderance of conventional force assumed to be maintained by that country. The decision to discriminate against army and navy spending and force levels was in fact an early feature of British policy.

What was lacking in the early British articulation of nuclear deterrence theory was a detailed plan of how to attack the Soviet Union, which were the vital targets, and how the Soviet economy and military capacity would stand up to a strategic air offensive.

"Until 1951 there had been very little serious study of the military implications of atomic weapons or their future development. Until then military calculations had taken account only of the British atomic bomb as a deterrent which, by threatening unacceptable damage, would prevent enemy attacks. As we have seen, because of ignorance about the American strategic air plan, even the military calculations surrounding the productions of the first bombs were very rough and ready."¹

1. Margaret Gowing, Independence and Deterrence, Vol. 1, page 437.

In this sense it is possible to say that the early British concept of deterrence was a purely theoretical construct. The lack of an atomic stockpile and of the means to deliver atomic bombs to Russian targets meant that there was not the spur to practical planning that there was in the United States. There was no immediate need for the British, in the 1940s to decide in what circumstances they would launch a nuclear strike, nor at which targets. This was compounded by inadequate intelligence facilities and a primitive knowledge of the economic and military infrastructure of the Soviet Union. From the time of the basing of United States Strategic Air Command bombers in Britain during the summer of 1948 (which was part of the renewed military relationship with the United States engendered by the Berlin crisis) the Chiefs-of-Staff sought to remedy their lack of information by gaining access to American plans. It was argued by them that, although the B29s were not in fact armed with atomic bombs, the deployment by the United States of bombers from permanent bases in Britain (long term stationing was agreed in 1949) meant that American nuclear strikes on Russia could be launched from Britain. Not only should the British government be informed before such actions, but the military should have access to the plans in order to be aware of what targets were to be hit and to determine their own plans in order to avoid duplication. The details were not given, and the best that Britain could achieve was a verbal agreement to consult before atomic bombers were launched from British bases. Thus, at least until 1954, there was no question of Britain acquiring planning data from the United States, nor of influencing the atomic plans and decisions of America except in the limited sense of trying to persuade Washington not to use them in a given situation.

There were, however, mechanisms for preparing the 1948 equivalent of the Western Air Plans. In the Air Staff this was the responsibility of the Policy and Intelligence Departments.¹ The Director of Plans (a member of the Policy Department) spent most of his time working with the Joint Planning Staff (a Chiefs-of-Staff sub-committee) preparing joint plans on interservice strategic matters. It was this organization which drew up a yearly review (Shape and Size) of the forces needed for the missions laid

1. In the PRO Class AIR 9 contains the Director of Plans files, 1939-1947. With a few minor exceptions, the documents cover only the period to the end of 1945. AIR 40 contains the Directorate of Intelligence and other Intelligence papers, 1926-1958. The bulk of these papers cover the war period. The documents for 1945-1958 have been carefully 'weeded' and are of very little value.

down.¹ According to Air Commodore Cozens (who was Director, Plans, July 1949 - January 1951), although the planning was somewhat crude, the RAF did have actual plans for the dropping of atomic bombs on Russia.² Lack of very detailed planning cannot really be used as a case in support of the argument that British thinking on nuclear deterrence was non-existent or grossly deficient. The United States Air Force from 1945 always possessed an atomic capability, albeit a very limited one at first, but for some years based its thinking also on a crude concept of nuclear deterrence and a simple vision of the strategic bomber offensive.

"For two years after Nagasaki, the JCS did not collectively or formally review or approve any plan contemplating the use of atomic bombs, although joint and service war planners (who did not receive specific clearance for nuclear weapons information until early 1947) were generally convinced that the nation would be forced to employ its atomic arsenal in any major confrontation with the Soviet Union. The first operationally oriented atomic target list was prepared in the summer of 1947, and incorporated into Joint Outline Emergency War Plan

1. The Joint Intelligence Committee (of the Chiefs of Staff Committee) papers are not consolidated in the Public Record Office (PRO). The staff at the PRO believe that this is because they are not available to researchers. The reports of the Joint Planning Staff, 1947-1952 are listed in the PRO as contained in DEFE 6 - a class of Chiefs of Staff Committee papers. Class DEFE 6 is a continuation of the wartime class CAB 84 (the War Cabinet Joint Planning Committee, 1939-1947). Class CAB 119 is listed as containing the Joint Planning Staff files, 1939-1948. Papers showing the existence of strategic war planning by the Chiefs of Staff and the Cabinet Defence Committee have been eradicated from the public record. Fortunately, some evidence has been overlooked by the 'weeder' - such as contents lists, internal references and footnotes in other documents, attendance lists, and reasons given to justify the attendance of people not usually at the committee meetings. Thus it is possible to know of the existence of such (closed) documents as: DO(50)101, note by the COS with Report by JIC - Summary of Military and Economic Strength of the Soviet Union at 1 September 1950; and DO(50)45, Global Strategy (June 1950?) (This paper was shown to the Americans.) It is also possible to infer that the Defence (Transitional) Committee was formed to undertake higher strategic planning and policy orientation. The first annual report of this Committee (closed) was discussed as item 2. at the Cabinet Defence Committee on 10 May 1950, DO(50) 8th meeting (PRO - CAB 131/8). (The record of this discussion is also closed.) If this inference is correct then I believe the report on Defence Policy and Global Strategy, June 1952, was a product of the ongoing work of the Defence (Transitional) Committee and did not spring de novo from an intensive weekend meeting of the Chiefs of Staff at the Greenwich Naval College, as has been fancifully suggested. In any case, evidence of the way in which military bureaucracies work, and the manner in which long-term planning is formulated, militate against a belief that the Global Strategy paper of June 1952 was anything other than the culmination of a long period of strategic policy and planning development.

2. Conversation between Air Commodore H.I. Cozens and Mark Venables, 1st August 1984.

BROILER that Fall. JCS war plans FROLIC and HALFMOON which followed BROILER placed heavy emphasis on a atomic air offensive."

1. The primacy of the offensive

Air power doctrine provided the earliest conceptual shape to the deterrence theory. Although it is undoubtedly true that the prospect of atomic bombs enhanced the RAF's case for the strategic utility of the bomber, the genesis of nuclear deterrence theory is to be found in the doctrine of offensive air power based on the bomber. This was not simply because atomic bombs were understood as obviously and inherently weapons of the attack, for which no direct defensive role could be envisaged, and for which the bomber was the only available delivery vehicle. The relationship between air power and atomic weapons depended more subtly upon the ascendancy of the case for strategic air power, and the military validity of the arguments about national security put by the Air Staff.

The pre-war argument about the independence of bomber operations (which had been as much a political as a military one) was superseded after 1945 by the view that air power had become the decisive element in warfare. Thus Lord Tedder could state (undoubtedly expressing not only the Air Staff consensus but the considered view of a majority in government and amongst the senior military leaders) that, although "In my view all three arms of defence are inevitably involved [in winning wars], though the correct balance between them may and will vary" - at the same time

1. David Alan Rosenberg 'The Origins of Overkill - Nuclear Weapons and American Strategy, 1945-1960' in International Security, Spring 1983, vol. 7, no. 4, page 12.

"From 1945 through 1948, the vaunted era of American nuclear monopoly, the nation's stockpile and delivery capability were extremely limited. There were only two weapons in the stockpile at the end of 1945, nine in July 1946, thirteen in July 1947, and 50 in July 1948. None of the weapons was assembled. They were all Mark 3 'Fat Man' implosion bombs, which weighed 10,000 pounds, were relatively inefficient in their use of fissionable material and took 39 men over two days to assemble. Because the bombs were so large and heavy, they could only be loaded on their bombers by installing a special hoist in a 12 foot by 14 foot by 8 foot deep pit, trundling the bomb into the pit, rolling the aircraft over it, and then hoisting the weapon into the specially modified bomb bay. Through 1948, there were only about 30 B29s in the Strategic Air Command modified to drop atomic bombs, all in the 509th Bomb Group based in Roswell, New Mexico." *ibid.* pp. 14-15.

"I am utterly convinced that the outstanding and vital lesson of this last war is that air power is the dominant factor in this modern world and that, though the methods of exercising it will change, it will remain the dominant factor so long as power determines the fate of nations I also believe that, in view of the inevitable dominance of air power, purely passive defence would be certain and painful suicide."¹

The importance of the bomber offensive was integral to this view of the dominance of air power. This fact only subsequently drew support from the invention of atomic bombs - the centrality of the bomber had been fundamental to pre-war British air power doctrine, and was held to have been established as the decisive weapon by the experience of the Second World War.

"I think there are few people who would not agree that air power, and particularly strategic air power, was decisive in the war against Germany, and indeed against Japan too. The outstanding enemy leaders who remain to testify, are unanimous in that opinion. I speak of economists, production chiefs and soldiers and sailors as well as airmen. It was decisive "²

The offensive essence of the bomber was to be elevated to the highest principle of modern warfare, and in conjunction with atomic bombs assumed the character of the quintessential weapons system of the future.

"The basic weapon of the Air Force is the bomber, and the basic strategy of air power must be offensive. The characteristic which distinguishes the striking arm of the Air Force from all other forms of force is ability to strike direct at objectives in the heart of an enemy country. With modern weapons of mass destruction this may be decisive in the sense that it may itself induce capitulation."³

In the post-war elaboration of air power doctrine, the primacy of the offensive subsumed both the strategic character of air power and the aim of economic destruction. The very nature of offensive intention accounted for the strategic quality of the force because the goal of the offensive was the economic devastation of the enemy economy. This then became the highest strategic objective, the object which conditioned all other approaches to major international conflict and the determinant of national strategy. The power of this case for an air offensive lay in its ability to produce a decision (in the circumstance of the contemporary military balance of forces and conditions of military

1. The Lord Tedder, Air Power in War, pages 88 and 123.

2. Air Chief Marshal Sir Norman Bottomley, Lecture to the Army Staff College Camberley, The Strategic Bomber Offensive during the War and its likely Future Development. No date, paragraph 60, page 17. Bottomley Papers. AC 71/2/78.

3. Royal Air Force War Manual, Air Ministry, January 1950, AP1300, pages 19 and 20.

technology and industrial resources that underpinned it) that did not depend upon the clash of opposing mass across a confined space. The struggle of prepared forces, opposed on land, remains most likely to result in an inconclusive and protracted 'clinch' until one side collapses from exhaustion. For the armies, the enormous advances in military technology by the end of the Second World War had not overturned the lessons of the First World War, in which the loss of strategic mobility had proved to be a decisive influence on the course of the fighting. The use of local mobility, of armour, and the increase in fire power had only magnified the dilemmas of attrition and mass rather than providing the key to the decisive land engagement. Many of the battles in Russia during 1942 and 1943, and the assault on German territory in 1944/45 demonstrated the continuance of the dilemma. Even an example like El Alamein, fought between grossly uneven armies, did not suggest that a solution was in sight. The strategic mobility that might have been provided by naval forces supporting combined operations landings on enemy coasts was subject to limitation by tactical air power.

The strategic and independent character of air power had, since Trenchard's time as the CAS, been deemed to rest on the ability of air forces to transcend the problem of opposing mass by penetrating enemy defences, either by evading them or fending them off by employing self-defending bomber formations. The strategic offensive over Germany had modified this approach, but had not negated it, in spite of some of the evidence that was being advanced by analysts of that campaign and by some branches of the military scientific effort. The tactics of evasion that had been established during the war were incorporated into the Air Staff's plans for the next generation of front-line bombers. In addition, the air force turned to advanced technology in order to counter the capability and growing comprehensiveness of modern defensive systems. Thus the correlation of air power mobility and flexibility with new technology was judged by the Air Staff to provide a continuing guarantee of the offensive. This is most notably demonstrated in the nature of the post-war operational requirements and the course of the research effort.

A further contribution to the ability to produce a decision lay in the power of the bomber offensive to strike at the enemy economy. This target was not only regarded as a profitable one, it was believed to be the most fundamental route to crippling the enemy's capability of waging

war on any front, and to destroying his will and means to continue the struggle. Again, in spite of mounting evidence to the contrary, this approach was held to have been vindicated by the Second World War. However, there were additional reasons for arguing this case in the circumstances after the war. As the industrial and technological base of the major nations self-evidently became more and more important to the fighting of modern war, so the destruction of it was judged to be increasingly decisive. Indeed, this evolution was deemed the more significant because the products of that base enhanced air power more than other types of military power. Bombers would be able to fly higher, faster and operate at greater ranges, armed with the most advanced weapon then available. Furthermore, the power of concentration afforded by atomic bombs held out the prospect of delivering a decisive blow to the enemy economy, creating such a condensed shock that the ability to recover might prove beyond reach. During the attack on Germany it had been recognized that the necessity to shift targets (both in time and geographically) had given the German planners vital pauses in which to reorganize production, and thus the full impact of bombing had not been realizable.

2. Visions of a future major war

These arguments conditioned the judgement of what course another major war would take. Although there were proponents of the long war theory (who tended to argue for a period of 'broken-backed' warfare after a very destructive opening phase) by 1952 the Chiefs of Staff view was that the outcome would be decided in weeks.

"We also recommend that the preparations for war should be primarily directed to requirements of the first few intense weeks, little provision being made for more long term requirements."

1. The Defence Programme, report by the Chiefs of Staff to the Cabinet Defence Committee, D(52)41, 29 September 1952. PRO - CAB 131/12. The assumption of a cataclysmic opening phase had been present in 1945 - "In any future war there seems every reason to suppose that, if major powers are involved, the opening phases may be so shattering in their effects as to dictate the final outcome." (Chiefs-of-Staff Committee, Memorandum on Central Direction of Scientific Effort, 7th November 1945. COS (45) 648 (O). PRO - CAB 80/98.) The idea of a 'broken-backed' period of warfare increased the relevance of the Navy's role in a future war, because the protection of sea communications was a long term operation. (See D(52)41.) The Royal Navy's role in support of the Middle East base also depended on the longer view, (see D(50)58 21 July 1950).

It seemed obvious that all major powers, once possessing a viable atomic strike force, would employ it during hostilities to attack the economic centres (in effect, the cities) of the enemy. The question of whether air strikes would be used at once, perhaps in the form of surprise attack, or whether they would be held in reserve for use after a more conventional offensive had run its course was a matter for debate - for Britain, the crucial fact seemed to be that the country could be 'knocked out' by a determined atomic attack with much more certainty than in the case of the Soviet Union or the United States. The early use of atomic bombardment was regarded as most likely, and the scale of the atomic attack on Britain at the beginning of a war was foreseen as devastating.

"This, like departmental war planning generally, is, on the advice of the Chiefs of Staff, related to a possible European war in 1957; and, on the basis of an expectation supplied by them, assumes that, in the event of war then, we must expect large-scale attack with weapons of mass destruction, and also, from the beginning, attack with high explosive and incendiary bombs on a possible initial scale of 30,000 to 40,000 tons a month (i.e.: three to four times the total tonnage dropped on this country by the Luftwaffe in the peak month of their attack in World War Two - September 1940)."¹

However, this type of prognosis depended also on an estimation of Soviet intentions and on the conditions prevailing when Russia acquired an atomic capability. Clearly, a second source for British calculation on what course another major war might take rested on the belief that the Soviet Union would be the enemy and almost certainly the aggressor. Russian intentions and the extent of Russian military objectives (to be achieved both with conventional and atomic forces) were built into war planning quite early, although the date of and reasons for the outbreak of hostilities were matters for speculation.

"The assumptions on which this plan has been based are summarized as follows. (a) The risk of war within the next five years is small and this risk must be accepted. Thereafter the risk will tend to grow until in 1957 the threat of war may become grave. This forecast is of necessity highly speculative and subject to modification in the light of events. (b) Owing to its fundamental importance the manpower requirements of the control and reporting organization will be met in full. (c) The scale and nature of attack is as assessed by the JIC [ref. 2 JIC(46) 95(0)]. 5. The scale and nature of attack. We can assume for the purpose of this plan that Russia is the only country likely to be a potential enemy in the foreseeable future."²

1. Civil Defence Expenditure over the next Four Years, Ministerial Committee on Civil Defence, CD(M) (50)12, 18 July 1950. PRO - CAB 131/9. "The initial attack against the United Kingdom is likely to be in the form of a heavy air bombardment which will start as soon as war is declared, or without warning." (Ability of the Armed Forces to Meet an Emergency, DO(50)58, 21 July 1950. PRO - CAB 131/9.

2. Sub-Committee for Air, Coast and Seaward Defences, Requirements for the Air Defence of the United Kingdom COS(ACS)(48)11, 6 April 1948. PRO - DEFE 2/1650.

The belief in the hostility of Russian policy, and the conviction that the next war would be fatal to Britain strengthened the case for a strategy of nuclear deterrence, and thus enhanced the place of the RAF in national strategy, reducing the role of the other forces. The utility of the traditional forces, at least in the European theatre, seemed to be solely for defensive measures, at best performing a check to a Russian advance which they could not hope to match in the long run.¹ The presumed preponderance of the Russian army in Europe was conditioned only by the strength and employment of Western air power. For example, Field Marshal Montgomery (in 1954) although arguing for the dominance of air power in future war, believed that this should be expressed in both strategic and tactical terms in order to ensure the viability of the land forces.

"The land-based air forces must always provide whatever offensive air support is needed in the war on land, using air forces that are highly trained in that particular work. But they must carry out this task without sacrificing their own flexibility. On occasions the whole of the available air power may have to be used to help to save the armies from destruction, and the air organization must provide for such a contingency arising at short notice."²

Although these words were spoken in a NATO context, their validity pertains also to the circumstances of European land war before 1949. Yet it remained inescapable for British strategy that the ultimate value of land forces in the next war, and the need for protection of seaborne supply, would depend on whether or not the war would in fact begin with atomic air strikes; on how well Britain could be defended from incoming bombers; and on how well British society could survive atomic attack. It seemed that the prospects were not good and that, whatever course a future major war using atomic weapons took in detail, it also seemed that the eventual outcome in Europe would be widespread ruin.

1. "We have since held discussions with the American Chiefs of Staff, at which our whole strategic thought was exposed and fully thrashed out. The American Chiefs of Staff are in general agreement with our views on the longer term. But they rate higher than we do the likelihood of war in the near future and regard 1954 as a dangerous year. They are not wedded to the longer term goals set at Lisbon, but they are insistent that every effort should be made to build up the largest possible land and air forces in Europe within the next two years. They think we have over estimated the effect of atomic air power on Russia in that period, though they are not unanimous on that point." (The Defence Programme, D(52)41, 29 September 1952. PRO - CAB 131/12.

2. Field Marshal Montgomery, 'A look through a window at World War III' in The Journal of the Royal United Service Institution, November 1954, vol. 99, no. 596, page 511.

"I think any other major war would almost inevitably mean the ruin of all Western Europe beyond recovery - and I'm afraid I can see very little chance of these islands emerging from such a war unruined. The trouble is surely that we have got to make up our minds one way or the other - are we going in for the modern weapons or are we going to stick to the old ones. We can't do both because we can't afford it; we can't have another 'phony war'; we can't say well, we'll hang on to the battleships and present type heavy bombers and armoured divisions just in case they may come in useful, but, of course, we'll have A.W., B.W., and C.W. in the pigeon-hole so to speak, to pull out when required. That seems to me one of the snags about your highly mobile 'fire brigade' for the 'land-check' role. It's going to be frightfully expensive."

3. Vulnerability and attrition

The British articulation of nuclear deterrence theory naturally stressed the particular vulnerability of Britain to atomic attack. Not only were the obvious targets few in number and concentrated, the British Isles possessed no geographical 'depth' either to absorb attack or spread an air defence system. British cities were much closer to potential Russian air bases, than were Russian cities to British air bases. Two immediate counterbalancing measures could be found in the option of basing strategic bombers in the Middle East, and ensuring that the Soviet Union could not gain access to bases further West, but these were minor palliatives and did not alter the essential fact of British vulnerability. What ideally should not be tolerated was a war of attrition between opposing strategic bomber forces. This, of course, ran counter to the earlier air power theories which accepted the notion that there would be mutual bombardment of the belligerents' cities until one power was forced onto the strategic defensive. In the course of such an attritional struggle between Britain and the Soviet Union, it would seem inevitable that Britain would be forced onto the strategic defensive first, and the vital commitment to the offensive would be lost. One solution to this dilemma lay in deploying a strategic force sufficiently large as to devastate the majority of the cities of the Soviet Union early in a war, but as the construction of such a huge force was beyond Britain's resources, the problem of vulnerability was first approached by attempting to construct an air defence system, and then by turning to the concept of striking first. The strategic concept of attritional air

1. Letter from Sir John Slessor to Basil Liddell Hart, 22nd January 1948, Liddell Hart Papers - Slessor Correspondence File, 1/644/unnumbered.

warfare was clearly inappropriate, and from this perspective Britain would obviously benefit from seeking to fight a short war. I have already drawn attention to the attritional basis of Herman Kahn's views of nuclear deterrence, and while there may be logic in the United States and the Soviet Union contemplating a deterrence system based on damage limitation and the strategy of second strike, it could have no attraction for Britain. The intention to absorb a first strike and deploy the deterrent threat in the shape of a riposte was not a strategy Whitehall could rationally follow.

The strategy of striking first accorded closely with British air power doctrine which emphasized the importance of seizing the offensive initiative. However, in the circumstances of atomic warfare, it implied grave risks. Unless the first strike destroyed the bulk of the enemy's strategic forces, it would not reduce Britain's own vulnerability. A first strike on Russian cities would be unlikely to blunt the immediate power of her riposte, whereas a first strike aimed at the Soviet air forces was not only contrary to doctrine, it was also a terrible gamble. In the event, Britain's strategic forces continued to plan to attack cities, obliged by the balance of geography and military capabilities to rely on a deterrent threat through punishment rather than denial. In Andre Beaufre's view¹ it seemed that all that could be done by the smaller power was to threaten to tear off a limb, and hope that this would be sufficient disincentive to an attack. The idea of a first strike therefore remained an important aspect of doctrine. The strategic force had to have the capability and resolve to take the offensive as soon as an air attack threatened (which of course might be after the opening of conventional hostilities) - striking first but without much prospect of blunting the riposte. The basis of British deterrence therefore always emphasized the war fighting intentions, in which the whole force would be committed from the start.

4. Vulnerability and the force-in-being

It was only during the 1950s that the vulnerability of the strategic bombers themselves to a disabling first strike became an active concern. Prior to that time, the vulnerability of the force was directly related

1. Andre Beaufre, Deterrence and Strategy.

to that of the economy. It follows from the considerations that I have discussed that Britain, in the opening stages of a major war, would not have the luxury of a period in which to build up and mobilize the strategic forces. It therefore became essential to maintain a permanent strategic force-in-being, because any force in preparation would be destroyed when the industrial base was attacked. This requirement imposed a number of testing conditions. The force would have to be one of real and improving modernity, constantly adapting to developments in the enemy air defence systems. Speed of reaction would be vital and therefore the force would have to exist in a state of constant front line readiness. But most significant of all, the force would have to be permanently dedicated to its strategic role and could not be risked during a major war on secondary missions. The parallel with the naval battle fleet is obvious, but the acceleration of air war technology placed an entirely different order of priority on the development of the bomber fleet-in-being. There was only a limited degree to which the mere existence of the bomber fleet could guarantee its effectiveness. The requirement of perpetual modernity and the resultant importance of the industrial infrastructure which was the primary target in atomic warfare meant that, as Sir Henry Tizard had predicted, technology became as crucial to modern warfare as the front line forces themselves.

5. Defence through deterrence

I have already suggested that there was a period during the post-war development of military policy when a viable air defence system seemed attainable. This was while the threat to Britain came from enemy bombers, and extended into the early era when those bombers could be expected to be armed with atomic bombs. During this earlier period, before it became axiomatic that there was no direct defence against atomic attack, the object of a defensive system was measured against the performance of contemporary bombers and was pursued more or less independently of the technology and planning of the strategic bomber offensive that Britain was preparing. Thus, while it could be asserted that the strategic offensive was the real basis of national defence, there was also a practical effort to build up an immediate defence along traditional military lines. Once medium range ballistic rockets became operational in the superpowers' arsenals direct defence seemed hopeless,

but it had been regarded as increasingly futile for some time before that. One reason for this was that the defence systems could not be developed rapidly enough to cope with massed bomber formations, approaching at great speed and height. Another, more fundamental reason, lay in the estimation that no contemporary defence could provide anything approaching a 100% kill rate. This was not a handicap against high explosive bombs, but against atomic bombers it meant that a percentage of bombs would reach their targets. In addition to this, the Air Staff believed that the advanced bombers (such as the V-bombers) would possess a significant margin of advantage over the defence - the technical specifications were designed to ensure this. Thus the Staff tended to regard defensive efforts as doomed in the long run, even against bombers.

Although progress on air defence systems perhaps suggest a different conclusion, and by the time the V-bombers became operational did indeed pose an extremely serious threat to manned bombers, by 1950 this conclusion could hardly be reached, and while work in Britain on air defence was pushed forward unabated, a new strategic concept began to emerge - that of defence through deterrence. This concept, which was nascent in all the original thinking on the theory of nuclear deterrence, became the twin pillar, alongside the primacy of the offensive, which supported the pediment of British deterrence theory. It is easy to appreciate the attraction of the notion that the sorts of dangers outlined above, faced by Britain in the atomic era, could be defended against by the credible threat of offensive air power armed with atomic weapons. The idea of defence based on such a threat seemed the only tolerable solution to the range of imponderables and vulnerabilities, and was worked up as the key rationale of the deterrence system. Thus the system of deterrence came to be treated as a defensive one, based on the power of the offensive. In this respect the British experience is distinct from that of the United States, and demonstrates the early maturity of the completed deterrent concept. The British felt a much more urgent need to think in both defensive and offensive terms, and drew what many now regard as the 'inevitable' conclusion from the conjunction of air power doctrine, atomic bombs, the modern vulnerability of cities and the seeming hopelessness of traditional defence.

6. Conclusion

Strategy is narrowly defined as the use of engagement for the purpose of war. In the age of nuclear deterrence strategy takes on a wider meaning, expanding into a grand strategy of deployment and employment, scientific, industrial and technological planning and production, and the articulation expression of a theoretical and political system of threat and manoeuvre. This sort of expansion was prefigured in the period when heavy industry became important to warfare. It is demonstrated, for example, in the construction and deployment of the British Grand Fleet for a range of strategic operations which included, but was not defined by, actual combat. However, with the development of nuclear deterrence theory, the analytic distinction between preparation, which I term the strategy of deployment, and combat, the strategy of employment, not only loses much of its force, but restricts accurate analysis of the military situation. Thus the distinction that Clausewitz sought to make has been superseded -

"Essentially, then, the art of war is the art of using the given means in combat; there is no better term for it than the conduct of war. To be sure in its widest sense the art of war includes all activities that exist for the sake of war, such as the creation of the fighting forces, their raising, armament, equipment, and training. It is essential to the validity of a theory to distinguish between these two activities."¹

The reason for this has to do, in essence, with the increasing connection between industry and war. The products of the industrial economies of the major powers facilitated a steady increase in the destructive capabilities of the armed forces, and allowed for the creation of a massive reservoir of weapons and ammunition. The onset of material exhaustion in a war was made a more and more remote consequence of fighting. The invention and production of atomic and hydrogen bombs was merely an extension of this military/industrial nexus. I believe that, although there is obviously a vast quantitative accretion of destructive potential in this development, judged solely as a means of destruction, nuclear weapons do not represent a qualitative break with what went before. The industrial and scientific technology that supports military aviation is the most significant, as well as the most advanced, product

1. Carl von Clausewitz, On War, edited and translated by Michael Howard and Peter Paret; page 127.

Obviously, I am not saying that preparation for nuclear war, and nuclear war itself, are objectively the same thing. But for the purposes of military analysis, preparation for nuclear war is only notionally distinct from the conduct of war.

of the industrial application to war - indeed, the technology involved stands in a class of its own when measured by the pace and sophistication of the progress that has been made. Air power stands in the most direct relation of dependency to modern science and economy. Without the technology, air warfare would not be possible, but, perhaps through an inevitable process of military logic, air power presents the most acute threat to the base on which it, and all modern warfare and society, depends.

By the intellectual and material progression which I have described, the primary employment of air power has evolved into the strategy of attacking the economic infrastructure and industrial and technological base on which it, and military power in general, rests. The initial problem that this base is inseparable from the fabric of society at large, epitomised by the great industrial cities of the modern world, was translated into a virtue during the bombing offensive of the Second World War. For a variety of reasons, it came to be judged that urban destruction, per se, formed a valid, profitable and vulnerable target of war. The rationale for this judgement was summed up in the notion that the morale of the workers (and ultimately, the urban population as a whole) was as vital to economic production as was plant, fuel, raw materials and transport. The distinction between the concept of attacking morale, and bombing purely for purposes of terror, became an increasingly difficult one to sustain.

The reasons behind this judgement might be summed up as follows. It was argued by the early air power theorists, and eventually accepted by the British War Cabinet and some of the military leaders, that the enemy economy was the natural target because it formed the mainspring of the enemy's war effort. Bombers could strike at it directly, and paralyse it, thus producing a rapid decision in war and avoiding the need to seek a climactic land battle. Furthermore, it was an offensive strategy when no other was open to the British war effort. Partially because the bombers could not perform as it was predicted they would, and partially because air warfare involved much the same offensive/defensive struggle that was common to other types of warfare - but primarily because the large city was immeasurably more resilient to aerial bombardment than had been imagined; the early techniques of the bomber offensive underwent radical transformation. The first two reasons given above were

transitory limitations on the offensive as equipment and tactics were evolved to overcome them, but the third reason was more intractable. It is true that the development of mass owed something to the need to saturate the defence, but the main impulse for it was the ability of cities to endure seemingly unlimited punishment. It is also true that the progression from precision to area bombing was due to technical limitations that existed to successful pinpoint targetting, but the fundamental reason for the shift lay in the desire to achieve results at a rate not possible by precision bombing (even assuming that precision bombing could eventually produce results!). The concept of attacking the enemy economy directly by destroying vital parts of it evolved into one of destroying the economy as a whole employing methods of mass devastation. Destruction was elevated to a strategic end in itself.

This evolution cannot be regarded as the consequence of passing technological limitations nor of the obsession of a few deranged 'bomber barons'. Bomber Command continued to employ area tactics even when it was capable of very precise bombing, and over Japan the United States Air Force turned to area bombing in order to achieve quick results. It is not so much the Tokyo Fire Raid of 9th March 1945 that symbolises this decision, it is the atomic bombing of Hiroshima and Nagasaki. Whatever the case for the utility of selective precision bombing made after the war, the fact remains that it was not believed to be a practical route to the object that was closest to the heart of air power theory - the ability to produce independently the capitulation of an enemy.¹ Although

1. Take, for example, the following argument:- "During the last war we have been told that some 61 towns were attacked by Bomber Command and that immense destruction was achieved, but that destruction took a very long time to reach fruition. I think the attack, or the series of attacks, on Hamburg in 1943, when a high density of bombs was achieved, resulted in the dispersal of the labour force down to some 40% of the original body working in that area, and that no reasonable recovery was made for something like five months afterwards. If it had been possible to apply a similar density of attack to a large proportion of the other targets hit, if those effects had been carried out in a much shorter period, the results might have been very different. As a nation, we have always been extremely sceptical of the short war. In fact we have never been in a position where we have been seriously menaced by the prospect of a short war. But it seems to me that there are possibilities in the future which do hold prospects of a short war becoming a reality; and we in this country are not well placed to meet the possible weapons which might be used. I do suggest that in considering a choice between area targets and precision targets, one must bear in mind the speed at which you wish to achieve a decision. The effect of attacking precision targets, as I see it, is usually very far reaching but the results are a long time, generally, in showing effect." (Air Commodore Huddleston, 2nd day transcript, 'Exercise Thunderbolt', AIR8/1536, 11-16 August 1947.)

there was some reticence after the war to press this claim, because it was unrealised during the war against Germany (though more tenable in the case of the war against Japan), the assertions of airmen such as Tedder, Bottomley and Slessor that strategic air power is only an aspect of the national war effort should not mask their argument that air power was dominant, and their anticipation that atomic bombs would restore the air power case for independent capitulation. The resilience of cities and of a war economy implied that selective targetting would involve a difficult and protracted struggle, and not produce a decision independent of the other arms. A strategy of massive destruction seemed to have more chance of restoring the calculation that an economy could be broken by a decisive blow. That this involved the slow grinding down and dismemberment of cities was also necessitated by the limitations of technique and destructive capacity during the Second World War - the ideal approach from the point of view of Bomber Command was the concentrated assault on Hamburg in the summer of 1943 rather than the protracted pulverising of Berlin during the following winter. But even the case of Berlin could be fitted into the strategic approach - before the Battle of Berlin began Harris asked simply for the means to be made available so that Bomber Command might bring down Germany in six months.

The awkward fact that cities could absorb enormous punishment and still function seemed to be resolved by the advent of atomic bombs. With them, not only could enormous destruction be guaranteed, but a decisive concentration of force could be achieved which would rapidly produce results. The ability to deliver a decisive blow was at hand. However, this prospect compounded a difficulty that became apparent during the war, and transcended the original precepts of the military strategy. The doctrine of attacking an economy from the air, of conceiving of the target as civilian morale and in effect cities as such, and of seeking to achieve the object of complete collapse through mass devastation can be properly described as a doctrine of total war - a description which gained widespread currency during and after the war. Liddell Hart connects the development of this doctrine to the war aim of unconditional surrender.

"It was the combination of an unlimited aim with an unlimited method - the adoption of a demand for unconditional surrender together with a strategy of total blockade and bombing devastation - which, in the recent war, inevitably produced a deepening danger to the relatively shallow foundations of civilized life. The bitter fruits are already being reaped in the countries which have undergone this process of liberation by devastation. The results, for Europe, of reducing Germany to a worse state, comparable even to that produced by the

Thirty Years War, are only beginning to mature.

In the circumstances of this war, it was difficult for us to avoid carrying these means to an extreme if we took as our end the unconditional surrender of the opposing powers. But that reflection on the practical compulsion does not alter the fact that this policy involved the paradoxical course of seeking to preserve European civilization through practicing the most uncivilizing means of warfare that the world has known since the Mongol devastations."

Total war implies that utter collapse is a condition of victory, and that there is no easily defined point during such a war at which any other conclusion could be acceptable. For, paradoxically, although the notion of careful calculation of effort expended and damage achieved co-existed with the air offensive over Germany, the outcome of the struggle was to indicate that calculation was difficult and uncertain, while traditional standards of judgement on the effects of military action (territory gained, prisoners taken etc.) became irrelevant. The feasibility of anything other than the grossest of calculations is denied by the employment of a strategy of massive destruction, eschewing as it does the statistical rationale for selective targetting. The process was taken further by the introduction of atomic weapons, leaving only the compilation of the number of cities 'put out' as an interim stage in the procession to collapse. In a sense, therefore, the ability to calculate national war aims rationally in general war became impossible, and the escalation of violence and potential violence seemed to leave states with no choice between immediate bloodless surrender and mutual suicide. No doubt the concept of victory is meaningless in any war involving the atomic bombardment of cities, but this is a consequence of not only the horror of devastation that can be expected, but also the inability to calculate expected losses against expected gains except in whole city-wide terms. Thus one of the presumed essential features of war, that it should have political objectives and a politically conditioned course, has been negated by this development of strategy. The only exception would seem to be the case where national survival itself is either believed to be unavoidably threatened, or has already been destroyed.

The conjunction, then, of total war with atomic weapons and a dedication to an offensive air strategy gave rise to a situation in which the notion of victory in war was substantially deprived of political content and which came to approximate closely to the position of having unconditional surrender as a permanent military aim. The consequences of atomic war were recognized as incalculable except in the broadest delimitation of

1. B.H. Liddell Hart The Revolution in Warfare, page 95.

the levels of destruction - the attempt to equate specific political aims to detailed military action, at the atomic end of violence, was surrendered to the strategy of achieving maximum destruction. The character of modern total war took on the form of an absolute struggle for national life and death. However, because politics between nations inevitably goes on, the necessity for calculation remains, and has been transferred, through the operation of the theory of the nuclear deterrence, to the relationship between opposing forces in the stage prior to hostilities - that is; in what might be termed peace. This is why the analytic distinction between the strategy of deployment and the strategy of employment is of such limited value. The mechanism by which this transference has come about can be demonstrated by the character of preparations for first and second strike and the concept of defence through deterrence.

Military forces deterred in pre-nuclear days through a form of deterrence that was a semi-active part of a continuum which ended in war. The deterrent value of conventional forces lies in their size, their capability and in their rational military potential. (I use rational in this discussion to mean a relationship between political goals and military means which can be quantified in terms of a 'reasonable' expectation of gains outweighing losses as a result of war.) Conventional deterrence is part of a war strategy, the essentially passive quality of which contains within itself, of necessity, its own actualisation. The means of deterrence are also the rational means of war.

The forces involved in nuclear deterrence are subtly different. Nuclear deterrence is a strategy of deployment using the instruments as active agents of threat in a prior sense. The threat does not simply exist as a transparent entity freely open to challenge, but as a permanent sanction conceived of as operating fully, even self-containedly, at the pre-conflict stage. This threat is conveyed through deployment, but lacks the finite and calculable quality of conventional deterrence. The emphasis of such a threat, and the quintessential importance of the force structure that relays it, centres on the constant actualisation of the deployed potential. This is because there is no rationally calculable limit to the maximization of violence in nuclear war, for there is no certain way of determining the size, capability or the degree of rational

content nuclear deterrence forces might contain - except in a theoretical and simulated fashion. (Thus, for example, realistic manoeuvres, the experience of previous major nuclear wars, and the technical functioning of strategic forces in combat, indeed, of societies during nuclear warfare, are not available against which to test performance and the strategic hypotheses. Only the deterrent effect of deployment has a history, [although even this assertion is subject to dispute].)

In constructing a strategy of deployment which can be credible, that is, which accommodates the dilemma of having unconditional surrender as a permanent war aim and infuses political content back into the strategy, it is essential to make the threat contained within the deployed deterrent forces one which makes military sense in the light of the destructive potential. This has been achieved by a strategy of second strike aimed at enemy cities. Although the initiative of striking first is given up, an enemy who contemplates striking first has to account for the probability of the devastation of his own cities. There is thus very little incentive to strike first, and if all deterrent powers accept this, deterrence can be regarded as stable. This assumes that cities will be the target, an assumption which underlies the entire discussion. To an extent the policy of using strategic forces to attack the equivalent forces of the enemy was worked through and rejected during the Second World War. Attack on enemy forces would not produce the decision that was aimed at, and could be judged, in essence, as defensive use of air power. Furthermore, to base a nuclear deterrent force on the intention to attack the enemy force structure would carry real risks. If the attack was not successful it would be unlikely that the retaliation would be against the force structure, in fact there would probably be an incentive not to retaliate in this manner. Furthermore, a threat to the force structure can be countered by a variety of military manoeuvres which renders the threat dubious. Cities are immutable targets.

I have suggested reasons why British thinking about atomic warfare was impelled towards the approach of threatening to strike first at enemy cities. This is the third and least attractive of the permutations. While it gives primacy to the initiative in the offensive, it also brings the threat and its concrete implementation very close together. In other words, the British government would have to be in the position of having to decide first to launch a nuclear strike in response to hostilities or to what seemed unacceptable provocation. It is my contention that the

reality of a nuclear deterrence strategy was first fully manifest when the British, after 1949 were obliged to ask themselves whether they would be the first to launch a nuclear strike in the face of the highly probable retaliatory consequences. In spite of declarations to the contrary¹ it must be likely that the answer was negative. The threat to strike first is inherently irrational because the consequences are incalculable; the threat to strike second at least appears rational, provided the deployed forces credibly support the threat, because then neither side has an incentive to strike first. The best, therefore, that the circumstances of British deterrence strategy could offer was the prospect of a 'defence' from nuclear attack secured by a very delicate balance of terror which was founded on minimal deterrence and a, to say the least, dubious threat of an offensive first use. Winston Churchill's aphorism is not only a brilliant encapsulation of the essence of nuclear deterrence, it is also an accurate description of the British situation.

"Then it may well be that we shall, by a process of sublime irony, have reached a stage in this story where safety will be the sturdy child of terror, and survival the twin brother of annihilation."²

Of the Big Three, Britain was least favourably placed, geographically and materially, to make use of a system of nuclear deterrence. Yet for many reasons after 1945 it seemed necessary for the country to do such a thing. The development of the forces and the theory in Britain is fundamental to any appreciation of the genesis of the system because the dilemmas common to all nations using nuclear deterrence strategy are most clearly demonstrated, and the contradictions of the strategy are most immediately evident. Britain, the Soviet Union and the United States continue to this day to deploy and elaborate the theory. While, I believe, the case for a British nuclear deterrent makes less and less sense as time passes and circumstances change, the United States (at least) seems increasingly dissatisfied with the stable second-strike counter-city formulation that was perfected by the Kennedy administration two decades ago, and is searching for a nuclear strategy that would

1. See for example, Field Marshal Montgomery, "I want to make it absolutely clear that we at SHAPE are basing all our operational planning on using atomic and thermo-nuclear weapons in our defence. With us it is no longer: 'They may possibly be used'. It is very definitely; 'They will be used if we are attacked.'" ('A look through a window at World War III', Journal of the Royal United Service Institution, November 1954, Vol. 99, no. 596, p. 508).

2. Winston Churchill in the House of Commons, 1st March 1955, quoted in Andrew Pierre, Nuclear Politics, page 94.

enable it to resume the offensive initiative. The inability of strategic analysts and military chiefs to penetrate the absurdity of this quest stems from the endurance of doctrines that have their origins in an early period of the industrial impact on warfare, and owe their supreme formulation not only to Clausewitz but also to the airpower theorists who were so influential during and after the Second World War. So powerful has this ruling ideology become that it has acquired the status of an idealism and therefore makes up an intellectual system that has great difficulty acknowledging internal flaws. In the pursuit of what has become Clausewitz's central tenet - that war is nothing more than the continuation of politics by other means - a strategy of nuclear use in war is sought. But beyond this the concepts of the maximisation of violence at the enemy's weakest point, of the crucial importance of securing a decision in the most convincing fashion, and of the primacy of the offensive all stand as irrefutable tenets in an age when the material conditions of major international war make them not only redundant, but also dangerous.

APPENDIX I.

The organization of the RAF

The hierarchy of the Air Ministry and the organization of the Chief of the Air Staff's Department can be expressed diagrammatically as follows on pages 239-241. Details are taken from the Distribution of Duties Handbook, Air Ministry, April 1951 edition.

ORGANIZATION OF THE AIR MINISTRY

THE AIR COUNCIL

Secretary of State for Air (President of the Air Council)
Parliamentary Under Secretary of State for Air (Vice-President of the Air Council)

Controller of Supplies (Air)
(from the Ministry of Supply)

Permanent Under
Secretary's Department

Department of the Air Member
for Supply and Organization

Department of the
Air Member for Personnel

Department of the
Chief of the Air Staff

Vice-Chief of
the Air Staff

Deputy-Chief of
the Air Staff

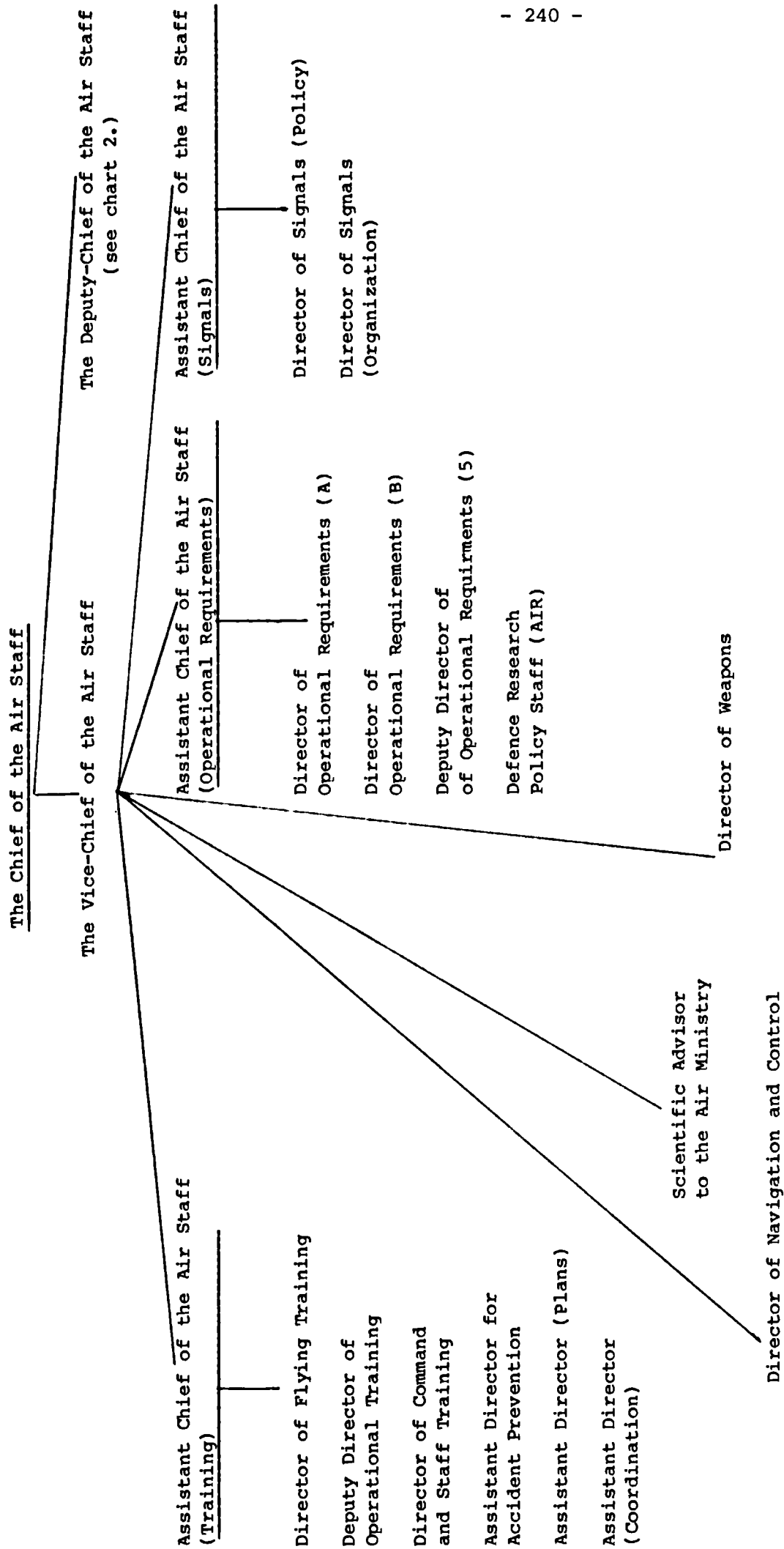
(for details see charts 1 and 2)

for brief outline
see page

for brief outline
see page

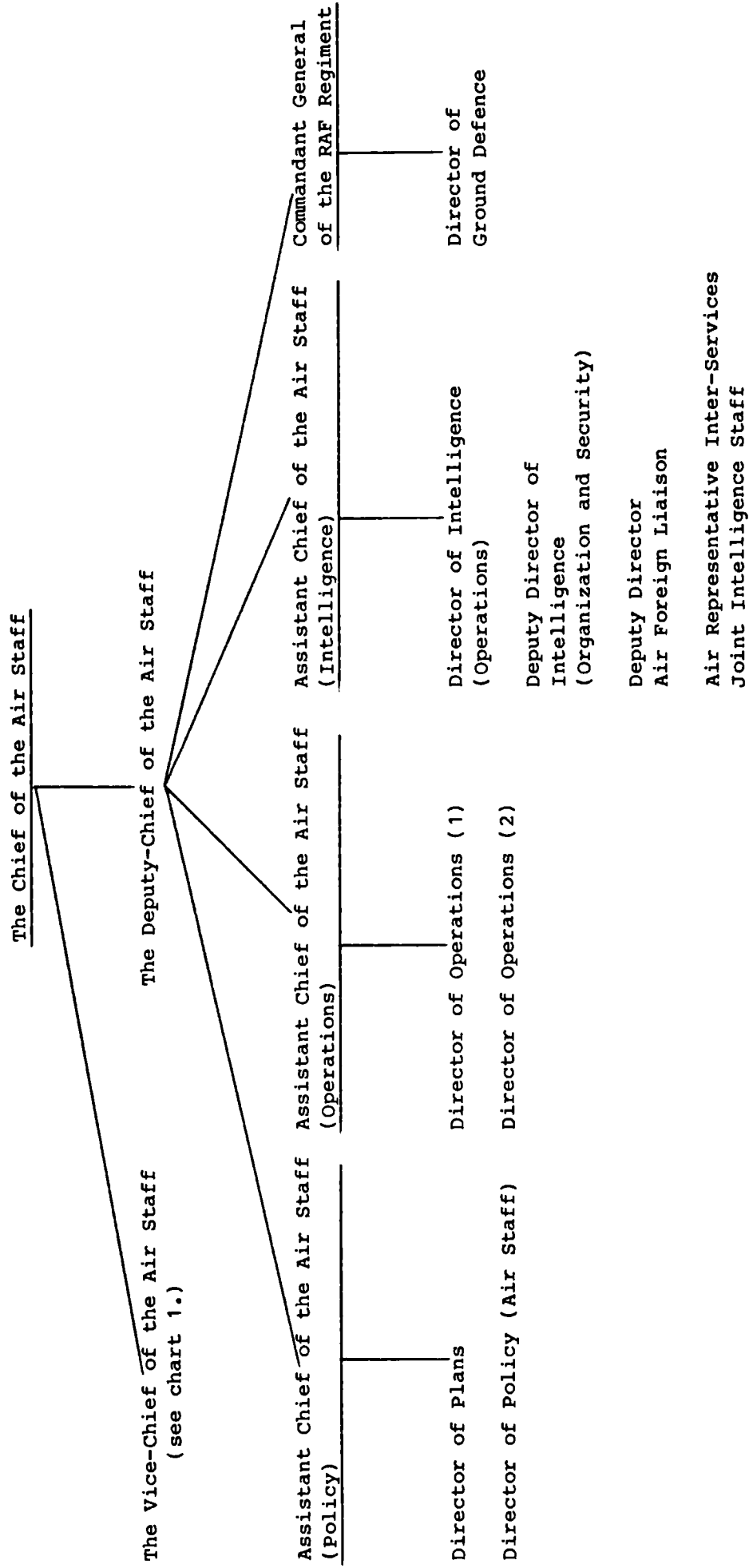
Chart 1.

THE DEPARTMENT OF THE CHIEF OF THE AIR STAFF



THE DEPARTMENT OF THE CHIEF OF THE AIR STAFF

Chart 2.



THE AIR COUNCIL

SECRETARY OF STATE FOR AIR (President)
PARLIAMENTARY UNDER SECRETARY OF STATE FOR AIR (Vice-President)
PERMANENT UNDER SECRETARY (PUS)
CHIEF OF THE AIR STAFF (CAS)
AIR MEMBER FOR PERSONNEL (AMP)
AIR MEMBER FOR SUPPLY AND ORGANIZATION (AMSO)
CONTROLLER OF SUPPLIES (AIR) (from the Ministry of Supply)
VICE CHIEF OF THE AIR STAFF (VCAS)
DEPUTY CHIEF OF THE AIR STAFF (DCAS)

The CAS, AMP, AMSO and PUS controlled the four departments which made up the Air Ministry in April 1951. The CAS's department was the locus of strategic decision making within the Air Force. The department was divided in two, one part overseen by the VCAS, who dealt with 'tomorrow's war', the other by the DCAS, who dealt with 'today's war'. Immediately subordinate to these two offices were the ACASs, the Assistant Chiefs of the Air Staff, each of whom presided over one of the directorates.

Secretaries of State for Air:

Sir Archibald Sinclair MP	(11 May 40-26 May 1945)
Harold Macmillan MP	(May-Aug 1945)
Viscount Stansgate	(3 August 1945-5 October 1946)
P J Noel-Baker MP	(5 October 1946-1947)
Arthur Henderson MP	(1948-51)
The Lord De L'Isle and Dudley	(1952-55)
Nigel Birch MP	(1956-)

Permanent Under Secretaries:

Sir Arthur Street	(1940- October 1945)
Sir William Brown	(October 1945-1946)
Sir James Barnes	(1947-1954)
Sir Maurice Dean	(1955, 1956)

Parliamentary Under Secretaries

Lord Sherwood and H H Balfour MP	(May 1940-May 1945)
Lord Beatty and Quintin Hogg MP	(May-August 1945)
John Strachey MP	(6 August 1945-1946)
Geoffrey De Freitas MP	(1946-1949)
Aidan Crawley MP	(1950-1951)
George Ward MP	(1952-1955)
Christopher Soames MP	(1956-)

In this period the Air Council was the senior committee in the RAF. Its formal composition varied little. It was chaired by the Secretary of State for Air. The Permanent Under Secretary of State (PUS) at the Air Ministry was always a member, as was the Chief of the Air Staff (CAS), the Vice Chief of the Air Staff (VCAS) and the Parliamentary Under Secretary of State for Air. To these five can be added the Air Member for Personnel (AMP), the Air Member for Supply and Organization (AMSO), and the Controller of Supplies (Air), who was an additional member of the Air Council from the Ministry of Supply (MOS). The size of the Air Council varied between nine and ten members. During the war there was an Air Member for Training (AMT). Shortly after the war Training had been renamed Technical Services (Air Marshal Sir Roderick Hill was AMT and then AMTS between May 1945 and June 1948, and Air Marshal Sir Victor Goddard was AMTS from June 1948 to the end of 1950). At the end of 1950 the AMTS Department was split and absorbed by two of the other departments. The flying training function was taken over by the CAS Department, and technical training was carried out in the Technical Services Section of the AMSO Department. The Deputy Chief of the Air Staff (DCAS) had a chequered career on the Council; by 1951 he appears to have become a permanent member. On occasion there was an Additional Member.

The Air Council stood at the apex of the departmentally organized Air Ministry. Each of the departments consisted of a series of directorates. I have given a detailed breakdown only for the CAS department (the yearly size of which is given in Appendix V), because the AMP, AMSO and PUS departments are not central to the formation of strategic policy (although the Air Members and some of the Directors might at times have had an influence).

In brief, the department of the AMP had four sections:

Personnel (1):	Personnel welfare (sport, religion, physical fitness, police, WRAF etc.)
Personnel (2):	Postings (who moved, where they went and at what rank)
Medical:	All medical and hygiene aspects
Manning:	Recruitment and selection

The department of the AMSO had three sections, one of which was trifurcated:

Organization:	The administration of equipment
Works:	Buildings, lands and structural engineering
Controller of engineering and equipment:	(a) Equipment (supply and testing) (b) Technical services (plans, training and inspection) (c) Engineering (aircraft, armament, radio)

For a definition of the PUS Department see below, page 250.

Broadly speaking, each Directorate of the CAS Department (training, signals etc.) was headed by an Assistant Chief of the Air Staff (ACAS). Under him was a series of Directors and Deputy Directors, dealing with closely defined areas of Air Staff work. The names, sizes and functions of the Directorates in the CAS Department varied little between 1942 and 1952 - at least sufficiently little to allow of valid evaluation of roles of the men who held the posts at different times. British air policy had its genesis, formulated as an Air Staff position, within this Air Ministry Organization.

However much the final decisions on policy might in theory belong to the Cabinet and parliament, it was the Chief of the Air Staff and the members of his Department who exercised the crucial influence¹.

The Air Staff functioned both in a traditional departmental manner, and through a network of personal contacts and ad hoc meetings. Requests for briefs and information would pass down from the CAS, VCAS and DCAS, but the more common conduct of business was for the staff in each department, under the direction of their relevant Assistant Chief of the Air Staff (ACAS), to generate papers and information documents in terms of their

1. It should be borne in mind that the 'Air Staff' comprised only the members of the Chief of the Air Staff's Department, not the members of the other Air Ministry Departments. This unambiguous definition applies throughout this thesis. Formal contact between the Air Staff and other Air Ministry offices was at meetings of the Air Council, although there were of course informal contacts as well.

departmental remit. These papers would deal with current matters, issues decided on by the ACASs and subjects arising from the concerns of individual officers. Thus the bureaucratic flow of paper and opinions was largely upwards to the DCAS and VCAS¹. The CAS had the final say on what should go to the Air Council from the Air Staff. Technically, the Air Council was the final point of decision, in practice it was largely a rubber stamping body and the executive mechanism by which the AMP and AMSO had their orders relayed to them. The only occasions on which the Air Council became the focus of really pertinent discussions was when the politicians disagreed with the Staff, or had unwelcome orders to pass on from higher authority, and when the interests of the RAF seemed to be threatened by the moves of the other services, other ministries or the government. The Air Council, then, was the 'front organization' of the Air Staff, and policy which bore its imprimatur gained special force in wider policy making fora.

"The CAS's department worked pretty well along the lines of its organization. The Air Staff Planners, Operational Requirements people, and Operators would generate and jointly consider proposals at, say Group Captain level. These would go up the chain to be considered by Directors, Assistant Chiefs of Staff and finally VCAS and DCAS, before being put to CAS. (Of course various outside agencies would be consulted on the way.) Obviously CAS, VCAS and DCAS have always been very influential in the decision making process. Ultimately, when the Air Staff view was firm, a briefing team was formed to sell the project to the other services and to Ministers."²

One of the key officers on the Staff was the ACAS (Policy), whose job was to coordinate the work of the Directorates, the flow of information and the coherent formulation of policy. This was achieved primarily by the compilation of briefs for the CAS, the Air Council and the Chiefs of Staff Committee. Another important part of the process was the Standing Committee - one of the few permanent committees. It could meet as often as two or three times a week, and consisted of the service members of the Air Council - thus forming a regular link between the Air Staff and the Personnel and Supply Departments, and providing a mechanism for discussing policy in the absence of politicians and civil servants.

1. This summary is condensed from conversations with Air Chief Marshal Sir Alfred Earle, Air Marshal Sir Geoffrey Tuttle, and Mr Humphrey Wynn of the Air Historical Branch, Air Ministry; and from correspondence.

2. Letter from Air Marshal Sir Gareth Clayton to Mark Venables, 8th August 1984. It is interesting that he does not mention the Air Council.

Every one I consulted agreed that the Air Staff was not 'committee minded', and that when officers needed to venture beyond their department remit, it was done on a one-to-one or a small group basis.

"The Air Staff were not 'sub-committee minded'. Interdept. problems were normally discussed in informal visits to each other's offices or if too complicated, by ad hoc meetings. I cannot recall a sub-committee. The 'Air Staff position', on any question was normally arrived at by ACAS (P) coordinating views of departments into a brief for CAS. Don't forget that the Air Force policy was settled by the Air Council - not the Air Staff as such."¹

Committees were formed at various times, but few had a long life. Examples of these special committees are the one formed to deal with the Berlin Air Lift, and that set up to revise bombing techniques when carrying nuclear weapons.

"Committees were formed for specific purposes and discontinued when the purpose had been achieved. I cannot remember the names of these committees or of the standing committees of which there were some. There was a great deal of informal discussion between directors. We met each morning at the Air Staff morning conference and discussion followed as appropriate."²

Three classes of committee deserve mention. The Operational Requirements Directorate would establish a special committee before aircraft requirements were finalised for transmission to the Ministry of Supply. Membership of this committee would be drawn from the OR Directorate itself, the department of the Scientific Advisor to the Air Ministry, and the operational commands. Once the Ministry of Supply had produced a specification based on the requirement, and industry had been consulted, another, more wide ranging and widely constituted committee (sometimes large enough to be styled a conference) would be set up to review the requirement and discuss any design adjustments suggested by industry or the ministry, or dictated by circumstances. A third class of committee was interservice, and there were many of these - ranging from the permanent, high strategy ones such as Defence Research Policy Committee and the Deputy Chiefs of Staff Joint Committee, as well as the Chiefs of Staff Committee itself - to small interservice committees (usually subordinate to the Chiefs of Staff Committee) set up to deal with very

1. Letter from Air Chief Marshal Sir Walter Dawson to Mark Venables, 30th June 1984.

2. Letter from Air Chief Marshal Sir Kenneth Cross to Mark Venables, 25th June 1984.

specific topics. Apart from the Chiefs of Staff and the Scientific Advisor, the Director of Plans in the Policy Department was the officer most involved with the other services, being the Air Staff representative at interservice higher strategy discussions.¹

Finally, the Chief of the Air Staff held regular conferences with the Commanders-in-Chief, attended by the C-in-Cs and some members of the staff. These were not decision making meetings. They were laid on to brief the Commanders on the latest operational and policy planning, to discuss major issues of policy, and to assess the response to developments of the Commanders. More wide ranging conferences, such as 'Exercise Thunderbolt' in 1947 and 'Exercise Dagger' in 1948, were held with some regularity.² Their impact on policy was supposed to be greater than that of the C-in-C conferences.

Judging from discussions I have had with Staff Officers, the part played by the permanent civil servants in policy formation was minimal. All stressed the crucial role played by the Air Staff Secretariat (S6) (the PUS's Department) in the Air Ministry's dealings with the Treasury - meaning getting money from the Treasury which it did not wish to allocate, and securing for the Air Force priorities which were being resisted by other Departments of State. There was in addition some awe at the PUS Department's ability to 'interpret' the desires of the Foreign Office, and translate them into proposals that the Air Staff could deal with. It is clear that the departments of the Air Staff were predominantly run by seconded serving officers - the notion of there being a 'civil service position' on air doctrine or policy was generally thought ludicrous. It was acknowledged that there were serious disputes with the Secretariat, invariably over the control of the budget, in which area the civil servants had great influence. It would be unwise, however, to accept uncritically this characterisation of the somewhat tangential role of the permanent officials, in particular the Assistant

1. Examples of interservice committees dealing with specific topics are: the Air Defence Committee; the Maritime Air Defence Policy Committee; the Joint Technical Warfare Committee; the sub-committee for Air, Coast and Seaward Defences; and Joint Air Ministry/Admiralty Committees to discuss such matters as standardization of radar and signals, road transport, and ammunition.

2. AIR 8/1536 and AIR 20/6765.

Under Secretaries. They were a powerful force towards continuity of certain policies and influences and could intervene in the decision making process over an extended period of time, whereas the serving officers were usually rotated at least every three years.

Ultimately, the power and influence of the CAS was enormous, the more so if he was a strong personality. Equally, it must be observed that the Air Staff's writ did not run entirely unchecked beyond the Air Ministry. The Chiefs of Staff Committee was very powerful - here the three services met to thrash out overall strategy for presentation to the Cabinet Defence Committee, and the RAF could not always get its own way. The COS Committee remained very powerful - indeed it became a permanent feature of defence policy making, developed its structure and influence, and became essential to the Services' ability to persuade the cabinet. The Ministry of Defence, which might have changed this power, was of limited influence in the period to 1952.

Beyond the Air Ministry lay the RAF Commands (Bomber, Fighter etc.). These were organized in Groups. During the period of reorganization, Bomber Command was reduced to two Groups (numbers One and Three) which were retained until 1968 when Bomber Command disappeared upon the creation of Strike Command. Fighter Command was also reduced to two Groups (numbers Eleven and Twelve); however, this number rose to three in 1952 with the creation of number 81 Group, and to four in 1955 with the creation of number Thirteen Group. The major Overseas Commands that emerged after demobilization were the Far Eastern (FEAF), the Middle East (MEAF) and the British Air Force of Occupation (BAFO) stationed in western Germany, and retaining that title in 1952. There were of course, other Home Commands, such as Coastal, Training, Transport, Reconnaissance¹. BAFO was the descendant of the Second Tactical Air Force. This Force had originated as number Two Group, Bomber Command; which was the Light Bomber Group established in 1936 (which was the date of the major pre-war reorganization of the RAF). In May 1943 this Group became part of Fighter Command as the Tactical Support Group.

At the head of each Command was an Air Officer Commander-in-Chief, who had his own staff. The most important positions on the Command Staffs

1. A useful, brief history of the Home Commands is: Home Commands of the RAF since 1918, compiled by Denis C Bateman, MOD-AHB(RAF), May 1978.

were the Senior Air Staff Officer (SASO) and the Air Officer Administration (AOA). The Commands were made up of Groups, the Commanders of which (who were usually Air Vice Marshal/s) also had a small staff at their disposal. The chain of command ran from the CAS to the AOC-in-Cs of the Commands, who then gave operational orders to the AVMs commanding the Groups. The Commands were answerable only and directly to the CAS, and had considerable autonomy which the AOC-in-Cs attempted to preserve. The CAS was responsible to the Air Council (and thus the Cabinet). The Groups were subdivided into wings and squadrons.

The functions of some Air Staff positions

There was a great degree of interchange of personnel between the Air Ministry and the operational commands and groups. It was not unusual for a RAF officer of this period to have three separate spells at the Air Ministry during his career. Some attended the Imperial Defence College which seemed to be a mark of special success¹. It would be possible to be on the staff of one of the RAF's own colleges, (such as Cranwell or Manby), be on the staff of an international command (such as Allied Air Forces Europe), be an Air Attache or part of the Air Delegation to Washington or the United Nations, or to serve with one of the Commonwealth Air Forces. Thus the most senior members of the Air Staff would have had practical experience of command, and frequently of the technical matters which had to be resolved by the staff, while the senior operational commanders were familiar with the mechanisms of the Air Staff. This would be very important for the Directorate of Operational Requirements - the members of which would be involved in frequent visits to, and intensive discussions with, the commands before finalizing an Operational Requirement.

What follows is a series of definitions detailing the remit of the most important Air Staff posts and defining the scope of the departments.

1. It has been put to me that a year at the IDC was a reward for promising officers. Apparently, a relaxing time was to be had there, notable for the value of the interservice contacts which were established.

Department of CAS: "RAF policy and planning operations, tactics, intelligence, signals (other than technical aspects), operational requirements, accident prevention, ground defence, flying and combat training, operational, administrative and training research."¹

Department of AMP: "All matters in connection with the personnel of the RAF, its reserves and auxiliaries (except training and establishments). This includes conditions of service, discipline, ceremonials, honours and awards, appointments, exits, promotions, postings, casualties and welfare, medical, educational, dental, nursing, chaplaincy and legal services."

Department of AMSO: "Organization of the RAF in peace and war. Establishments of personnel, aircraft, mechanical transport etc., provisioning, transportation, civil engineering, technical training, control, coordination and direction of technical services of the RAF."¹

Department of PUS: "Domestic economy of the Air Ministry finance, purchases, accounts, and general administration. Public relations, parliamentary and legal business. Air Ministry procedures and conduct of official business and correspondence. All civilian staff questions."¹

The Chief of the Air Staff "is the principal service adviser to the Secretary of State for Air on the direction of the RAF. He is responsible for its fighting efficiency, for the considerations of all questions of Air Force policy and planning, for advice on the conduct of air operations. As a member of the Chiefs of Staff Committee he is responsible for advice to His Majesty's Government on all matters affecting the defence of the United Kingdom and Commonwealth."²

The Chief Scientific Officer, "who has the title of The Scientific Adviser to the Air Ministry is responsible to the members of the Air Council concerned for:- a) control of operational research, b) control of administrative research, c) control of training research, d) scientific advice on the 'user' aspects of RAF equipment in close collaboration with the D.G. of Scientific Research of the MOS, e) scientific advice to the appropriate Air Staff authorities on operational, administrative and training problems and the planning in these spheres of research in time of peace."²

1. Quoted from the Distribution of Duties Handbook, Air Ministry, April 1951 edition.

2. Quoted from the Air Estimates 1947-1948, February 1947, HC51.

The Vice Chief of the Air Staff: 1) preparedness of the Air Force for war in accordance with accepted strategic plans; 2) all command, staff and air training, the conduct of Air Ministry and command staff and flying exercises (including inter-Allied exercises) and all flying and operational training; 3) Air Staff aspects of development and production of future aircraft and weapons; 4) Air Staff aspects of RAF organization, expansion and re-equipment policy.¹

The Assistant Chief of the Air Staff (Training): 1) initial training of all air crew; 2) operational training in squadrons; 3) combined operational training between commands and other services; 4) navigation and weapons training; 5) administration, staff courses and officer training.¹

The Assistant Chief of the Air Staff (Operational Requirements): 1) responsibility for the preparation of all Air Staff operational requirements, including guided weapons, but excluding ground signal matters; 2) Air Staff aspect of modifications to airframes, engines and equipment; 3) guidance to the appropriate Air Staff branches on the trend of operational requirements.¹

Serving under the ACAS (OR) were a number of departmental directors, including:

(i) **Director of Operational Requirements (A):** 1) preparation of Air Staff targets and operational requirements for aircraft and armaments; 2) installation of armament and equipment in aircraft; 3) controlled OR1(A) dealing with bombers and OR1(B) dealing with fighters.

(ii) **Director of Operational Requirements (B):** preparation of Air Staff targets and operational requirements for all flying-related equipment (ie instruments, clothing etc.).

(iii) **Deputy Director of Operational Requirements (5):** 1) operational requirements for guided and homing weapons; 2) controlled departments OR14 and OR15 (guided weapons)¹.

The Assistant Chief of the Air Staff (Signals): was the joint chairman of the Fighter Defence Committee¹.

1. Summary condensed from the Distribution of Duties Handbook, Air Ministry, April 1951 edition.

The Deputy Chief of the Air Staff: 1) strategic policy and plans; 2) interservice policy and planning and the work of the Joint Planning and Joint Intelligence Staffs; 3) RAF operations; 4) air intelligence; 5) Atlantic Treaty and Western Union affairs; 6) RAF/USAF planning; 7) standardization; 8) RAF Regiment policy; 9) policy re Commonwealth, colonial and foreign air forces.¹

The Assistant Chief of the Air Staff (Policy): had responsibility under CAS and DCAS for all questions of Air Staff policy and planning.

The two Directors under ACAS(P) were:

(i) Director of Plans, dealing primarily with interservice higher strategy matters.

(ii) Director of Policy, dealing with major matters of strategy and target forces and, Air Staff Policy for the size and shape of the RAF front line in respect of aircraft and equipment generally.¹

The Assistant Chief of the Air Staff (Operations): had responsibility under the DCAS for advice on the day-to-day conduct of air operations.

The two Directors under ACAS(Ops) were:

(i) Director of Operations (1), dealing with Air Defence (AD), bombing (B) and maritime (M). Within these subsections, the following roles are included. AD includes strategic location of industry (Ops(AD)2). (B) is the operational policy for the employment of the bomber forces, including,

(Ops(B)1) Operational policy and plans.

(Ops(B)2) Current bomber operations and exercises, operational readiness.

(Ops(B)2(a)) Current bombing, marking and mining techniques.

(Ops(B)2(b)) Target selection material, preparation of current summaries and memoranda.

(ii) Director of Operations (2), dealing with Air Transport (AT), photographic, overseas and standardization.¹

The Assistant Chief of the Air Staff (Intelligence): including DDI(3)-intelligence on all aspects (except scientific and technical) of foreign air forces and the political and strategic policy as necessary; and, the production capacities of the industries supporting foreign air forces.¹

1. Summary condensed from the Distribution of Duties Handbook, Air Ministry, April 1951 edition.

APPENDIX II

Names of the officers who held important Air Staff posts.¹

The posts listed are those the occupants of which had the most direct bearing on air force policy.

They are:

- Chief of the Air Staff
- Vice Chief of the Air Staff
- Deputy Chief of the Air Staff
- ACAS (Operational Requirements)
- ACAS (Policy)
- ACAS (Operations)
- ACAS (Intelligence)
- Director (Plans)
- Director (Policy)

I have also listed the Air Member for Personnel, the Air Member for Supply and Organization and the Controller of Supplies (Air), because they were members of the Air Council. I have listed the A.O.C-in-Cs and SASOs for Bomber and Fighter Command.

1. Chiefs of the Air Staff

- Marshal of the Royal Air Force the Lord Tedder, 1 January 1946
- Marshal of the Royal Air Force Sir John Slessor, 1 January 1950
- Marshal of the Royal Air Force Sir William Dickson, 1 January 1953
- Marshal of the Royal Air Force Sir Dermot Boyle, 1 January 1956

2. Vice Chiefs of the Air Staff

- Air Marshal D.C.S. Evill, 21st March 1943
- Marshal of the Royal Air Force Sir William Dickson, January 1946
- Air Marshal J.M. Robb, 17th November 1947
- Air Marshal A.P.M. Sanders, 1st November 1948
- Air Chief Marshal Sir Ralph Cochrane, 1st March 1950
- Air Chief Marshal J.W. Baker, 17th March 1952
- Air Chief Marshal R. Ivelaw-Chapman, 1st November 1952

1. Details from the Air Force List, published quarterly by the Air Ministry. Ranks given are those at time of most senior appointment listed, dates denote beginning of appointment.

3. Deputy Chiefs of the Air Staff

Air Chief Marshal Sir Norman Bottomley, 21st May 1941, and July 1943
(Post of DCAS did not exist May 1942 to July 1943.)

Air Marshal A. Durston, 15th September 1945
(Post lapsed again for a period. Air Marshal Durston retired,
13.8.46.)

Air Marshal H.S.P. Walmsley, 4th February 1948

Air Marshal A.P.M. Sanders) Listed as DCAS for varying

Air Chief Marshal J.W. Baker) periods between March 1950

Air Chief Marshal R. Ivelaw-Chapman) and November 1953

Marshal of the Royal Air Force Sir Thomas Pike, 9th November 1953

Air Marshal Sir Geoffrey Tuttle, 4th July 1956

4. ACAS (Operational Requirements)

(known at the end of the war as Technical Requirements)

Air Vice Marshal J.N. Boothman, July 1945

Air Vice Marshal C.B.R. Pelly, 17th August 1948

Air Marshal Sir Geoffrey Tuttle, 17th September 1951

Air Vice Marshal H.V. Satterley, 6th August 1954

(Holders of junior positions within the OR department)

Tuttle had been Director (OR) (E) between 29.12.47 and 16.1.50

Pike had been Director (OR) (A) between 27.7.47 and 9.1.50

Satterley had been Director (OR) (A) between 16.1.50 and 30.6.52

Air Marshal Sir Patterson Fraser was on the ACAS (OR) staff and was

RAF member on the Defence Research Policy Committee from 1948 to April
1951

S.O. Bufton and A.C. Cross had been Directors of Weapons

5. ACAS (Policy)

Marshal of the Royal Air Force Sir William Dickson, 21st December 1944

Air Vice Marshal W. Elliot, July 1946

Air Vice Marshal R.M. Foster, July 1947

Air Vice Marshal D. MacFadyen, 1st August 1949

Air Chief Marshal Sir Walter Dawson, 9th January 1952

Air Marshal Sir Edward Chilton, 22nd September 1953

Air Chief Marshal Sir Alfred Earle, 1st March 1955

5a Director (Plans)

Marshal of the Royal Air Force Sir John Slessor, 22nd December 1938

Air Marshal C.E.H. Medhurst, 21st October 1940

Marshal of the Royal Air Force Sir William Dickson, 1st March 1941

Air Vice Marshal W. Elliot, 26th April 1942

Air Chief Marshal Sir Walter Dawson, 26th January 1944

Air Chief Marshal G.H. Mills, 17th July 1946

Air Vice Marshal D. MacFadyen, 1st January 1949

Air Commodore H.I. Cozens, 7th July 1949

Air Marshal Sir John Edwards-Jones, 15th January 1951

(Ivelaw-Chapman and Earle had both served in the Plans Directorate
during the war.)

5b Director (Policy)

Air Vice Marshal D. MacFadyen, 21st January 1944
Air Commodore W.A.D. Brook, 3rd August, 1946
Air Commodore J.G.W. Weston, 1st January 1949
Air Commodore D.W. Lane, 3rd January 1952
Air Chief Marshal Sir Alfred Earle, 16th April 1954
(Edwards-Jones had been Deputy Director (Plans) 13.11.45 to 1947;
Fraser had been Deputy Director (Policy) 1947/1948)

6. ACAS (Operations)

Air Vice Marshal T.M. Williams, 1st August 1944
Air Vice Marshal J.D.I. Hardman, July 1947
Air Vice Marshal C.E.N. Guest, 6th December 1948
Air Vice Marshal H. Broadhurst, 19th April 1952
Air Vice Marshal L.F. Sinclair, 4th November 1953
(Fressanges had been Director (Operations) July 1946 to 1.11.48 and
Cross had been Director (Operations) (I) 8.9.52 to 2.1.56)

7. ACAS (Intelligence)

Air Vice Marshal F.F. Inglis, until late 1945
Air Vice Marshal T.W. Elmhurst, late 1945
Air Vice Marshal L.F. Pendred, 6th January 1947
Air Vice Marshal N.C. Ogilvie-Forbes, 18th January 1950
Air Vice Marshal F.J. Fressanges, 10th May 1952

8. Air Member for Personnel

Marshal of the Royal Air Force Sir John Slessor, 5th April 1945
Air Marshal H.W.L. Saunders, 1st October 1947
Air Chief Marshal L.N. Hollinghurst, 31st October 1949

9. Air Member for Supply and Organization

Air Chief Marshal L.N. Hollinghurst, until September 1948
Air Chief Marshal Sir George Pirie, 1st September 1948
Marshal of the Royal Air Force Sir William Dickson, 2nd March 1950

10. Controller of Supplies (AIR)

Air Marshal W.A. Coryton, 1945-1949
Air Marshal J.N. Boothman, 1950-1953

11. Bomber Command

a) Air Officer Commander-in-Chief

Air Chief Marshal Sir Norman Bottomley, 15th September 1945
Air Marshal H.W.L. Saunders, 16th January 1947
Air Marshal A.B. Ellwood, 8th October 1947
Air Chief Marshal Sir Hugh Lloyd, 2nd February 1950
Air Chief Marshal G.H. Mills, 9th April 1953

b) Senior Air Staff Officer

Air Marshal H.S.P. Walmsley, 25th April 1945
Air Vice Marshal S.C. Strafford, 24th April 1947
Air Vice Marshal G.D. Harvey, 26th September 1950
Air Vice Marshal A. McKee, 19th October 1953
Air Vice Marshal S.O. Bufton, 15th October 1955

12. Fighter Command

a) Air Officer Commander-in-Chief

Air Marshal J.M. Robb, 14th May 1945

Air Vice Marshal W. Elliot, 17th November 1947

Air Marshal Sir Basil Embry, 19th April 1949

Marshal of the Royal Air Force Sir Dermot Boyle, 7th April 1953

b) Senior Air Staff Officer

Air Vice Marshal S.F. Vincent, 16th August 1945

Air Vice Marshal E.J. Kingston-McCloughry, 1st June 1948

Air Vice Marshal D.F.W. Atcherley, 21st January 1950

Air Vice Marshal H.P. Fraser, 9th January 1952

Appendix III

Discussion of data on defence manpower, defence budgets and defence expenditure for the period 1945-1952

It is as well to admit that there is a degree of uncertainty in all data for this period. Figures for the period 1945/52 are scarce, and, when available, not consistent even when published in government statistical documents.

The tables that follow as Appendices IV to VIII cover defence manpower, defence budgets and defence expenditure. I have used as my primary sources the Statements on Defence and the Air Estimates. For the RAF, I have also cited Air Ministry statistics from the papers in the PRO (Public Record Office) - at least when I have felt reasonably sure that they are confirmed figures as opposed to estimates, projections or Cabinet targets. It is by no means always easy to make these distinctions.

In any case, for my purposes the absolute veracity of the figures is secondary to the value they have in demonstrating relative declines and comparative strengths and expenditures. Because of the gaps in my chosen sources, there are gaps in the tables. I have only filled these gaps from secondary sources when the rest of the data in the secondary sources appears reasonably compatible with the primary data I already have. I have always noted where this filling-in has occurred.

The tables in Appendices IV and V deal with defence personnel. Richard Rosecrance gives the following figures, but does not state at what part of each year they were recorded, which makes them of limited use. (Richard Rosecrance, 1968 Defense of the Realm pp 298-299 Columbia University Press who cites, for these figures - Annual abstract of statistics, No 93, HMSO 1956.)

Uniformed strength (in thousands)

Date	Total	RAF	Navy	Army
1946	1917.4	438.5	350	1128.9
1947	1247.6	284.5	189.6	773.5
1948	807.5	222.2	135.3	450
1949	737.4	205.1	136.9	395.4
1950	666.1	182.7	129.4	354
1951	804	241.4	135.8	426.8
1952	848.4	262.2	141.2	445

Thus, for example, the anomalies are clear in attempting to determine uniformed strength at the end of 1946. Command 7042 quite unequivocally gives the figure as 1 427 000; Rosecrance's figure lies between 1 917 400 and 1 247 600; and Eatwell (who cites Bartlett CJ The Long Retreat) gives 1 000 000. The only reference Bartlett in fact makes is on p 12 -

"Attlee replied on 4 March 1946 that the government was hoping to reduce personnel in the armed forces to about 1 200 000 by the end of the year."

Greenwood (Greenwood, David 'Economic Constraints and British Defence Policy' in Gregory, F. et al.; Perspectives upon British Defence Policy 1945-1970. University of Southampton 1978, p 93 who cites: Stone, T. Historical abstract of British military manpower statistics, Aberdeen Studies in Defence

Economics, No. 7 December, 1975, Table 2:6 part 1.), another secondary source, seemed to me not only a reliable one, but also the most compatible. Unfortunately, his data only begin in 1951, but at least they are for 1 April each year. I have added them to the table in Appendix IV.

The tables in Appendices VI, VII and VIII deal with defence expenditure. The second column of the table in Appendix VII is probably not an absolutely reliable guide to annual RAF expenditure, as it only records the sum of the original vote and any supplementary vote, but at worst the real RAF expenditure could only be very marginally different.

The table in Appendix VI attempts no more than to record the annual defence budgets - actual expenditure is only given once in this series of Command Papers. Both Greenwood and Rosecrance give figures for actual expenditure. (Greenwood, David *ibid.* p. 94 citing: SIPRI, Yearbook of World Armaments and Disarmament 1968/69 and 1974. Stockholm: Almqvist and Wiksell, 1969, 1974; Rosecrance, Richard *op cit.* p 297, citing The British Economy Key Statistics, 1900-1964. Table E (London School of Economics and Cambridge University edition.)

in £millions.

Date	Rosecrance	Command 8475	Greenwood (Calendar year basis)
1946/47	1736		
1947/48	974		
1948/49	770		
1949/50	777		779 (1949)
1950/51	829		849 (1950)
1951/52	1110	1131.5	1149 (1951)
1952/53	1489		1561 (1952)

As for Eatwell's figure of £1653 million defence expenditure for 1946, he again cites Bartlett, who in fact gives £1736 million (same as Rosecrance); although he does agree that this represents one fifth of the gross national product.

APPENDIX IV¹

Table of defence personnel levels²

(In thousands)					
	Total Uniformed Strength	RAF	NAVY	ARMY	(3)
In May 1945 ⁴ Command 6743 - Feb.1946	5,100	1,110*	955	3,035	3900
on 31 December 1945*		745			
on 31 December 1946 Command 7042 - Feb.1947	1,427		200**		459
on 31 Mar. 1948 Command 7327 -Feb.1948	940	261	145	534	
on 1 April 1949 Command 7631 - Feb.1949	793	232	145	416	450
on 1 April 1950 Command 7895 Mar.1950	718.8	202.4	140	376.4	500
on 1 April 1951 Command 8146, Jan.1951 (Greenwood ⁵)	800 (809.2)	230 (237.8)			
on 1 April 1952 (Greenwood ⁵)	(862.7)	(270.8)	(145.2)	(446.7)	

Notes accompanying Appendix IV

- (1) Figures taken from the "Statements relating to Defence", dates as listed; Command numbers (in chronological order) as follows:-

	<u>Date</u>	<u>Command</u>
(i)	1946	6743
(ii)	1947	7042
(iii)	1948	7327
(iv)	1949	7631
(v)	1950	7895
(vi)	1951	8146

(2) These are confirmed figures, not projections

(3) For the end of war figures, this entry is described as "manpower in direct support". The later figures refer to manpower engaged in production for the armed forces.

(4) These are the close of hostilities (Europe) levels.

(5) Greenwood, David 'Economic Constraints and British Defence Policy' in Perspectives upon British Defence Policy 1945-1970. University of Southampton 1978, p 93 who cites: Stone, T. Historical abstract of British military manpower statistics, Aberdeen Studies in Defence Economics, No. 7 December, 1975, Table 2:6 part 1.)

* J Strachey in Commons, 12 March 1946, on Air Estimates 46/47 (HC85)

** Speech in Commons, 5 March 1947, on Navy Estimates 47/48

The Defence Statement of February 1952 assumed an altered form. The following table is thus useless for comparative purposes, showing only regulars (excluding national servicemen) - but does give a guide to the projected expansion of the Air Force.

Regular male strength (thousands)

	Actual 1 Apr. 1950	Actual 1 Apr. 1951	Estimated 1 Apr. 1952	Estimated 1 Apr. 1953
Navy	122.3	125.6	135.4	133.7
Army	184.3	202.2	209.8	207.8
Air Force	114.7	139.4	173.5	213.0
TOTAL	421.3	467.2	518.7	554.5

(from Command 8475, February 1952)

The details, given in this manner, can however, be usefully compared to a breakdown given in response to a parliamentary question at the end of 1948.

Estimated strengths of the Armed Forces on 1 January 1949 (thousands)

	Regulars	National Service personnel		Total
		Men	Women	
Royal Navy	118	19	7.5	144.5
Army	180	237	12.0	429
RAF	112	111	14.0	237
TOTAL	410	367	33.5	810.5

The estimated net reduction during 1948 was 310 000
(Hansard 7 December 1948 col. 38)

APPENDIX V

ROYAL AIR FORCE: Table of annual personnel targets and actual strengths (1)

HC85* Feb. 1946	HC105 Mar. 1946	HC51 Feb. 1947	HC59 Feb. 1948	HC73 Feb. 1949	HC? Mar. 1950	CMD7898 Mar. 1950(M)	HC17 Dec. 1950(S)	HC102 Feb. 1951	CMD8162 Feb. 1951(M)	HC90 Feb. 1952(S)	HC96 Feb. 1952
Maximum uniformed strength permitted per year, in <u>thousands</u> (2)		370	325	255	215	198 by 31.3.51	215 +28	270		270 +15	315
Actual strengths in <u>thousands</u> (3)			261+	232++		202			230		(270.8)+++
Size of the Chief of the Air Staff Department (3)	1129	877	639	621	584			687			763
Civilian Scientific Officers, Air Ministry (3)(a)	109	71	27	26	17			22			23
Civilian Scientific Officers, RAF Commands (3)(a)	not given	not given	23	21	25			24			26

(1) From the Air Estimates, 1946-1952.

(2) (Except where stated), figures represent maximum strength permitted at any one time during year at head of column.

(3) Figures are the actual strengths for the month and year at head of column.

(S) The Supplementary Estimates.

(M) Memoranda to accompany the Air Estimates

(a) Refer also to the Air Force list.

+ = CMD7327

++ = CMD7631

+++ = Greenwood, D. .op cit p.261, ref 5.

*House of Commons paper no.

HC = House of Commons

CMD = Command

Appendix VI

Table of defence budgets

To an extent the figures in the tables in this Appendix and in Appendix VII speak for themselves. I have listed budgeted expenditure (Appendix VI), RAF financial estimates and supplementary estimates (Appendix VIII), and approached the question of actual defence expenditure in Appendix III. All three series of figures show the same pattern. There is a sharp decline between 1946 and the end of 1948, although, when terminal payments are excluded, the decline appears less dramatic. During the next two years there are small increases, while from the start of 1951, budgets and expenditure rise steeply. Within this pattern, the RAF does proportionately better than the other two services: the Navy takes deeper cuts, and the Army budget is falling at a time (1948-1950) when the budget for the other two services is rising. The RAF's share of the budget in 1946/1947 is 15.36% (Navy 15.30%, Army 41%); in 1952/1953 it is 31.78% (Navy 24.13%, Army 35.7%).¹

1. Rosecrance, using the figures which I have listed in Appendix III, calculates defence expenditure as a percentage of Government spending, and of gross national product (GNP), with the following results.

Date	% Government spending(1)	% GNP (2)
1946/1947	44.4	20.1
1947/1948	30.4	10.6
1948/1949	24.2	7.4
1949/1950	23.0	7.0
1950/1951	25.5	7.1
1951/1952	27.4	8.7
1952/1953	34.2	10.7

Richard Rosecrance, Defence of the Realm page 297. He cites as sources; (1) Annual Abstract of Statistics No. 93 HMSO 1956; (2) Annual Abstract of Statistics No. 94 HMSO 1957.

Table of defence budgets (1 & 2)

£ Millions

	Total	(a)	RAF	Navy	Army	(b)(3)	(c)
Feb. 1946 (for fiscal 46/47)	1667	1091	256	255	682	474	576
Feb. 1947 (for fiscal 47/48)	899	780.5	214	196.7	388	100.3	118.5
Feb. 1948 (for fiscal 48/49)	692	631.5	173	153	305	61	60.5
Feb. 1949 (for fiscal 49/50)	759.15	(4)	207.45	189.25	304.7	57.75	(4)
March 1950 (for fiscal 50/51)	780		223	193	299	65	
Jan. 1951 (for fiscal 51/52) (5)	1300						MOD (6)
Actual expenditure 51/52, as given in statement of Feb 1952	1131.5		330.5	278.5	428.8	81.5	12.2
Feb. 1952 (for fiscal 52/53) (7)	1377.2		437.6	332.3	491.5	98.5	17.3

- (a) Total excluding terminal charges.
 (b) Aircraft production and supply paid to Ministry of Supply.
 (c) Terminal charges.

Notes accompanying APPENDIX VI

- (1) Figures taken from the "Statements relating to Defence", dates as listed; Command numbers (in chronological order) as follows:-

	<u>Date</u>	<u>Command</u>
(i)	1946	6743
(ii)	1947	7042
(iii)	1948	7327
(iv)	1949	7631
(v)	1950	7895
(vi)	1951	8146
(vii)	1952	8475

- (2) These are the budgetted figures and thus do not necessarily reflect the actual expenditure. But see the table and discussion in Appendix III.
- (3) Defence Departments paid the Ministry of Supply in an inter-departmental transaction.
- (4) Separate details not given beyond 1948.
- (5) Command 8146 of Monday 29 January 1951 was entitled "Defence Programme - Statement made by the Prime Minister in the House of Commons". It was his statement on the re-armament programme occasioned by the Korean War, and contained few figures.
- (6) The Ministry of Defence itself was budgetted for less than £1 million per annum until fiscal 1952/53.
- (7) The 1952/53 budget reflects the first post-war payments of American military aid. This was provided in the form of currency adjustment in favour of sterling, on British imports from the USA. The value in this year was £85 million.

Appendix VII

Royal Air Force: table of Financial Estimates

in £ millions (1)

	ESTIMATE FOR THE FISCAL YEAR (THE AIR VOTE)	REVISED ALLOCATION BY SUPPLEMENTARY ESTIMATE	
HC85, Feb 1946 Fiscal 46/47	255.5	266.787322	HC 80, March 1948 Fiscal 46/47 (S)
Cmd 7053, Feb 1947 Fiscal 47/48 (M)	214	214	(2)
Cmd 7329, Feb 1948 Fiscal 48/49 (M)	173	189.4	HC 72, Feb 1949 Fiscal 48/49 (S)
Cmd 7634, Feb 1949 Fiscal 49/50 (M)	207.45	207.45	(2)
Cmd 7898, March 1950 Fiscal 50/51 (M)	223	233	HC 80, Jan 1951 Fiscal 50/51 (S)
Cmd 8162, Feb 1951 Fiscal 51/52 (M)	328.75	330.55	HC 90, Feb 1952 Fiscal 51/52 (S)
Cmd 8474 Feb 1952 Fiscal 52/53 (M)	437.64 (3)		

(1) From the Air Estimates, 1946-1952.

(2) There was no supplementary estimate for fiscals 1947/48 and 1949/50.

(3) Figure net of USA military aid; gross appropriation was £520,843,100.

(S) The Supplementary Estimates.

(M) Memoranda to accompany the Air Estimates.

Appendix VIII

Royal Air Force: Table of Air Estimates; vote 7¹

Technical supplies and services, in £ millions ²

	HC 51* Feb 1947	HC 59 Feb 1948	HC 73 FEB 1949	HC ? March 1950	HC 102 Feb 1951	HC 96 Feb 1952
Aircraft - new, spares, upkeep	42.75	38.73	50.65	54.78	81.0	111
Armament and ammunition	6.25	2.55	5.32	6.75	17.6	29
Radio, radar & electrical equipment	4.4	4.4	6.08	9.165	12.3	21
Instruments & photographic equipment	1.23	1.55	3.3	5.23	5.87	8
Other categories	16.3	11.57	17.15	19.58	34.0	46.5
Total (gross)	70.928	58.8	82.5	95.5	150.75	215.5 (5)
Total net of appropriations- in-aid (3)	57.958	48.0	64.5	78.0	132.75	161.0 (5)
Amount of total (gross) paid to the Ministry of Supply (4)	not given	51.87	71.5	84.0	133	197

Notes accompanying Appendix VIII

- (1) The Air Estimates are financial statements consisting of a series of 'votes'. Vote 1 (RAF pay) and vote 7 (technical supplies and services) consumed the bulk of the money.
- (2) From the Air Estimates, 1947-1952;
- (3) Appropriation-in-aid represent interdepartmental adjustments, and thus can be seen as the RAF income received for services provided to other parts of government, as well, it would appear, received from the sale of items, including things sold to RAF personnel.
- (4) During the war, and until the end of 1946, the practice was not to make financial adjustments between the Ministries. RAF supplies came almost entirely under the vote of the Ministry of Supply. From 1947 part of the Air Vote was 'paid' to the Ministry of Supply, which was the aircraft and equipment purchasing and contracts agent for the RAF and the Army (Navy retained its own supply system except in respect of aircraft and guided weapons). However, all expenditure in connection with research and development continued to be borne on the vote of the Ministry of Supply.
- (5) The appropriations-in-aid here of £54.5 million include £30 million in American aid.

* = House of Commons paper no.

Appendix IX

Memorandum by the Minister of Supply; 'Acceleration of the Guided Weapons Programme'.

1. The Defence Committee at its meeting on 11th July 1950 (D.O. (50) 13th Meeting, Minute 1), agreed that the guided weapons programme should be accelerated to the maximum possible extent, and invited me to lay before the Committee my proposals for achieving this acceleration. On 25th July the Prime Minister directed that this meant in practice 'that it must be accorded the same special degree of priority that has been given to the atomic energy programme.'

Summary

2. This paper sets out -
 - (a) the content of the guided weapons programme;
 - (b) the allocation of work between Industry and Experimental Establishments;
 - (c) the rate of progress and the factors which have limited it;
 - (d) the measures taken, or planned, to accelerate progress;
 - (e) the resultant acceleration and its cost in terms of finance and diversion of effort from other work.
3. The salient points are:-
 - (a) Before the Defence Committee decided that the guided weapons programme should be accelerated to the maximum practicable extent the programme was running a year or more late (paragraph 7).
 - (b) The principal factor limiting progress, both in Experimental Establishments and in industry, is shortage of suitably qualified staff, particularly at the section-leader level (paragraphs 7 and 14).
 - (c) With the measures taken and to be taken by the Ministry of Supply, there are good hopes of meeting the target dates. These dates could perhaps be improved upon by as much as one year if it were possible to disregard the requirements of all other high-priority items in allocating new staff (paragraphs 18 and 19).
 - (d) The chief effect of the acceleration of the guided weapons programme on other important projects will be to deprive them of staff. The depletion would be about 10 per cent if the full requirements for the guided weapons programme were met, but it would not bear equally on all programmes. Serious diversion of effort from other electronic research and development is almost inevitable, but it is not yet possible to be more precise in estimating the effect on other programmes (paragraphs 18 and 19).
 - (e) The cost of guided weapons research and development work in industry over the next three years is likely to be-

	£ million				
1951-1952	...	...	...	...	4.2
1952-1953	...	...	...	...	6.3
1953-1954	...	...	...	...	8.4

(Paragraph 20)

The annual cost of the additional 330 staff required (paragraph 11) would be about £1 million allowing for ancillary expenses such as subordinate staff, stores, materials &c.

Content of the Guided Weapons Programme

4. Effort is concentrated on the five projects designed to meet the following requirements (details are at Appendix A):-

	Target Date for First Production
A ground-to-air anti-aircraft weapon (Red Shoes) ...	1957
A ground-to-air anti-aircraft weapon (Red Duster) ...	1957
A ship-to-air weapon (Sea Slug)	1957
An aircraft-to-aircraft weapon (Blue Sky)	1954
(giving place later to Red Hawk)	1957
A guided bomb (Blue Boar)	1957

Until more progress has been made in the solution of the problems thrown up by these requirements, it is most important that no further commitments be undertaken. These would lead to dispersion of effort with consequent delay. The estimated acceleration given in paragraph 18 below assumes that requirements will not be altered for the next two years or so.

Apportionment of Work between Industry and Experimental Establishments

5. As much of the development as possible is being carried out in industry. With the exception of a few items such as warheads, fuses and solid-fuel rockets, for which the Experimental Establishments are solely responsible, the Establishments act primarily as suppliers of basic scientific and technical data. However, fundamental problems arise much more frequently than in the development of longer established weapons, and a large part of the work has to be carried out in the Establishments.
6. To ensure maximum progress the widest possible use is being made of staff and technical facilities suitable for guided weapons work in the Experimental Establishments (a list of Establishments engaged on guided weapons work is at Appendix B), but the problems arising from the design of the various components of a guided weapon (vehicle, power unit, radar, control mechanisms) are so interwoven that a high proportion of the work must for the present be centralised at the Guided Weapons Department of the Royal Aircraft Establishment, Farnborough.

Factors Limiting Rate of Progress

7. By the middle of this year it had become clear that the target dates for first production would not be achieved by a year or more unless exceptional steps were taken. Development had, in two instances, been held up pending completion of test facilities. Also, lack of supersonic wind tunnels necessitated more firing trials than would otherwise have been required. Nevertheless, the primary factor limiting progress both in Establishments and Industry had been (and remains) availability of research and development staff.

Measures Taken, and Planned, to Accelerate Progress

(a) At Headquarters

8. The Ministry of Supply Headquarters organization has been strengthened by the appointment of a Chief Executive (Guided Weapons) ranking with the Controllers and Chief Scientist. The scientific staff at Headquarters will be increased from 21 to 32 during the next 12 months.

(b) At Establishments

9. The number of scientific staff directly engaged on guided weapons work has increased from roughly 350 in April to 412 now (both figures include 50 employed under the Admiralty). In addition to the direct effort a further 208 scientists are engaged on work which, while necessary for guided weapons, would have gone on even if there were no guided weapons programme, and another 231 are engaged on basic work necessary for a well-planned attack on guided weapon as well as other defence problems. In the main the increase in the number of directly engaged staff is due to recruitment, but there has been some redeployment of staff. Arrangements are in hand for further redeployment by placing work with the Armament Research, Armament Design and High Explosive Research Establishments.
10. As well as the Establishments which exist for defence research and development, the Atomic Energy Research Establishment has for some time been working on certain electronic aspects of guided weapons development. Steps are being taken to place more of this work at A.E.R.E. as quickly as possible.
11. In order to achieve the maximum possible acceleration of the programme, some 330 additional scientific staff would be required up to 31st March, 1952 (12, in addition, will be needed by the Admiralty). Of these about 80 will be found by recruitment well before the end of the present financial year, leaving a requirement of about 250 for the financial year 1951-52. It is estimated, however, that with the maximum recruiting effort, it will not be possible to increase the Ministry of Supply staff as a whole during 1951-52 by more than about 400 (allowing for expected wastage this will necessitate an intake of over 600). If the guided weapons requirements were met in full, only about 150 additional staff would be available for other high-priority work. This number would only be sufficient to fill vacancies in the complements allotted for the current financial year 1950-51 which, owing to restrictions on recruiting earlier in the year, it will not be possible to fill by 31st March 1951. With these vacancies filled there would remain a shortage of not less than 500 in the staff available in 1951-52 for the other high-priority work, and in particular for other electronic research and development.
12. Additional laboratory space and houses are needed for the staff. The provision of laboratories should not be difficult. Under the general housing scheme for Establishments, 200 houses are being provided at the Royal Aircraft Establishment (Farnborough), 71 at the Rocket Propulsion Department, 100 at the Explosives Research and Development Establishment, and 400 at Malvern for the Telecommunications Research Establishment and Radar Research and Development Establishment. The construction of these houses should be well on the way to completion by the end of 1951, and will enable the additional staff for guided weapons work to be housed. Smaller schemes have been put in hand at other Establishments.

(c) In Industry

13. The appointment of the Chief Executive has had a stimulating effect on Industry. All firms have been informed of the new priority attached to guided weapons work, and they have made a variety of suggestions for accelerating their individual contributions. In a few firms, mainly aircraft firms, a significant diversion of effort from other defence work has already taken place. In general, however, firms tend to regard any further effort on guided weapons as additional to their existing commitments, and there is still some reluctance to divert more effort from civil work. This reluctance is gradually being overcome. While every effort will be made to build up industry's confidence in the future of guided weapons work, and to persuade firms to divert further effort from other activities, it will be necessary, at this stage, to arrange schemes for expanding staff and facilities.
14. Where housing limits recruitment, firms have been asked to state their needs so that we can give them whatever assistance is possible. But generally the most difficult problem is to find suitably qualified men, particularly at the section leader level, and it is difficult to see the solution of this problem. To second suitable men from the Admiralty or Ministry of Supply would merely accentuate the shortage of staff at Establishments. The possibility of securing staff by secondment from other Departments is being considered.
15. Five firms - English Electric, Ferranti, Sperry, Electric and Musical Industries, and the General Electric Co. - have applied for capital assistance to meet the cost of expansion of development facilities. The Ferranti and G.E.C. schemes are going ahead, and approval of the other schemes will follow as soon as agreement can be reached with the Board of Trade on the location of the new facilities.
16. Efforts are being made to interest other firms in guided weapons work. In addition, the United States Government have been asked to agree to direct exchange of information between the (British) Sperry Gyroscope Co. and their parent firm in America on control mechanisms and between the Bristol Aeroplane Company and Boeing Aircraft Ltd. on Ram-jet work.
17. Measures will be taken to shorten the period between prototype trials and first production. For example, components will be approved for production as soon as there is reasonable confidence that their design is not likely to be affected by further trials.

Acceleration of Programme and Cost

18. If the full requirements for new staff mentioned in paragraphs 11 and 13 were met, there would be good hopes of meeting the target dates mentioned in paragraph 3, and possibly of improving on them by up to one year. It seems unlikely, however, that the damage to other high-priority items that would result from allocating so high a proportion of the available recruitment to the guided weapons programme could be tolerated. A revised estimate of the staff required for other high-priority work is being undertaken at the request of the Defence Research Policy Committee, and until that estimate has been completed and considered in detail it is impossible to say to what extent interference with other work for the benefit of the guided weapons programme would be acceptable.

19. Staffing the guided weapons programme to the full requirements described in paragraphs 9-11 would deplete the staff required for other high-priority work by about 10 per cent, but the effect would not, of course, be spread uniformly over all fields. In particular, it would be impossible to meet the guided weapons requirements without serious diversion of effort from other important electronic work.
20. The cost of guided weapons research and development work in industry under the accelerated programme over the next three years is likely to be:-

	£ million				
1951-1952	...	...	...	...	4.2
1952-1953	...	...	...	...	6.3
1953-1954	...	...	...	...	8.4

The annual cost of the additional 330 staff required would be about 1 million allowing for ancillary expenses, including subordinate staff, stores, materials, &c.

18th November 1950

G.R.S.

APPENDIX A

THE GUIDED WEAPONS PROGRAMME

Ground-to-Air Weapon (Range 50,000 yards)

1. Two projects have been undertaken to meet the requirement.
2. The first (Red Shoes) is with the English Electric group of companies which provides, within the one organization, the experience necessary in the aerodynamic, propulsion and electronic fields. During the past 18 months they have studied the problem of the ground-launched anti-aircraft weapon, and now have a contract to proceed with its development. It is proposed that this weapon should be rocket-propelled and should be guided by radar-homing from the ground to the target. It is hoped that the first missile will achieve an effective range of the order of 40,000 to 50,000 yards at heights up to and above 35,000 feet.
3. The second project (Red Duster) is with the Bristol Aeroplane Co. Ltd, in collaboration with Ferranti. They have been engaged on the work for a shorter time than the English Electric group and are still studying the design problem prior to the commencement of development. The firms are, however, engaged in producing test-vehicles for the Ministry of Supply, and are thereby gaining valuable experience. The Bristol-Ferranti proposal is for a ram-jet-propelled missile with radar-homing guidance. Less is known about the ram-jet than about the rocket, but the potential advantage of the ram-jet makes it worthwhile to have a strong industrial group working on these lines.

Sea Slug

4. This is primarily a ship-to-air weapon with a range of about 30,000 yards. It may possibly be used by the Army should it be ready before Red Shoes or Red Duster.

5. The project is under development by Armstrong-Whitworth Aircraft Ltd, in cooperation with the General Electric Co. and the Sperry Gyroscope Co. The weapon is to be rocket-propelled and guided by a method of riding a radar beam to the target, with provision for homing onto the target at the end of its flight. This was the first guided weapon project to be started and development is correspondingly advanced. The programme includes, however, the special problems of fitting the weapon in ships.

Blue Sky

6. This is a weapon for arming fighter aircraft to attack heavily armed bombers of the B.29 type. The method of guidance will depend on visual sighting of the target, so the use of the weapon will be restricted to daytime and to attack from a limited cone astern the bomber. The Fairey Aviation Co. assisted by the Plessey Co. have undertaken the development.

Red Hawk

7. This is to be an air-to-air weapon that can be used by day or night and launched from any direction relative to the target. The decision of the Air Staff to accept Blue Sky as an interim weapon led to a reduction in priority of the Red Hawk. Nevertheless, the limitations of Blue Sky are so severe that work on Red Hawk is being continued so long as it can be done without prejudice to the remainder of the programme. It is to be expected that Red Hawk will be available one or two years after Blue Sky: its progress will depend substantially on the results of the work on Blue Sky.

Blue Boar

8. This is a television-controlled bomb: its use will therefore be limited to conditions in which the target can be 'seen' by the television camera in the bomb. Vickers-Armstrong Ltd, with Electric and Musical Industries Ltd, have undertaken the development. The importance of this project has not yet been defined by the Defence Research Policy Committee.

Other work in industry

9. Rolls Royce Ltd, and Armstrong-Siddeley Ltd, are engaged on research and development in the field of expendable gas turbines.

APPENDIX B

MAIN ESTABLISHMENTS ENGAGED ON GUIDED WEAPONS

<u>Establishment</u>	<u>Type of Work</u>
A. Royal Aircraft Establishment projects. (R.A.E. Farnborough)	Technical consideration of Trials
B. R.A.E./Rocket Propulsion Dept. (R.A.E./R.P.D.).	Solid and liquid rocket fuels. Motor design and testing.
C. National Gas Turbine Establishment (N.G.T.E.), Pyestock Cove, Nr. Farnborough	Ram jet research and development.
D. Telecommunications Research Establishment (T.R.E.) Gt. Malvern, Worcs.	Radar homing and infra-red investigations. C.T.V. guidance, and airborne radar and guidance for Blue Sky. C.W. investigations for semi-active homing for Red Duster.
E. Radar Research & Development Establishment (R.R.D.E.), Malvern, Worcs.	Research and development of ground radar equipment. Development of ground equipment for Red Shoes, tactical (Orange Yeoman) and tracking (Yellow River) radar. Instrumentation for ranges.
F. Signals Research & Development Establishment (S.R.D.E.), Christchurch, Hants.	Research and development on telemetry.
G. Explosives Research & Development Establishment (E.R.D.E.), explosives. Waltham Abbey, Essex.	Research on liquid and solid fuels for rocket motors and on
H. High Explosives Research Establishment (H.E.R.E.), Fort Halstead, Sevenoaks, Kent.	Research in collaboration with R.A.E. into fragmentation and warhead design.
I. Armament Research Establishment. (A.R.E.), Fort Halstead, Sevenoaks, Kent.	Research into fragmentation.
J. Armament Design Establishment. (A.D.E.), Fort Halstead, Sevenoaks, Kent.	Warhead design.
K. Admiralty Signals and Radar Establishments (A.S.R.E.), Haslemere.	Research and development of type 901 beam-riding radar set and type 902 gathering set for Sea Slug.
L. Admiralty Gunnery Establishment (A.G.E.), Teddington.	Research and development on servo-mechanisms for Sea Slug, ship directors, &c.
M. Joint Services Experimental Research Laboratory (S.E.R.L.), Baldock, Herts	Work on valve reliability and valve design

Note on Sources

During the course of my research I wrote to a number of men who occupied senior service or departmental positions between 1945 and 1952. Most replied to my letter. I had the opportunity of talking to some of them.

The letter I wrote asked the recipients to comment on: (1) whether or not, in their opinion, there existed a post-war bomber school of air power; (2) the informal organization of the Chief of the Air Staff's Department; (3) the quality, organization and direction of the post-war military scientific effort. Some of the replies were so comprehensive that I have felt justified in quoting from them - in almost all cases the comments added to my understanding of the period.

Replies were received from the following:

Air Chief Marshal Sir Denis Barnett
Marshal of the Royal Air Force Sir Dermot Boyle
Air Vice Marshal S.O. Bufton
Air Marshal Sir Edward Chilton
Air Marshal Sir Gareth Clayton
Sir William Cook (Chief of the Royal Naval Scientific Service, 1950-54;
Member of the Defence Research Policy Committee)
Air Chief Marshal Sir Kenneth Cross
Air Chief Marshal Sir Walter Dawson
Marshal of the Royal Air Force Sir William Dickson
Air Marshal the Revd. Sir Paterson Fraser
Air Chief Marshal Sir William MacDonald
Air Marshal Sir Lawrence Pendred
Air Chief Marshal Sir Hugh Saunders
Air Vice Marshal Sir Lawrence Sinclair
Air Marshal Sir Hugh Walmsley
Air Marshal Sir John Whitley

My correspondence with the following resulted in their inviting me to visit them to discuss the issues raised, and related subjects:

Sir Robert Cockburn (Scientific Adviser to the Air Ministry, 1948-54;
Chief Scientist, Ministry of Supply; Director, RAE)
Conversation of 3 September 1984, recorded on tape
Air Commodore H.I. Cozens (Director of Plans, 1949-51)
Conversation of 1 August 1984, written notes
Air Chief Marshal Sir Alfred Earle (ACAS Policy, 1955-57)
Conversation of 30 July 1984, written notes
Air Marshal Sir Victor Goddard (Air Member for Technical Services, 1948-51)
Conversation of 2 August 1984, written notes
Mr H A Popham (Director, RAE Aberporth, 1948-56)
Conversation of 17 September 1984, recorded on tape
Air Marshal Sir Geoffrey Tuttle (ACAS O.R., 1951-54)
Conversation of 16 July 1984, written notes

I also had discussions with Professor Margaret Gowing (Linacre College, Oxford, the Official Historian of the United Kingdom Atomic Energy Authority), Mr Humphrey Wynn (then Air Historical Branch, Ministry of Defence) and Sir Frederick Page (Chairman and Chief Executive, British Aerospace Aircraft Group). The information I received from these people was of great value to my work.

I talked with Professor Gowing on 7 March 1979 at the London Office of the United Kingdom Atomic Energy Authority; with Sir Frederick Page on 7 February 1980 at the British Aerospace Offices in Kingston-upon-Thames; and to Mr Humphrey Wynn on 22 November 1983 and 10 January 1984 in his office at the Ministry of Defence. (Written notes taken of conversations.)

I wish to record my thanks and appreciation to all these people for the trouble they took on my account.

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