IN THREE DIMENSIONS

By the same author

WINGED WARFARE

WAR
IN
THREE DIMENSIONS

The Impact of Air-Power upon
the Classical Principles of War

by

Air Vice-Marshal
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And in the thunder of their wings
I heard an Empire speak

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Dedicated to the memory
of my brother, Wilfred

FOREWORD

IN December 1943 I was appointed Chief Operations Planner to Air Chief Marshal Sir Trafford Leigh-Mallory at Headquarters Allied Expeditionary Air Force for the invasion of Normandy in the summer of 1944. Very soon I found myself grappling in practice with strategical problems to which I had devoted much thought over many years. The same bomber forces would be needed for immediate support of the surface operations and for attack upon the sources of Germany's war power. For Lord Tedder, the Deputy Supreme Allied Commander, this was the crux of the air problem in the invasion of Western Europe. The plan which emerged met both claims upon the bomber forces. Without it the enemy's land forces would almost certainly have won the build-up race of army divisions after our initial assault in Normandy, and pushed us back into the sea; without it, also, Germany's war economy would not have crashed so disastrously in the autumn of 1944.

My experience in the planning of the Normandy Invasion decided me to attempt two new studies: one on the principles of strategy in modern war, and another on planning and high command. The former of these projects has resulted in this book.

On the conclusion of the Normandy operations, I was appointed to His Excellency the Commander-in-Chief's Committee on Reorganization of the Army and Air Forces in India. It was here that I came in contact with Brigadier J. E. Powell, late Royal Warwickshire Regi-

ment, a fellow member of the Committee. This was indeed my good fortune; for, with his analytical and penetrating mind, he got to the core of my problems. Throughout our time in India, and subsequently, we discussed and together worked out many ideas on strategy. On this book we have collaborated closely at every stage.

I also wish to thank several other friends who have helped me with this book, in particular, Professor S. Zuckerman, C.B., F.R.S., Wing Commander G. W. M. Dunn, Flight Lieutenant R. S. Moir, W. Demel, D. F. C. and Mr. Leslie Scarman.

I must of course emphasize that the ideas and opinions expressed in the book are in no way to be taken as official or as being those of anyone but myself.

E. J. KINGSTON-MCCLOUGHRY

Bendameer
July 1949

CHAPTER I

THE CLASSICAL CONCEPT OF WAR

FOR over a hundred years the theory of strategy has taught that the object in war is to break the war-will of the enemy and that the method of achieving this object is to disorganize his armed forces by battle. It is this theory which I propose to examine in its application to present and future conditions.

The seat of a state's war-will varies according to the nature of the state. In elementary forms the war-will has often vested almost exclusively in the person of the sovereign, so that his elimination, or the frustration of his purpose, was sufficient to destroy it. This is seen in an extreme case in oriental warfare, where the death or flight of the monarch, present on the battlefield in person and taking part in the fighting, has often decided the contest, because little or no part of the war-will of the opposing states resided in the armies or nations. This incarnation of the war-will in a single person is symbolized by the primitive institution of deciding wars or disputes vicariously through champions, like David and Goliath in the Old Testament.

Where armies are mercenary, and to a lesser degree when they are professional, the war-will of belligerent states is still concentrated in a very few persons, while the mass of the populations passively accept decisions reached upon the battlefield. On the other hand, where

conscript or citizen armies, imbued with a patriotic spirit, are fighting for a national cause rather than for pay and employment, they themselves share in the will-to-war, which in these cases is broadly based upon the sentiment of the nation at large. This is exemplified in the wars of the democratic city-states of ancient Greece, where the citizen body which declared wars and governed their course was identical with the army which prosecuted them. The more nearly the forces necessary to conduct the war are identical with the state itself, the more widely diffused is the will-to-war.

The will-to-war of a state may not only be more or less widely diffused. It may also vary in its strength and intensity according to the value attached to the prizes at stake. The annexation of a province or the capture of a stronghold will only justify the expenditure of a proportionate quantity of effort and resources. As soon as the prospect of achieving the object with that expenditure has disappeared, the will-to-war disappears also, unless the object has by then been replaced by a different one, such as the salving of national pride, which may be worth a higher, but still not unlimited, price. Thus the more essential to the existence of the state appears the object at stake, the stronger becomes the will-to-war. Where the object of the war is of supreme importance, as when a state is fighting to save itself from virtual elimination, from a defeat meaning the loss of national identity, and a long future of suffering for all the citizens, then the expenditure of effort and resources which appears worth while is limited only by their physical availability.

It may be observed that while the objects which promote the outbreak of war are often positive and clearly

defined on one side, if not both, the objects which maintain it, once declared, are usually on both sides negative and more or less blurred. The conquest or annexation of a specific territory may be the pretext to start a war, but it may well be maintained, long after the original cause of war has been forgotten, by both sides being anxious, even to fanaticism, to avoid failure or escape defeat; for nations are capable of redoubling their efforts when they have forgotten their original purpose.

The political and economic changes of recent centuries in the nations of the West have tended to transfer power from ruling individuals or classes to the whole body of the nations, and with this transference of political power, the war-will also passed from individuals or groups to the masses. Parallel with this change the objects of making war have changed. Wars are no longer fought merely for dynastic change or territorial acquisition — aims, which would not normally evoke the war-will of the masses. Instead of these simple aims, more complex ones which intimately affect every person in a country, are the occasion of modern wars.

An important stage in this process of change was the emergence in modern Europe of great citizen or conscript armies which replaced the smaller professional or mercenary armies of the past, concurrently with the rise of a militant political creed which sought to revolutionize the constitution and the way of life of Western European nations. The contemplation of the French Revolutionary and Napoleonic wars which followed inspired Clausewitz to write his great philosophical inquiry into the nature of war and the principles of strategy. Yet ironically enough, the disappearance of the conditions which his

theory assumed was heralded by these very events themselves.

The classical doctrine of war, that the object of war is to break the war-will of the enemy by the disorganization of his armed forces in battle, rested upon the following reasoning. The will-to-war existed in the minds of certain individuals and in a certain intensity. By acting, therefore, upon that will, hostilities could be brought to an end long before the physical capacity to make war was exhausted. The method of acting upon that will was to render useless the instrument on which it relied. The aim could consequently be achieved most easily, speedily and economically by disorganizing the armed forces, without any further destruction of men or material beyond what was necessary to achieve that.

By the beginning of the nineteenth century, however, the armed forces were beginning to lose their separateness from the rest of the nation as the exclusive and self-sufficient instrument for waging war. At the same time, with the deepening or broadening of the war-will and the widening of the scope of war aims, the difficulty of acting upon that will had greatly increased. This is not to say that the principles of classical strategy ceased to be valid at any time in the nineteenth century. Neither the economic and scientific advances nor the political changes of the hundred years after the battle of Waterloo rendered the disorganization by battle of the enemy's armed forces any less the essential process of warfare than it had been before.

It is true that the functioning of armies and the conduct of war had come to depend not merely upon the wealth but also upon the physical resources and industrial

capacity of a belligerent. Thus the home front — the mines, the factories, the transport system, the workers and the civil population themselves — equalled the battle front in importance, because without the support of the home front the battle front could no longer be maintained for any appreciable time. The home front, however, continued to be defended by the deployment of the armed forces on land and sea. An enemy could act upon the home front only, as in the past, through the destruction or rout of the armed forces.

It is also true that democratic movements and new methods of political organization and propaganda had enabled whole populations to be permeated by the war-will to a degree previously unknown, so that the will-to-war might actually outlive the physical ability to wage it. No fresh methods of acting upon that war-will had, however, disclosed themselves, and therefore these changes, by themselves, could bring about no revolution in strategy.

The trends which have been described only produced a practical revolution in the principles and conduct of warfare during the last generation, when far-reaching changes in the weapons with which war was fought released the imprisoned forces. Before we turn to examine these changes and their effects, it will be well to understand clearly the functions of the armed forces in warfare before these changes took place.

CHAPTER II

TWO-DIMENSIONAL WARFARE

THE sea is principally used by man for the movement over its surface of persons and things. In time of war these may include the land forces of a nation in transit from their base to the theatre in which they are to operate, together with the supplies and reinforcements necessary for their maintenance. They may also include materials upon which, either as exports or imports, that nation's economic life, and consequently its ability to make war, depend. A belligerent will therefore attempt to prevent his antagonist from using the sea for these purposes, and the latter in his turn will attempt to counter these hostile acts. The forces by which interference with sea transport is either attempted or countered have, in the cause of efficiency, become specialized; it is proposed to describe them as *maritime forces*. The word 'maritime', to describe all forces concerned with preserving or denying the use of the sea, is chosen in preference to the term 'naval', because 'naval' so readily introduces a notion of naval vessels or of the Senior Service, whereas it is desired to focus attention upon the function rather than on the instruments by which the function is performed. The armed merchant vessel protecting itself or the aircraft patrolling a sea-route is as much a maritime force as one of H.M. ships, but could not well be designated by the word 'naval'. The power to interfere with an enemy's use of sea transport, while preventing his interference with

one's own, is termed 'command of the sea' or, more vaguely, 'sea power'.

How much influence the operations of maritime forces have on the outcome of a war as a whole, necessarily depends upon the geographical and economic situation of the belligerents. In the case of a nation which is actually or virtually insular, fully effective interference with its power to use sea transport will render it unable to act against the land forces of an enemy in a country other than its own. If in addition it is wholly or largely dependent on the movement of goods by sea for its power to wage war, such interference may well be sufficient to achieve victory. This type of case, however, though ever-present to the minds of the British people because they themselves exemplify it, is in reality an exception. In all operations of war other than the defence of a wholly or virtually island state, or group of states, the gaining of command of the sea cannot be decisive but must be followed by the operations of other forces.

Although an enemy's maritime forces are superior, it may nevertheless in certain circumstances be possible to transport forces and materials successfully by sea. This can occur where the area of sea available for use is extensive in comparison with the size and radius of action of the maritime forces available for interference. Nevertheless for most purposes a fairly general and continuous use of sea transport is requisite, and this can only be secured by the neutralization, if not destruction, of an adversary's maritime forces. For example, while it is probable that at most times in the summer and autumn of 1805 Napoleon could have completed the movement of his army from France to England before the British fleet

effectively intervened, he did not feel able to accept the severing of his sea communications which must follow immediately afterwards. Therefore he considered it necessary to delay invasion until he could destroy or seriously reduce the British fleet and so secure a longer period of safety for his sea transport in the Channel.

Thus in two-dimensional warfare (before the submarine as well as the aircraft) the prime function of maritime forces was by battle to destroy or neutralize the maritime forces of the enemy and only secondarily to operate, if necessary, against his sea transportation itself. Unlike an army, a fleet could not always be brought to battle against its will by an enemy fleet but could remain in the shelter of its bases. In such a case the maritime forces were neutralized by threat of battle instead of actually destroyed in battle; but, for the time being at least, command of the sea was equally secured.

The prime function of land forces in two-dimensional war, even more clearly than that of maritime forces, was the disorganization of the opposing forces by battle. Under the 'classical' conditions which obtained before World War I the army of a belligerent nation covered the other essential elements of its power to wage war and was alone exposed to the action of an enemy. Non-military objectives, such as even the capital city, could be relinquished for a time if their continuous possession was not indispensable to the conduct of the war: to gain victory it was still necessary to seek and destroy the enemy's main forces on the battlefield. (This was the predicament of Napoleon in 1812, when his occupation of Moscow failed either to bring about the capitulation of the Russian government or to force the Russian army to give battle.)

On the other hand, any non-military objective which was vital to a combatant's power to prosecute the war would be covered by his army as long as that remained in existence, and the way to its capture could only be opened by defeating the field forces in battle. Hence the classical principle that the function of an army is to defeat the enemy's army.

It followed that the business of a commander of land forces was to bring them on to the field of battle and manipulate them there in such a way as to achieve the maximum disorganization of the enemy's army.

Battle itself — and this applied to all forces — fell logically into two phases, though in practice they might be intimately interwoven and extremely difficult to separate. In the first phase neither side had gained such ascendancy over the other as to enable it to inflict greater disorganization than it suffered itself. In this phase the losses in personnel and material on either side might be equal or might even be greater on the side of the eventual victor. The second phase began when one side or the other had established a definite ascendancy over the other, and continued from that time until contact was broken or the action otherwise ended. It was in this phase that the one side disorganized the other by inflicting heavy losses in personnel and material at small cost to itself.

The handling of forces in actual contact with the enemy was denoted *tactics*. On the other hand *strategy*, as opposed to tactics, related to the handling of forces not actually in contact. Since a commander could freely move only those forces which were not committed, that is, not in actual contact with the enemy, strategy (at least in this strict sense of the term) was concerned with

decisions whether and how to move forces. Further, since the reserves of a lower formation were always, from the point of view of a higher formation, already committed, each level of command had different spheres of tactics and of strategy, right from the smallest sub-unit, for which the movement of a reserve section was strategic, up to the supreme command, for which strategy related to the movement of forces between theatres. This last formed part of *grand strategy*, which embraced the deployment and committal of the total resources of a belligerent. The object in strategy was to ensure that the result of battle when contact did take place was as far as possible a foregone conclusion, while the object in tactics was to reduce to a minimum the first phase of battle, which consisted of fighting properly so called, and to augment the length and effect of the second phase, which was that of pursuit and disorganization.

Both in tactics and in strategy, the essential difference between the offensive and the defensive was that forces on the offensive sought the enemy, while forces on the defensive awaited or avoided him. The choice of the offensive or defensive in the strategic sphere would generally depend not only on the full circumstances both of the war and of the respective antagonists, but also upon the object with which a given campaign was being fought. Yet the side which was strategically on the defensive might adopt offensive tactics, and *vice versa*; for in the tactical sphere the choice depended upon the temporary situation of the two forces on the particular field. Whether the tactical offensive or the tactical defensive was characteristically the stronger form depended upon the exact state of technique and weapons at a particular

time, and might vary in the course even of a campaign and certainly of a war. On the other hand, the strategic offensive — in land warfare, at any rate — was characteristically the weaker form, since it exposed the attacker to certain inherent disadvantages, such as lengthening communications, the occupation of enemy territory and the confronting of enemy prepared positions. It was therefore a form which in land warfare, and in warfare generally so far as its operations were regulated by those of the land war, could only correctly be adopted by that side which was stronger in the true military sense.[1]

The above is a brief review of the functions of the armed forces in two-dimensional warfare and of the conceptions of battle around which classical strategy centred. When the implications of war in three dimensions are considered, it will appear that the forces which use the third dimension have different functions and operate upon different principles. These differences in turn react upon the role of the forces operating in two dimensions. In consequence the classical concept of the aim in war as the destruction of the enemy's war-will through the disorganization of his armed forces in battle requires complete re-examination. It must now be replaced by a new one, based upon an understanding of the true nature of three-dimensional warfare.

I have made reference to the classical concepts rather than to 'the principles of war' or 'the principles of strategy'; for these are ambiguous expressions used in two distinct senses. In one sense they are axioms derived directly from the nature of things and therefore immut-

[1] This idea may be found fully developed in the Sixth and Seventh Books of Clausewitz, especially VI 1-3, and VII 4-5.

ably true. Such are the principles of concentration and of economy of force. In the other sense they are rules of practice obtained by applying the former to particular conditions of warfare, and therefore valid only as long as those conditions remain materially unchanged. It is principles of the latter kind that this book is concerned to examine and revise.

CHAPTER III

THE THIRD DIMENSION: LONG-RANGE BOMBARDMENT

APART from the purely tactical devices of mining and countermining and a few tentative experiments in tunnelling in World War I, subterranean warfare still lies entirely in the future. For practical purposes three-dimensional warfare means the combination of surface warfare with warfare below the surface of the sea and above the surface of the land and sea.

The potentialities of submarine warfare were realized earlier than those of air warfare, and it was possible to develop the submarine to a fairly mature stage during World War I. The scope of three-dimensional warfare in its submarine aspect is, however, fairly limited. The sea gives no access to an enemy's country beyond the coast-line, nor does movement through or under the surface of the sea enable his land forces to be by-passed. Submarine navigation merely confers upon maritime forces the ability to pass through their element relatively unobserved, albeit hitherto at the expense of speed and carrying power. How far these limitations can be overcome and whether maritime warfare will not in future become increasingly submarine in form are questions which will be touched on later.

The use of the third dimension above the surface, though its potentialities are much greater, developed somewhat later and is still far from fully explored. The

use of this element permits projectiles to be brought to bear upon targets situated even at great distances from the base of operations or from any position occupied by armed forces on the surface. All projectiles, admittedly, except the torpedo, travel to their targets through the medium of the air; but the enormous extension of range resulting from the discovery of new methods of propulsion has been so great as to introduce into warfare entirely new possibilities. These consist essentially in the exposure to direct enemy action of constituent elements in a belligerent's war power *other than his armed forces*. I shall throughout describe such direct action against these other constituent elements by the term 'long-range bombardment'.

The methods of long-range bombardment fall into two main categories. In the first category the weapon which discharges the projectile (usually containing an explosive) is itself conveyed to the proximity of the target. In the second category the projectile is discharged from a weapon which remains stationary at a great distance from the target. Both methods of long-range bombardment were first employed in World War I, the former by means of the aeroplane and airship, the latter by means of 'Big Bertha', the German gun which shelled Paris in 1917 and 1918 at ranges of up to eighty miles. In the period between World Wars I and II the development of the internal combustion engine and aeroplane carried the former category of long-range bombardment weapon far ahead of the latter, which, in the form of the superheavy rifled gun, had proved extremely clumsy and incapable of further development. In World War II, however, the pendulum began to swing the other way,

and long-range bombardment weapons of the second category — exemplified by the pilotless aircraft and the long-range rocket — came into increasing prominence. The Japanese suicide aircraft (Kamikaze), although containing a human directing agency, was also essentially a projectile, being non-returnable and completely destroyed at the target.

Regarded purely as an instrument of long-range bombardment, the second type of weapon has great potential advantages over the former. As long as the mobile discharger (such as the aircraft) is expected to return to its base, the radius of action must always be rather less than half its maximum range, whereas the full range of the stationary discharger can always be utilized as the radius of action. The stationary discharger effects great economy in personnel, both because crews are not exposed to enemy action over the target and because the same crew is capable of discharging several projectiles in the period which would be required for a single journey to and from the target. This consideration of economy in man-power is the more important, as the operation of all types of long-range bombardment weapon demands a high degree of intelligence, skill and training in the human material, which must therefore be all the more jealously conserved. However much aircraft may be perfected, atmospheric conditions must almost certainly continue to interfere with their operations far more than with those of projectiles, and the human element — the situation and condition of the crew at the critical period of the attack — must always remain a factor to be reckoned with. Finally, as the development of long-range bombardment aircraft proceeds and they become larger and heavier, larger and

more elaborate bases are required to accommodate and operate them, with a corresponding reduction in the number of suitable sites available and increase in the expenditure of materials and man-power. Until methods alter again, these limitations may in practice halt the increase in range of long-range bombardment with aircraft (see p. 95).

Hitherto the advantages of the stationary discharger have been more than offset by its much lesser range and relatively low accuracy. Transfer of the base of long-range bombardment operations presents no less difficulty for stationary dischargers than for aircraft, in view of all the attendant complications of installation and supply. This weakness, however, is serious only because of the present limited range of stationary weapons which makes it impossible to cover all likely targets from a few base areas. Should it — and there is no fundamental reason against this — prove practicable to endow stationary dischargers with at least the same range and accuracy as bombers, then their other advantages must give them decided superiority. Aircraft, at least in their role of long-range bombardment weapons, even against moving targets, would then become obsolete, appearing in the history of warfare merely as a transitional and clumsy expedient.

In the last phase of World War II public attention was distracted from the rapid development of long-range bombardment as a mode of warfare by the phenomenon of the atomic bomb, the potentialities of which closed World War II with a question-mark, as those of the high explosive bomb and gas closed World War I. In 1917 the combination of a familiar type of explosive and a novel

type of carrier, that is the aircraft, produced a high degree of anxiety. It was assumed that panic would be the typical reaction to this weapon and that consequently long wars would never again be feasible. Now we have a similar phenomenon: the combination of a familiar carrier and a novel weapon. The fact that Japan, though in fact already on the verge of collapse, capitulated almost immediately after the use of the atomic bombs has given rise to a popular idea that, in future, the inevitable reaction to the use of the atomic bomb will be the break-down of morale precipitating capitulation, and that long wars will therefore not be possible. The prospects of the future use of atomic weapons in their known form or in others will be discussed in a later chapter (pp. 100ff); but one of the conclusions reached in that chapter must be mentioned here, namely, that whatever the probability or otherwise of such future use of atomic weapons, warfare by all other current methods must also be expected and will have to be prepared for.

It is well to pause at this point to fix upon our mind the outstanding characteristics of the long-range bombardment weapon as such. In doing so, it must be clearly realized that weapons are here considered in respect of one specific function only — that of long-range bombardment. The fact that some long-range bombardment weapons, such as the aeroplane, are multi-purpose and can perform other functions must, for the present, be left out of account. In general, it is my opinion that the functional study of warfare has in the past been unduly neglected in favour of study arm by arm, service by service, or weapon by weapon. Certain highly important conclusions can be reached only if differences in the instru-

ments themselves are ignored while attention is directed solely to differences in the functions performed.

The essential characteristics of third-dimensional warfare in the form of long-range bombardment are derived from its length of range and the qualities of the medium in which it is conducted. That medium is homogeneous, ubiquitous and of practically unlimited height. Consequently the possibilities of evasion, which are insignificant in land warfare and limited in maritime warfare, become of outstanding importance, both in the offensive and the defensive aspect. In two dimensions, attack on any target is bound to pass through some point on a circle; in three dimensions, the 'zone of interception' constitutes a hemisphere or (at sea) two hemispheres. The greater possibilities of evasion in two-dimensional warfare on sea as opposed to land are due to the relative lack of obstacles to canalize movement and to the small physical extent of the forces in proportion to the area over which they operate.

The long-range bombardment weapon can therefore reckon with the possibility, if not probability, of reaching its target without collision with enemy forces or interference from them. These possibilities of avoiding contact are still further increased by the added characteristic of great speed, which distinguishes the long-range bombardment weapon in all its forms, and particularly in the form of the discharged projectile. *A fortiori* long-range bombardment does not have to reckon with the physical obstacles, such as mountains, rivers, deserts, or coastlines, which by opposing themselves to surface action canalize it into certain definite directions, along which opposition can be organized.

This characteristic of evasive power connects naturally with that of flexibility. A weapon which possesses great radius of action can, without changing its base, engage a correspondingly great variety of targets and can engage them in quick succession. This is what is meant by describing the long-range bombardment weapon as 'flexible'. Within the limits of its radius of action from base, a guided projectile or aircraft, either before take-off or during flight, can shift its operation from one target to another at the shortest notice.

The combined characteristics of evasion and flexibility confer upon long-range bombardment weapons that power of penetration which fundamentally differentiates three-dimensional from two-dimensional warfare. Theoretically there is no surface target in a belligerent country which the long-range bombardment forces of its opponent cannot engage, practically without regard to the disposition and relative strength of the armed forces operating on or below the surface, and even, to some extent, of those operating in the air. The choice of target is at all times open and can readily be varied.

Long-range bombardment forces have this further peculiarity, that they can operate only on the offensive, since their function consists in seeking out at long range the targets which they engage. Hence the long-range bombardment force in action is always in an offensive attitude, in the sense of that term defined at page 18 above. An army operates in brief periods of intensive offensive action separated by much longer periods during which it is, as a whole, in a defensive attitude, and an army on the defensive, both tactically and strategically, can inflict defeat upon an enemy. On the other hand, long-range

bombardment forces, when not being employed offensively, can exercise no positive effect upon the course of a war. Their mere existence may, and no doubt does, during peace exercise a deterrent effect; but once hostilities have begun, even this deterrent effect is limited to the fear of reprisals of a particular kind, as in the opening phases of World War II the existence of bombing aircraft on each side contributed to make both Germany and Britain defer the commencement of unrestricted long-range bombardment. Thus the naval theory of the 'fleet-in-being' has only a very restricted application to long-range bombardment forces.

When these characteristics of long-range bombardment are considered in their bearing on the aims and methods of war, it will be seen at once that the whole structure of classical strategy described in the preceding chapter has been subverted by the advent of war in three dimensions. The basic premise of that strategy — that the object in war is to break the enemy's war-will by the disorganization of his armed forces in battle — has lost its validity. Destruction of the enemy's physical ability to wage war had already become a more direct way to victory than destruction of his will to wage it. Long-range bombardment has now made it possible to attack that physical ability without necessarily engaging the enemy's armed forces at all. The indispensable condition of victory is no longer to bring the armed forces of the enemy to battle and there accomplish their disorganization: the armed forces of the enemy have ceased to be the sole objective and need not even be the main one. Incidentally, while the disorganization of armies is achieved primarily by destroying *men*, the direct destruction of a belligerent's

ability to wage war may be more readily accomplished by destroying *material.* Provided that vital materials were destroyed or damaged, a long-range bombardment operation could conceivably be fully successful even though not a single casualty was inflicted.

The reassessment of aims and objects which exploitation of the third dimension has brought about involves also a reassessment of the relative importance and functions of the various types of armed forces. If the object can be attained through means other than the destruction or disorganization of the enemy's armed forces, then successful land operations, to which maritime operations are essentially ancillary in the conduct of the war as a whole, are no longer the be-all and end-all of warfare.

The relative importance and respective functions of surface operations and of long-range bombardment, within the one great task of depriving the enemy of his ability to continue the war, must obviously be different for every different set of opponents.

It is possible to conceive a belligerent having an economy so delicately balanced, and so little resilient or capable of adjustment, that long-range bombardment alone could render his further resistance impossible; in this case the function of the surface forces would be reduced to the formality of territorial occupation. There will, however, be few cases which even approach this extreme. Generally, in war between great powers, the margin of resilience and adjustment, and the reserves and resources of strength and material, are great. To bring either to the breaking-point solely by long-range bombardment, without the additional strain imposed by surface operations, would be an extraordinarily long and

doubtful process, unless we assume an intensity and destructive efficiency of long-range bombardment, and a completeness of relevant intelligence, far greater than any yet in sight, though not, perhaps, ultimately unachievable. Some increase in accuracy and intensity is certainly practicable and to be expected; and as these qualities increase, so the task remaining to the surface forces is correspondingly reduced. Any great advance in destructive efficiency, however, leads to consideration of weapons of 'atomic' potency, to the use of which, as will be shown in chapter VI, inherent limitations may exist.

Where long-range bombardment operations are the only, or only important, operations in progress or apprehended, the entire resources, energy and ingenuity of the belligerent under attack can be devoted to recuperation and adjustment. Unless the elementary necessities of bare existence can be effectively denied to him, even the most severe dislocation of an opponent's war economy need not prove fatal to him. It will prove fatal only if it exposes him resourceless to other and simultaneous threats. In World War II the effects of long-range bombardment were never seen in anything approaching isolation. Even in Japan, the effective use of long-range bombardment was only the culmination of years of increasing pressure by surface as well as air forces. When in 1944-45 long-range bombardment of Germany may be said to have inflicted the mortal wound, some nine-tenths of her war effort was being devoted to surface operations; in other words, nearly the whole of the enemy war effort was taken up by the necessity to confront and resist the Allied land forces in the field. German-dominated Europe, even in the conditions to which it had been re-

duced by 1944, could probably have survived for years, if unassailed and unthreatened by any surface operations.

Germany and German-dominated Europe by no means represent the extreme end of the scale. It is conceivable that a belligerent may possess such reserves of strength and an economic structure so little exposed to drastic interference by long-range bombardment, at least in any form yet known, that the tasks not merely of bringing about the 'crisis' of the war but of delivering the decisive blow would still devolve primarily upon surface forces.

We thus come to conceive victory as being, under any readily foreseeable circumstances, achieved by a twofold but simultaneous action upon the enemy's ability to wage war: through his armed forces on the surface, by land and maritime operations,[1] and through the other elements of his war power, by long-range bombardment. By this double process the strain placed upon him is progressively increased up to the breaking-point. Seen in this light, surface operations and long-range bombardment play complementary roles, neither ancillary to the other but both taking up the slack and increasing the tension until the tautened thread snaps. All wars have a certain life-cycle, short or long, simple or involved. The stages of this life-cycle may be abridged and compressed by intensification of effort or by more skilful direction; they can never be altogether eliminated. The war effort of both belligerents progressively increases until on one side the remaining margin of reserve and power of recovery dwindles and finally disappears, leaving the loser exposed to the final blow. In three-dimensional warfare the

[1] These include the use of the third dimension in support, which is discussed in chapter IV.

increasing and eventually fatal pressure can be applied not only, as in two-dimensional warfare, through the armed forces but also simultaneously through the other elements of war power. It follows that, although the strategic offensive in long-range bombardment can be adopted independently of the strategic offensive on the surface, both must be related in order to achieve the object in the shortest time and with the greatest economy.

By three-dimensional warfare the principle of economy of force is placed in a new light. War is but an episode in the life of nations. It leads out of peace, and into peace again. The experience of two world wars has shown, what the first alone should have been sufficient to teach, that in the peace which follows war the victor is punished for uneconomical attainment of his war aims not only by his own prostration, but also by the devastated condition of his erstwhile opponent, which reacts upon him. Victors as well as vanquished have to pay for whatever waste of effort was involved in the long-range bombardment measures against Germany and Japan in 1943-45. We have learnt also that material destruction on the scale witnessed in World War II can prove more inimical to reconstruction and recovery than the destruction of human life which, on the whole, was more characteristic of World War I.

To extend the objectives of military action far beyond the armed forces themselves so as to embrace the whole content of a belligerent country implies the need for a knowledge of the structure and sources of the enemy's war potential which, in its detail and accuracy, is entirely novel. The whole scope and purpose of intelligence, in peace and war, is widened and altered by three-dimen-

sional warfare. The basic data upon which long-range bombardment operations throughout the course of a war will be planned must now be acquired in peace by unremitting detailed study of the economic life and structure of the principal nations and regions of the world. The economist and the scientific geographer are invading the traditional preserves of the agent, the spy and the traitor. Information which in peace can be had for the asking or cannot be concealed may in war prove more vital than any military secrets about location of forces or plans of fortresses.

Not only the conception but the progress of long-range bombardment operations are peculiarly dependent upon accurate intelligence of the right kind. In surface operations, the fortunes of a battle may for a short time remain in the balance, but a commander can never long doubt whether he is progressing towards his objective or not, or how much still remains before he achieves it. In maritime warfare the sinking or disablement of vessels, and in land warfare the gain or loss of ground, provide immediate evidence of the progress of a battle or campaign. In land or maritime warfare the efficacy of one's own weapons can also be estimated immediately and without serious room for doubt. On the other hand the extent of the success of long-range bombardment operations has to be assessed purely upon the interpretation of complex and necessarily incomplete intelligence, and even the efficiency of the weapons employed can only be determined from intelligence sources.

Into the choice of target systems for long-range bombardment there enter two considerations which are themselves never constant and which may even conflict with

one another. One consideration is degree of vulnerability to the forms of long-range bombardment available. The other is degree of essentiality at any given time to the enemy's power of waging war. The object is so to select target systems that the resultant of vulnerability and essentiality is maximized.

A target system may be essential to one particular side of the war economy, or essential to the war economy as a whole. For describing the latter class the term 'common denominator' has come into use. In all industrial economies power targets are common denominator; in some economies one particular class of power targets, for instance oil or hydro-electric installations, may be such. It is usual to find that common-denominator targets are, by reason of duplication, dispersion or otherwise, not of particularly high vulnerability, though certain forms of transport may in some circumstances be an exception. Another expression used in classifying target systems is 'weak link', which denotes that element in a process or in a side of the enemy's economy or even in that economy as a whole, which by its nature is most vulnerable to long-range bombardment, perhaps because it cannot be duplicated or dispersed. It will be noted that the terms 'common denominator' and 'weak link' relate to different characteristics of a target or target system. They are by no means, as they are sometimes regarded, antithetical; indeed, they may both be applicable to one and the same target system.

It is not surprising that the far-reaching consequences of three-dimensional warfare for the whole conduct and philosophy of war were not immediately perceived, and that the significance of long-range bombardment is

only gradually winning recognition. The principles of two-dimensional warfare had been studied over centuries. Military thought was imbued with them. There was a natural mental resistance to change or adaptation of outlook and the usual reluctance to discard doctrines which had become ingrained. Pride of service and professional vested interest, reinforced by intellectual conservatism, imparted a tang of bitterness and personal jealousy to the disputations and struggles through which the new strategy asserted itself.

In the beginning the instruments of long-range bombardment were not effective enough to reveal their potentialities in true perspective. They came into being either with serious limitations, like the aeroplane before 1914, or as freaks, like Big Bertha. What was more, the aircraft in its primitive form lent itself less readily to long-range bombardment than to other functions, such as reconnaissance and support, which were more directly and manifestly of assistance to the surface forces in their operations. This very fact tended to delay and hinder the development of the independent function of long-range bombardment. We shall follow the story of its birth and growing pains in a later chapter.

CHAPTER IV

THE THIRD DIMENSION: SECONDARY FUNCTIONS OF AIR FORCES

UP to this point aircraft have been considered only as one of the means of utilizing the third dimension for long-range bombardment. The same characteristics, however, which fit them to be so used also render them suitable to perform other functions in war. Some of these are entirely new, while others are different or improved forms of functions already known. These functions, which, in comparison with the potency of long-range bombardment, it is permissible to term 'secondary', will be examined in this chapter. Stress has been laid already upon functional classification as the means to a right understanding of strategy (p. 25). The fact that the most important instrument of long-range bombardment at present — the aircraft — happens also to be used in discharging other, and perfectly distinct, functions has tended to cause confusion of those functions themselves with one another and with long-range bombardment. For the sake of clarity, therefore, as well as completeness, it is desirable to analyse the remaining roles which aircraft play in modern war.

In long-range bombardment, aircraft are employed to engage targets other than the enemy's armed forces, and these operations have no necessary direct relationship to

those of the remaining forces of the side which employs them. Aircraft may, however, also be used in conjunction with the operations of surface forces. The true distinction between these operations and long-range bombardment lies not in the distance of the target from the base, measured in terms of miles or kilometres, but in the nature of the target and its relation to the campaign or the war as a whole. Where targets are engaged in aid of a particular operation of surface forces, then the aircraft which engage them act 'in support'. If, however, the targets are targets which affect the enemy's will and ability to wage war, without special relation to a particular surface operation, then the aircraft engaging these targets are used in a long-range bombardment role. Admittedly, targets in the former category will usually be closer to the bases of the aircraft engaging them than targets in the latter. There is nevertheless no inherent reason why this should be so, and cases can be conceived in which a long-range bombardment target might actually be the nearer to the firing line. Similarly, a target selected for its bearing upon the success of a particular surface operation may be one which would also be an appropriate target for long-range bombardment. Thus, in the ultimate analysis, it is not even the nature of the target which determines whether attack upon it is long-range bombardment or support, but *the object with which that target is selected at that particular time.* Oil installations in Germany were support targets during the latter part of 1944, when it was believed that their engagement would directly assist the invasion forces, whereas in 1940 after the fall of France the same installations were long-range bombardment targets.

The functions of long-range bombardment and support are frequently referred to as 'strategic' (or 'strategical') and 'tactical' respectively. Unfortunately, the term 'strategic' has not in the past been restricted, in reference to air warfare, to long-range bombardment operations — as, indeed, the conception of long-range bombardment itself has not hitherto been very clearly apprehended — and the words 'strategic' and 'tactical' have been applied to types of aircraft and of air forces, as well as to types of target and of operation. Since 'strategic' types of aircraft can engage support targets, while aircraft included in 'tactical' air forces may be capable of long-range bombardment, the terms have thus become not only useless, but positively misleading. In this book, therefore, the term 'support' is used throughout to designate those operations which are undertaken in assistance of, or preparation for, a particular operation of friendly surface forces, or in prevention or anticipation of a particular operation of hostile surface forces.

The epithet 'close', commonly associated with 'support', has been discarded, because the idea of distance thereby imported into the definition would be misleading. It is true that support operations may be directed against targets at varying distances from the firing-line; but their nature is not affected by this difference. If the commander had under his hand an artillery weapon of the same range and accuracy as the aircraft, he would use it equally against the 'close' and the 'distant' support targets. In this sense, it is possible to say that the action of aircraft in the support role corresponds roughly with that of artillery, in the same way as, in long-range bombardment, we saw that it corresponded with the action of the rocket pro-

jector and similar weapons. Where the targets engaged are maritime, the parallel is with the naval gun; in land warfare it is with the weapons of the field army.

Those third-dimensional characteristics of aircraft which first made long-range bombardment warfare possible also give them peculiar advantages in the role of support. Their length of range enables them to engage targets beyond the reach of any gunfire, yet nevertheless directly affecting the operations of the surface force being supported. For instance, dumps, railway centres and other vital points, upon which the movement and supply of enemy forces depend, can be attacked by aircraft when they would be out of range of the heaviest army artillery. Similarly fleets may be engaged and even defeated by means of aircraft before they come anywhere near the range at which a naval gun-fire duel can commence. The operation in which, on October 24th, 1944, carrier-borne aircraft of the United States Navy crippled the Japanese battle fleet in the Second Battle of the Philippines was not a whit the less a fleet action for the fact that the main units of the opposing navies never came within sight of each other. Where, indeed, an enemy fleet remains in harbour, air attack will usually be the only means of destroying it, and thus releasing forces which might otherwise be tied down in blockade.

The characteristic of flexibility, which results from the speed and range of aircraft and from their relative superiority to natural obstacles, has important consequences in the support role, especially in land warfare. The deployment of artillery and the organization of the necessary ammunition supply for engaging a particular target or set of targets involves considerable time, staff-

work and effort. Sudden alteration of the plan or the target is therefore not usually possible. But because aircraft operating from a given base or bases can switch their effort at the shortest notice from one to another of a very wide selection of targets, their use in a support role not only permits fire to be applied throughout a battle according to the exigencies of its various stages, but also admits of a greater intensity of fire effort in time and space, since all the aircraft operating in support on a particular front can, if necessary, be concentrated against a single target area, and even superimposed upon an artillery fire plan. Only the continuity of fire obtainable with artillery remains a characteristic in which aircraft are markedly inferior.

The combination of range, flexibility and observation in the aircraft makes it a useful weapon against the submarine, since it can search wide areas on the surface of the sea and deliver an attack immediately the target is recognized, though the location by aircraft of submarines beneath the surface is a still unsolved problem which, if it remains unsolved, will have far-reaching consequences for the future development of maritime warfare (see p. 94). Engagement of submarines by aircraft represents, indeed, the case of a maritime engagement in which the action of one of the fleets is actually replaced by that of aircraft — the same phenomenon as occurs when a surface fleet is engaged by shore-based aircraft without the presence of an opposing fleet. The functions and future of the aircraft carrier, which are bound up not only with support operations against maritime targets and with long-range bombardment, but also with counter-measures against support and long-range bombardment, are on

that account deferred for discussion in the following chapter (p. 55).

In land, as in maritime, warfare the object must be to safeguard, and as far as possible to increase, that flexibility and intimacy of co-operation which are the essential requisites of successful support. The choice of aircraft types, the organization for command, and the methods of combined training must alike be directed towards the achievement of this object. In order to perform the function of supporting surface forces to the best advantage, specialized types of aircraft such as the dive-bomber and fighter-bomber have been evolved, and specialized air forces for support, which in land warfare are commonly designated 'tactical air forces', have been organized. As a fleet takes with it carriers to base its attendant aircraft, so an army in the field must secure the availability of sufficient suitable airfields for the support and protection of its own operations. Indeed, the securing or construction of these airfields may be a dominant factor in the entire plan of a campaign. To guarantee the bases, the supply and maintenance, and the operations of its supporting air forces is now as essential for an army in the field as to ensure the availability and efficiency of its artillery.

From the characteristic flexibility of air forces as compared with other weapons follows an interesting and important corollary. The power to execute feints, especially on a grand scale, is far greater with aircraft than with any other weapon. In warfare before the advent of aircraft, the possibility, except in a very narrow, tactical sphere, of feints designed to deceive the enemy as to the point and direction of a main effort was extremely

limited. If a feint were sufficiently serious to deceive the enemy and so attain the object of enforcing upon him a major redistribution of his forces, it nearly always involved disproportionate expenditure of time and effort in the regrouping of one's own. For example, in order to simulate an intended attack by heavy artillery preparation, it was necessary actually to concentrate one's own artillery at the point of the feint, with the consequent necessity of shifting it back again for the real attack. Now, however, when the major preparation and support of a ground operation can be entrusted to a weapon so flexible as aircraft, the scope for feints is enormously widened. There is no longer any difficulty in carrying out preparation on three or four alternative fronts simultaneously and so keeping the enemy in suspense or actually deceiving him up to the very last moment before the attack. We shall see, in chapter VII, where the operations of World War II are reviewed, how successfully this potentiality of air forces in support was exploited in the operations immediately preceding the invasion of Europe (p. 87).

Another of the secondary functions of air forces in warfare, which derive from the basic characteristics of aircraft, is that of observation. The aircraft, through its use of the third dimension and its relative superiority to obstacles, is able to convey the eye of an observer (which includes the mechanical eye of a camera) to great distances beyond any area under friendly control. By this means direct information of a precise and documentary character can be obtained upon all aspects of the enemy's plans and war effort which disclose themselves to visual observation. With the development of infra-red photography and of high shutter-speeds, the value of the camera

as an observer is rendered independent of darkness or atmospheric conditions and also, to a great extent, of enemy interception, since photographic aircraft can operate at night or in poor visibility and at high speeds. To obtain the fullest advantage from these characteristics the type of aircraft used for this, as for the other roles, has been specialized, and the forces into which reconnaissance aircraft are organized have also been specially designed to bring together all that is necessary for the speediest and fullest evaluation of the intelligence obtained.

For deep reconnaissance, not to mention survey, the camera has, for the reasons given, almost entirely replaced the eye of the observer. There is, however, a type of information concerned with facts so fleeting, or requiring such immediate action, that the interposition of a photographic process is not practical. In this field, the observer, aided in night work by flares, retains his importance. This is a function nearly allied to the support role, and includes sweeps for naval and other vessels, artillery ranging and spotting (the 'air observation post') and the detection and reporting of enemy movements in close proximity to the actual firing-line. Apart therefore from the air forces employed in obtaining photographic information in depth, whether as a basis for long-range bombardment or for other purposes, support forces must always include reconnaissance elements which utilize the human observer as well as the camera.

The revolution in military intelligence which has come about through the conquest of the third dimension is profound. The field of direct observation, like the area within which targets can be engaged, has expanded beyond the area of physical contact to include practically

the whole territory controlled or used by a belligerent. The possibility that major movements of forces and economic or military preparations on a large scale may escape notice is, in consequence, becoming less and less. Unfavourable weather and visibility may still, though decreasingly, frustrate a particular reconnaissance, and deliberate measures taken to nullify it may to varying degrees be successful; but in practice every belligerent must reckon with the likelihood of his opponent getting detailed and exact knowledge of anything which a photographic record of his territory would disclose. While, therefore, the third dimension may have widened the scope for feint operations, it has taken away more than it has given, by largely eliminating secrecy and surprise from the major movements or operations of war.

In observation, the function of the aircraft itself is to convey the eye of the observer or the lens of the camera to within range of the point to be observed, just as in long-range bombardment it conveys the bomb-aimer and the bomb to the vicinity of the target. There is, therefore, room for partial or complete supersession of this two-stage process by a single-stage process. What the rocket projector and similar weapons represent in the future of long-range bombardment, is represented in the future of intelligence by television devices which bring the base into direct relation with the objective without an intervening link; and as the further development of long-range projectiles may render aircraft obsolete for long-range bombardment, so we may conceive that methods of presenting a televised record of objects at great distances may eventually supersede aircraft in all reconnaissance roles except that connected with support.

Under the head of 'observation' falls the use of aircraft to obtain meteorological information. Before 1939 meteorology was treated as mostly a two-dimensional problem, but the trend of modern meteorology is to study the atmosphere in three dimensions as a matter of routine. To obtain information of upper air conditions, aircraft are naturally the most readily available means. It is expensive to maintain aircraft specially for meteorological work; but there is no doubt that, for the present at least, aircraft fitted with suitable instruments and carrying a trained observer provide the most accurate means of obtaining information about the upper air. Even in the course of their normal duties, aircraft can furnish a large proportion of this information. In future meteorology, an important part will be played by radar and other scientific devices. Radar is already being successfully developed to give indications of precipitation clouds, and 'cold fronts' have been successfully located with it.

We come last to that secondary function of aircraft in war which is concerned with transport. Ultimately, of course, all the functions which have been discussed hitherto derive from the use of aircraft as transport — to convey the bomb and the bomb-aimer, the cannon, the ammunition and the air-gunner, or the observer and the camera. But in these cases the function of transport is ancillary to the task to be performed at the objective. In transport pure and simple, the aircraft is a means of conveyance like mechanical vehicles, railway trains or ships — a method of moving personnel and material from one place to another. Air transport, however, owing to its third-dimensional character, differs from the other forms of transport in an important respect. Both the route and

the destination of surface transport must be entirely in friendly hands, or at least must not be controlled or dominated by the enemy; air transport, on the other hand, can move loads across areas under enemy control and can even (in certain of its specialized forms) deliver those loads in enemy territory. We have, therefore, in the case of air transport, to distinguish two classes. One, where the destination as well as the starting-point is in friendly hands and the other, where the destination is in an area under enemy control. For each of these two classes specialized methods of air transport have been evolved.

In the function of transporting loads to and from friendly termini, air transport is essentially the same in character as other forms of transport. Except where any part of the route is controlled or dominated by the enemy, its employment in preference to alternative methods depends upon the balance between its characteristic advantages and disadvantages. One advantage is speed, and another may be rapid availability; the disadvantages lie in high ratio between effort and lift, and in unsuitability for moving bulky, indivisible loads.

The use of aircraft in this transport role has no special connection with their use in other roles. For the technical purposes of operation and maintenance, it may be convenient that they should be handled by the same organization as aircraft engaged upon other functions; but their employment and allocation is connected with air operations no more and no less than with surface operations. A rational distribution of air transport effort depends purely upon the nature of the loads offering.

Where the arrival terminus is in enemy-held territory, transport has only become possible as a result of the con-

quest of the air. Air transport, in this sense, has imported into warfare entirely new possibilities — those, namely, of introducing bodies of men and material into enemy territory at almost any desired point, an operation hitherto possible only on a coastline guarded scantily or not at all. The method adopted in air transport operations terminating in enemy territory depends upon the degree of immunity from enemy action which can be secured in the area of landing. The actual landing-point must not, of course, be in enemy occupation at the moment of arrival. Where no area suitable for landing and take-off and also free from enemy occupation is available, specialized forms of air transport have to be used. The least dependent upon the nature of the ground is the parachute. If, however, the necessary minimum of space exists, the towed glider provides an alternative or supplement to the parachute, and has the advantage that a quantity of men and stores can be brought to earth at the same moment and on the same spot. The parachute and glider, however, though necessary until control can be secured of a space where landing and take-off are practicable, constitute so limited and inefficient a means of transport (apart from being non-returnable), that an early object in any such operation must usually be to secure the use and control of an airfield, so that air transport can thenceforward be continued by aircraft.

The use of the third dimension for transport is peculiarly liable to interruption or prevention by the countermeasures discussed in the following chapter. From this characteristic and from that of limited capacity derives a condition of airborne operations which is of great importance. An operation cannot be maintained indefinitely

with supplies and reinforcements brought wholly by air transport. Therefore airborne operations larger than mere raids are rational only as integral parts of a general strategic offensive on the surface, which is expected to 'catch up with them' at an early moment; they have no place in a defensive campaign.

Attention may here be drawn to one or two special cases of air transport, in which the transport element is not, perhaps, at first sight, the essential one. The introduction of agents into enemy territory by parachute or aircraft and, in some cases, their subsequent removal by aircraft is, of course, a method of obtaining intelligence. Nevertheless the essence of the operation is air transport to a terminus in enemy territory. Similarly, the important operation of mine-laying from aircraft falls into the category of air transport; for aircraft are here used, like the mine-laying submarine, as a means of transport, although the terminus is one which lies within an area used by enemy vessels: the element of direct attack upon a target is in both cases absent.

In some of the functions mentioned earlier, where aircraft are the means of conveying weapons or projectiles to the vicinity of the target, the possibility has to be envisaged that they may be superseded by devices which operate direct. Such is not the case with air transport; and certainly, so far as movement of personnel is concerned, it is difficult to conceive that aircraft as a medium of transport can ever be superseded.

CHAPTER V

THE THIRD DIMENSION: COUNTER-MEASURES AND AIR SUPERIORITY

IT is an axiom that every new weapon or mode of warfare produces naturally, and usually within a short space of time, the appropriate counter-measures to meet it. Utilization of the air for long-range bombardment and for the secondary functions of air forces already described has proved no exception.

The forms of counter-measure fall into two distinct categories, though it is important to note that these do not correspond with the two categories of long-range bombardment (see p. 22). In the first class of counter-measure are those which destroy, or which interfere with the operation of, the instrument discharging the projectile, whether that instrument is mobile, as for example an aircraft, or static as in the case of a rocket-launcher. In the second category are those counter-measures which prevent the projectile itself from reaching its target or from proving effective. For rough convenience, the two categories may be designated respectively *active* and *passive*, though, as will be seen, the terms active and passive are here not used in quite their commonly accepted senses.

Where aircraft are employed, active counter-measures may consist of means to destroy the aircraft before they reach the area of the target. These include anti-aircraft

artillery fire of all kinds and the action of interceptor aircraft. It will be observed that aircraft in an interceptor role perform essentially the same function as anti-aircraft artillery, just as in long-range bombardment or support they perform the functions of artillery of other kinds. As higher speeds and altitudes for long-range bombardment aircraft are attained and the difficulty of attacking them on their way to the target is thereby increased, interception (in the narrow sense of the term) may well recede in importance compared with destruction of the aircraft otherwise than *en route* to the target. This is naturally easiest at the point where they are most readily to be found, viz. at or in the vicinity of their bases, whether on the ground or in the air. Destruction in the air is achieved by fighters (intruder), destruction on the ground by either fighters, bombers or other methods, according to the circumstances.

While the action of interceptor aircraft is always deliberate and selective, that of anti-aircraft artillery (at least as practised in World War II) may be either selective, in the case of directed fire, or 'blind', in the case of barrage fire. Another 'blind' form of countermeasure is the balloon barrage, which either actually destroys the aircraft before they reach the target, or else by the danger of destruction compels them to fly at heights, or along routes, where their effectiveness is reduced and their vulnerability to other forms of countermeasure increased.

The aircraft is not the whole of the instrument which discharges the bomb: the base from which the aircraft operates is essentially part of one and the same weapon. To the aircraft-plus-air-base corresponds the apparatus

used for launching the long-range projectile. Accordingly, active counter-measures include action both against the bases from which aircraft operate and against the launching sites of long-range projectiles. This action produces its direct effect by the damage or destruction of the bases or sites, but has also the indirect result that the enemy in his turn is forced to divert effort and resources to their defence and reinstatement.

Indeed, the idea of the active counter-measure may legitimately be extended beyond attack upon bases and sites. Long-range bombardment itself, against whatever targets directed, if it has the effect of reducing or destroying the enemy's ability to operate his own forces in long-range bombardment and other offensive roles, is a form of counter-measure, and may actually, in certain circumstances, be the most potent one available.

Turning from active to passive counter-measures, that is, to those which prevent the projectile after release or discharge from reaching its target or from producing its effect, these have hitherto largely consisted of the interposition of protective substances, such as earth, metal or concrete between the explosive and the target. This form of counter-measure, especially against long-range bombardment, is likely to persist and even assume increased importance with the advent of atomic weapons. But although this passive form of defence can sometimes afford complete immunity, and even when immunity is only partial, exerts a most beneficial influence upon morale, it has the drawback of being slow and costly to provide. Its application to some types of target, especially those of great extent, may be beyond the bounds of practicability. Moreover a nation may well not admit the probability of

war in time to undertake effective protection of its material and human resources by this means.

In the last stages of World War II there was opening a whole new field of passive counter-measures especially suited to the protection of long-range bombardment targets. This field embraces all counter-measures designed to destroy or divert the projectile in the course of its flight or fall, which may be exemplified by the use of the balloon-barrage against pilotless aircraft, in contradistinction to its use to destroy the piloted aircraft. Where the projectile is remote-controlled by magnetic or radar devices, it can be diverted by magnetic or radar interference. It may also in time prove possible to create some type of protective zone which has the effect of automatically exploding projectiles which impinge upon it. Further, there may be wide possibilities in projectiles capable of automatically seeking out and destroying oncoming projectiles. As the projector supersedes the aircraft as the instrument of long-range bombardment, many forms of active counter-measure, such as the interceptor and anti-aircraft artillery of the kind known today, will drop out of use (so far at any rate as long-range bombardment is concerned) and passive counter-measures of the kind indicated will assume relatively greater importance. Methods of long-range bombardment and of counter-measures against it, which a short time ago would have been considered Wellsian fantasy, have now entered the realm of probability; and no electronic device, however fantastic it may seem, can prudently be rejected without conclusive scientific inquiry.

Closely allied to passive counter-measures, but by no means identical with them, are methods which have the

result of concealing targets or of deceiving the enemy as to their location. We have already seen how long-range bombardment places an entirely new and far higher premium upon accurate intelligence. Measures of concealment and of deception are essentially counter-intelligence measures, designed to deprive long-range bombardment of the information necessary to complete accuracy and effectiveness. The effect is substantially the same whether the camouflage, concealment, deception or decoy deceives the eye of the bomb-aimer, the eye of the photographic interpreter, the eye of the enemy agent and his sources, or (even more insidiously) prejudices the mind of the observer or interpreter of evidence so as to lead him to overlook or misconstrue it.

The value of targets or the effectiveness of long-range bombardment against them may be reduced by dispersion, which may take various forms according to the nature of the target. Any particular activity or process may be multiplicated and carried on simultaneously in different places, so that attack upon one place, however successful, affects only a fraction of the output. For example, aircraft may be manufactured in several widely separated localities. Secondly, the particular process itself may be subdivided, and the component tasks carried on in different places. Thus, in aircraft production, ball-bearings may be produced in one place, wireless sets in another, wings in a third, engines in a fourth, and so on. This second type of dispersion, however, is futile without the first; for unless each task is multiplicated, the elimination of one essential component would bring completion of the composite whole to a standstill. Again, either type of dispersion may be regional or local. Local dispersion

reduces the potential damage of a single salvo, while regional dispersion minimizes the effect of an attack on a specific target or of attacks upon a specific target area. Both forms have an incidental value in that they afford a measure of concealment.

There are, however, severe limitations upon the efficacy of dispersion as a counter-measure. However much processes are subdivided and dispersed, there must be a restricted number of concentration points where the finished products are either assembled or stored. Assembly points and depots cannot be indefinitely multiplicated. Here, therefore, is the Achilles heel which no amount of dispersion can protect. Efficiency in manufacture is almost inevitably impaired by duplicating and subdividing; and inevitably there will be a point beyond which it does not pay to accept this impairment. Moreover, the greater the degree of dispersion, the higher will rise the importance of the transportation system, so that a reduction in the vulnerability of one type of target may be partly, completely, or more than offset by an increase in the vulnerability of another. Another limitation is that in countries having long established industries with only a limited amount of undeveloped territory, dispersion is difficult and costly to effect. This is all the more so where industry is not state owned, and voluntary dispersal is likely to be resisted until war becomes clearly imminent.

Passive counter-measures are obviously more generally applicable to long-range bombardment targets than to support targets, whose fleeting character militates against the successful use of protection or concealment. Nevertheless armies and fleets seek the highest degree of dispersion consistent with efficient performance of the task

on hand; they resort to concealment (such as the smoke-screen) and camouflage; and the army 'digs in'. The time is perhaps not far off, when maritime forces which at present operate on the surface will be obliged by the threat from aircraft to seek concealment and protection by acquiring the power to submerge themselves for shorter or longer periods.

Consideration of counter-measures for the protection of maritime targets leads directly to the question of the role and future of aircraft carriers. Aircraft carriers are in essence floating airfields. Formerly their use was necessitated, if by nothing else, by the short ranges of the available aircraft, which meant that targets, such as vessels or objectives overseas, which lay beyond a certain distance from a land base, could only be attacked by aircraft flown off carriers. The increase in aircraft ranges has, however, been such that most potential targets will in future be accessible to belligerents from land bases under their control. Apart, therefore, from the technical difficulties of operating large and heavy modern bombing aircraft from carriers, it is probable that carriers as a base for long-range bombardment will only be demanded in future if it is expected that, for one reason or another, the land bases may not be available.

This development, however, leaves unaffected the use of carriers in the defence of surface vessels at short notice against long-range bombardment or support operations; for it will be realized that while naval vessels are always support targets, other vessels may be either support targets (as in the case of ships bringing an invasion force or its supplies and reinforcements to our shores) or long-range bombardment targets (such as vessels taking chromium or

petroleum to an enemy port). The intimacy of co-operation and the flexibility required in support is such that for all practical purposes it is difficult to see how this role could be satisfactorily fulfilled by shore-based aircraft alone. Similarly, the length of notice available when interceptors are required for defence against support or long-range bombardment is inevitably short, the possible variation in weather between shore-base and scene of action is wide, and the practical value of shore-based standing patrols is limited. Therefore carrier-borne aircraft will probably be indispensable as long as defence of surface maritime targets against support or long-range bombardment aircraft by interceptors remains necessary. In so far as such targets tend to disappear or their protection to be secured by counter-measures other than the interceptor, the aircraft carrier will become less and less essential.

As surely as measures are followed by counter-measures, so surely do counter-measures give rise to anti-counter-measures. Belligerents take steps to protect their freedom of action against the counter-measures of the enemy. Here again, an active and a passive category can be distinguished. The passive category includes the armouring of aircraft to reduce the effectiveness of anti-aircraft and interceptor fire, and the adoption of those forms of counter-measures which have already been detailed in protection of aircraft bases and launching sites. Active protection consists, on the other hand, in attack upon the enemy's counter-measures. This may be achieved by arming bombers with cannon for use against interceptors, by accompanying them with escort fighters, or by direct attack upon anti-aircraft sites, interceptor bases, balloon sites, radar stations, in short upon every-

thing on which the enemy's counter-measures depend.

Having analysed the counter-measures and anti-counter-measures which use of the third dimension has evoked, it is possible to obtain a correct insight into the meaning of 'air superiority', a phrase used with dangerous frequency and facility but of which the full implications are rarely grasped. The term air superiority comprehends two perfectly distinct elements: successful counter-measures, and successful anti-counter-measures. These two elements we may, for convenience, designate respectively 'defensive air superiority' and 'offensive air superiority'. Defensive air superiority consists in the prevention of an enemy's effective use of the air, that is, in denial to him of effective long-range bombardment, support, reconnaissance and transport operations. Offensive air superiority consists in effective neutralization of an enemy's counter-measures against our own use of the air, that is, in our power to execute long-range bombardment, support, reconnaissance and transport operations freely and efficaciously.

Air superiority, and the 'command of the air' or 'air power' which it confers, have thus the same twofold aspect as the command of the sea (p. 14), which comprehends power to interfere with an enemy's use of the sea (defensive) and power to prevent his interference with our own use of it (offensive). The difference is that in two-dimensional warfare, defensive and offensive command of the sea were obtained, for all practical purposes, by the same means — the defeat or overawing of the hostile forces — and could scarcely be conceived separately. On the other hand, in three-dimensional warfare, defensive air superiority can perfectly well exist without offensive

air superiority, as the one may be attained largely by different means from the other.

In the sphere of long-range bombardment it is of immense importance to realize that, theoretically at least, air superiority, despite its name, can be achieved without using a single aircraft. If we assume that the passive counter-measures of a belligerent are fully effective, or that his active counter-measures depend entirely on the use of ground weapons, we see how defensive air superiority may exist without the possession of aircraft. Similarly, if long-range bombardment were dependent purely on weapons of the projector type and the enemy's counter-measures proved ineffective or could be neutralized, offensive air superiority would be attained without the use of a single aircraft.

In practice, of course, no belligerent would deliberately neglect any economical means of securing the air superiority which he needs. However, the strict analysis of air superiority into its two components, and of these again into their basic constituents, may well lead to a sounder order of priority in the provision of the various weapons and the build-up of the necessary types of force. A belligerent strategically on the defensive will normally seek to obtain the maximum degree of defensive air superiority at the outset of hostilities, deferring, if necessary, the development of offensive air superiority in the full sense of the term (p. 57) to a later stage, dependent on the course of the war and his prospects of a general change-over to the strategic offensive. It will be necessary later to discuss the application of this line of reasoning to the problem of Imperial defence.

Air superiority, either defensive or offensive, is never

absolute. The success of counter-measures and of anti-counter-measures may vary through an immense range of kind and of degree. In particular, air superiority can vary in respect of place and of time: it may be local and it may be temporary; alternatively, it may tend towards universality and permanence. Generally speaking, a high degree of air superiority can nearly always be achieved temporarily or locally by concentration, either in defence of a particular target or system of targets at a particular time, or offensively in support of a specific operation. It is, however, only as a belligerent gradually gains general ascendancy over his opponent that temporary and local superiority is converted into a superiority more widespread and lasting, which in the end secures practical immunity for his own targets and full power to operate against those of the enemy almost without interference.

CHAPTER VI

THE BEGINNINGS OF AIR WARFARE

IN the last three chapters, the new developments in warfare which the conquest of the air has made possible have been elicited in their logical order from the fundamental characteristics of the weapons used. The first and by far the most significant is long-range bombardment. Separate from this, and subordinate to it in importance, are the uses of the air in supporting surface forces, in observation and intelligence and in the movement of stores and men. Upon the counter-measures and their antidotes evoked by these developments rest the conceptions of defensive and offensive air superiority.

These possibilities were not, however, grasped in their entirety nor seen in their true character from the outset. The historical order in which the several developments presented themselves was very different from the logical; and looking back from the vantage of the present, it is instructive to observe through what stages, as weapons and methods evolved, military thought groped its way to a fuller realization of the meaning of warfare in three dimensions. For this reason, it may be well at this point, before turning to the future, to analyse the history of air warfare up to the end of World War II with the aid of the conceptions formulated in the foregoing chapters.

At the outbreak of World War I the Navy and Army Wings of the Royal Flying Corps, which had been formed

in 1911, held different views of the functions which aircraft would perform in war. The Army Wing had concentrated entirely upon reconnaissance, neglecting both speed and armament, neither of which it believed to be necessary in reconnaissance. The Navy Wing on the other hand was given as its task the protection of Britain against enemy air attack and, in the second place, co-operation with the Royal Navy against enemy warships and submarines — that is, primarily counter long-range bombardment and secondarily naval support. In the earlier part of World War I, the operations of the two forces developed along these lines.

The first reconnaissance reports made by the Royal Flying Corps in France, commencing on August 19th, 1914, revealed immediately the importance of this source of intelligence. Had these reports been properly evaluated, they might have prevented the defeat at Mons and given the Allies a fairly accurate picture of the whole German advance which ended with the Battle of the Marne. When trench warfare began, air reconnaissance behind the enemy lines became a normal feature, and artillery co-operation both by spotting and fire control, which the French Army had already developed, acquired importance. Radio, the essential auxiliary of visual reconnaissance, was fitted to aircraft as early as September 5th, 1914. Air photography also began at an early stage and the first successful air photographs of enemy positions were taken on September 15th, 1914. The heights to which reconnaissance aircraft were forced by anti-aircraft fire speeded the development of air photography until, during the five months' Battle of the Somme in 1916, no fewer than 19,000 air photographs were taken and

240,000 prints made. In the same battle, over 8000 artillery targets were registered by air observation.

It was the importance of air reconnaissance in the land war and the attempt to deny it to the enemy while securing it for oneself (counter-reconnaissance and anti-counter-reconnaissance) which first led to air fighting and to the development of the interceptor. The first attempt to intercept a reconnaissance aircraft was made on August 22nd, 1914, when several British pilots armed with Lewis guns, rifles, pistols and hand grenades took off against a German aircraft. We see a good example of anti-counter-reconnaissance in the practice late in 1915 of giving each reconnaissance aircraft an escort of three or more interceptors. Air fighting, first with the object of denying reconnaissance to the enemy and later with the object of denying air support, became a permanent feature on the Western front; and by 1918 50 per cent of all Germany's aircraft and 44 per cent of Britain's were fighters.

The support role did not appear in land warfare, to any significant extent, until 1916; but in the Battle of the Somme in that year nearly 300 bombing raids were made by the Royal Flying Corps and 17,600 bombs, weighing nearly 300 tons, were dropped. Interception and air fighting thereafter came to be concerned as much with the prevention or facilitation of support as with that of reconnaissance. Counter-measures thus appeared only as the importance of each successive development was appreciated. As interceptors improved and special bombing aircraft were devised to carry heavier bomb loads, bombing attacks by night became a regular feature. By the time of the Battle of the Somme they were being

undertaken against railways, rolling-stock and dumps at considerable distances behind the line.

While the roles of reconnaissance and support, and the function of interceptors in preventing or facilitating the fulfilment of these roles, developed in close conjunction with the land war, long-range bombardment, with its own attendant features, was being explored by the Royal Naval Air Service and by its German counterpart. Impelled by the public fear of zeppelin raids which prevailed in Britain, four counter long-range bombardment raids were made from Dunkirk in the last three months of 1914 against zeppelin sheds, and as a result of these raids the enemy took his first measures of active and passive air defence, introducing searchlights and anti-aircraft guns, shelters, warnings and black-outs. At the end of 1914, naval aircraft from Dunkirk also executed the earliest support operations by bombing the railway station at Bruges and co-operating with naval guns in coastal bombardment.

Naval support operations were possible from Dunkirk against the harbours of Belgium and Western Germany; but the short range of the aircraft available for counter long-range bombardment attacks and for naval support and reconnaissance, especially against submarines, forced on the development of carriers and of seaplanes. Ships were fitted with launching platforms; but while flying-off was fairly easy, successful landing on a carrier was not achieved until 1917, and though aeroplanes from the aircraft carrier *Furious* made a successful counter long-range bombardment raid on zeppelin sheds at Tendern in July 1918, aircraft carriers were still in the experimental stage when the war ended. Three channel

steamers were converted into seaplane tenders; but seaplanes were found to be operationally unreliable, and able to rise only from the smoothest water. However, in the spring of 1917, the flying-boat had so far developed that a 6-ton flying-boat was produced with a fair bomb load and several hours' endurance, which proved effective against the submarines. Forty of this type were commissioned, and accounted for a considerable number of U-boats. A further specialized type of support aircraft was the torpedo carrier, first built in 1913, but despite successes at Gallipoli little developed until near the end of the war, when the first squadron of torpedo aeroplanes for the fleet was completed and embarked in an aircraft carrier.

Despite the project of an allied bombing squadron to attack German munition factories in 1915, Germany retained the monopoly of long-range bombardment operations until 1916, when a new wing of the Royal Naval Air Service was formed with the object of attacking industry and especially munition works. This, however, was disbanded in May 1917, under pressure from the army to place every available aircraft at the disposal of reconnaissance and support, a pressure which owed not a little to the Army's jealousy of naval aircraft operating against inland targets. It was learned later that the operations of the wing had succeeded out of all proportion to the mere 20 tons of bombs dropped and that they had caused large-scale anti-aircraft preparations in the Rhineland and the diversion of German interceptors from the Western front. Ironically enough, the eventual reversion of the Allies to long-range bombardment was due not to military considerations but to the public

demand for retaliation after the big raids on England on June 13th and July 7th, 1917. The result was the formation of 41 Wing, comprising one day-bomber and two night-bomber squadrons, which opened their operations by attacking the iron works at Burbach on October 17th, 1917. On February 1st, 1918, 41 Wing became VIII Brigade. In spite of bad weather the squadrons of this Brigade made a total of 142 raids, of which 57 were into German territory, and the remainder on enemy communications on the Western front. The raids into Germany included day and night attacks on Cologne, Mainz and Coblenz, attacks which were maintained despite the unsuitability of many of the aircraft.

The Royal Air Force came into being on April 1st, 1918, as a separate service into which the Royal Flying Corps and the Royal Naval Air Service were absorbed. As the Air Ministry, which was formed at the same time, intended to keep a free hand for their policy of long-range bombardment, VIII Brigade was reorganized and expanded as a separate command called the 'Independent Force'. This Force was directly under the Air Ministry and had the mission of striking directly at the enemy's sources of supply and production centres. Amongst targets attacked were the arsenal at Essen, chemical works at Solingen, railway centres at Coblenz and a submarine accumulator factory at Hagen. The total weight of bombs dropped by the Independent Force during the five months of its existence was 550 tons, including one large bomb weighing 1650 lb. As was to be expected, the enemy concentrated his air forces for the defence of the home front, and losses to the Independent Force were very heavy, squadrons losing about 50

per cent of their aircraft and 40 per cent of their flying personnel every month. Information concerning the achievement of the Independent Force was difficult to obtain, but by comparison with the known effects of German raids on England it was estimated that production in the factories attacked must have been greatly reduced for a short period after each attack. There is evidence to show that the value of these attacks lay in their moral effect rather than in the material damage, because bombing was a new and unnerving experience for civil populations hitherto far removed from the scene of war. It was these reactions to bombing which gave rise to the widely held belief after World War I that long wars were no longer possible because civil populations would not be able to withstand the strain of heavy air bombardment.

The foregoing examples of third-dimensional warfare in World War I have all been drawn from the Western European theatre. There is little of significance from other theatres. At Gallipoli the Allies had only insignificant air forces and there were virtually none at all on the Turkish side. Mesopotamia provides a solitary example of air transport over enemy territory in the dropping of food and supplies to the army besieged at Kut in April 1916. In Palestine, an air force operating without opposition and in defiles against the Turkish armies in retreat inflicted crushing losses and provided a classic case of support operations under conditions of complete air superiority.

Thus, by the time World War I came to an end, all the forms of three-dimensional warfare as we now know them had been exemplified, even if only in embryonic

form; but the order in which they made their appearance seems curious in retrospect. Long-range bombardment was planned before 1914 by Germany alone, but based upon the zeppelin. Indeed, it was probably because the zeppelin, which they favoured, was specially suited to long-range bombardment, that the Germans were the first to give attention to this. It evoked counter long-range bombardment in an active form first in the Royal Naval Air Service attacks throughout the war upon zeppelin bases, and later in the allocation of interceptors and anti-aircraft artillery to protect home targets. On the Allied side long-range bombardment by aircraft began only late and tentatively. Its potentialities were little recognized and its development opposed by the high command of the army, so that it gained fair scope only when an independent air force was at last constituted. Reconnaissance played an early and outstanding part in land operations, followed only tardily by the development of air support; and it was the struggle to prevent or protect reconnaissance and subsequently support operations which led to the development of anti-aircraft artillery and of the interceptor long before these attained their importance in connection with long-range bombardment. Transport alone of all the functions of aircraft in modern warfare was practically unrepresented in World War I.

The military operations of the years between the two World Wars add little to the story of third-dimensional warfare.

In Somaliland and Iraq in 1920, and frequently on the North-West Frontier of India, aircraft proved a new and effective method of controlling tribesmen. The

Italians in the Abyssinian war of 1935-36 showed how effectively air power can shorten a 'colonial' war. Air supply was there used on a considerable scale in addition to the now standard functions of reconnaissance and support, and among the weapons of support was included gas spray. In all these operations, however, and in those of the Japanese in China in 1937-38, the party against which air power was used was totally or practically destitute both of offensive air strength and of all active forms of defence against it. Apart, therefore, from technical information as to the physical effect of particular weapons, and experience in the handling of aircraft and air forces, no reliable deductions applicable to warfare between great powers could be drawn.

In the Spanish civil war of 1936-39, though both sides possessed air forces and anti-aircraft weapons, neither was anxious either to cause more material damage than was absolutely necessary for assisting the operations of its land forces, or to disorganize and destroy the means of life in areas which it hoped to capture and occupy. The use of air power was thus subject to limitations which, quite apart from any inadequacy of the available resources, reduced the significance of these operations for international warfare on a European scale. Some tentative conclusions could, however, be drawn as regards the effect of bombing upon cities. It was proved that, when desired, a town could be practically razed to the ground, as in the case of Guernica, which, with its 10,000 inhabitants, was almost completely destroyed by some 40 aircraft attacking in relays. On the other hand, it was found that small-scale air raids on towns eventually lost some of their moral effectiveness, particularly when competent

counter-measures were taken. In fact, the evidence indicated that sporadic air attacks on populations of large towns actually increased the determination to resist.

Thus it was that when World War II began, the effect upon warfare of the immense advances in aviation made since World War I, and particularly during the '30s, was an enigma on which deductions from experience since 1918 shed little light. In these circumstances forecasts not unnaturally varied from the most exaggerated expectations of annihilating and decisive results on the one hand to prejudiced and partisan underestimates on the other. There has perhaps never in the history of warfare existed a comparable state of ignorance about the potentialities of available weapons.

CHAPTER VII

AIR WARFARE IN WORLD WAR II

AT the outbreak of World War II, the two protagonists, Germany and Britain, viewed warfare from very different points of view. Germany aimed at overcoming her opponents in succession by brief sledge-hammer operations — the *Blitzkrieg*. In pursuit of this strategy every method was to be employed which could intensify the offensive power of the German armies and shorten the period required to obtain success. It was as one such method that the German High Command primarily viewed the operations of the *Luftwaffe*. Accordingly the functions of support, counter-support and anti-counter-support were those which received the most attention, and for which the *Luftwaffe* was principally designed and organized. Its main task was to support the German armies in the field, and to eliminate hostile air forces which might interfere with those armies or with that support.

Air transport into enemy-controlled territory, by parachute, glider or aircraft, was another technique upon which Germany concentrated as a method of hastening military decisions. By means of it troops were introduced behind the fighting line, in order to aid the collapse of a front or expedite an advance by occupying from the air important points on the route. In so far as long-range bombardment was envisaged at all by Germany, it was

thought of principally as a means to break the morale of hostile populations and so to accelerate collapse: attack upon the economic bases of an opponent's war effort could hold no important place in the strategy of the *blitzkrieg*.

This orientation of German air strategy necessarily conditioned that of her neighbours and particularly of France, which likewise focused upon the roles of support and counter-support. Britain, on the other hand, traditionally accustomed to wage long and initially defensive wars and to break her enemies by the gradual throttling of their power to resist, not unnaturally envisaged long-range bombardment with a clarity shared by no other nation. The British air staff, the successors of the command of the Independent Force of 1918, based their theories in 1939 upon long-range bombardment of the enemy's vital home targets as the primary function of their arm. Thus, in a sense, the outlook of the combatants in 1939 was the reverse of that in 1914, when Germany had thought of long-range bombardment by zeppelin while Britain looked to aircraft rather for reconnaissance, support and counter long-range bombardment.

The *Luftwaffe* played its allotted part in Germany's *blitzkrieg* victories over Poland in 1939 and France in 1940. Apart from the relative weakness and inefficiency of the land forces of her opponents, their counter-support resources were utterly inadequate to prevent the *Luftwaffe* from attaining and keeping an almost complete air superiority. With the defeat of France, Germany turned to the problem of a successful invasion of Britain; and here, in the German failure to isolate with sufficient thoroughness and to fulfil with sufficient determination

the functions required from her air forces within the grand strategic object of conquering the British Isles, we discern the root cause of Germany's defeat in the Battle of Britain, and so indirectly, yet inevitably, of her defeat in the war.

The conquest of the United Kingdom might well be regarded by the Germans as certain if they could successfully land an army on British soil and maintain it for only a few weeks. To do this they relied upon the support of the *Luftwaffe* directed both against land targets and against the Royal Navy. Their problem was therefore to secure protection for that support; and in the preparatory stages of the invasion which go under the name of the Battle of Britain it was consequently a task of anti-counter support which the *Luftwaffe* had to discharge. Up to a few days before the intended date of invasion, the sole logical object for the *Luftwaffe* was to nullify the British fighter strength in order that its own aircraft could operate in security against our surface forces which would seek to oppose and hinder the formation, maintenance and reinforcement of the German bridgehead.

Germany's error was that she failed to persevere in this task, and in consequence had to abandon the invasion itself. The British fighter forces, their airfields, their radar stations and all upon which they depended for their operation, should have been the only targets of German air action right up to the eve of invasion. These anti-counter-support operations were, however, interspersed with preparatory support, such as the bombing of railway lines and focal points, and with long-range bombardment operations, such as the attacks upon

London, which had nothing to do with the relevant object. In consequence, the German air force, though it often approached, never actually achieved, the point at which Britain's fighter defences became so weak as a counter-support weapon that invasion was safe.

After the abandonment of the intention to invade Britain in the autumn of 1940, actual contact, or even the imminent prospect of contact, between the main land forces of Germany and Britain in Western Europe ceased for nearly four years. Air warfare in the European and Atlantic theatre was therefore restricted to long-range bombardment, to the support and counter-support of naval forces, and to reconnaissance. German long-range bombardment rose to its peak in the winter and spring of 1940-41 and then gradually declined, while Allied long-range bombardment capability increased, until its maximum was attained after the invasion of Europe in 1944.

The German long-range bombardment offensive against Britain in 1940-41 failed for many reasons. In the first place, since the German air force had, as we have seen, been destined primarily for support, their principal bomber was the two-engine type, with limited range and carrying capacity, designed for short-range daylight raids on military targets. It was never intended and was not suitable for the role of long-range bombardment, especially at night, to which the enemy was restricted by his losses sustained in the Battle of Britain and by the superiority of the British fighters. In the second place, the attacks fell upon a nation not required at that precise moment to make a supreme military effort. Even had the scale and intensity of the attacks been much greater,

the point at which Britain's economy would have been incapable of responding to her minimum essential requirements would still have been far off. The only effect of the attacks therefore was to delay and hamper that growth of Allied armed strength which eventually brought victory in Africa, Italy and Western Europe.

From this point onwards German long-range bombardment by aircraft had a negligible and ever decreasing effect on the course of the war. Yet towards the end, the Germans were the first to demonstrate on a significant scale the other form of long-range bombardment weapon — a projectile launched against its target direct from a stationary discharger. Although the V1 took the form of an aircraft, dependent on the same principles of flight as piloted aircraft and powered with an elementary jet engine, it will be seen on analysis to possess all the characteristics of a projectile: it was self-destroying, it inflicted damage directly without the interposition of an intermediate weapon, and the base from which it was launched (whether on the ground or in the air) remained at a distance from the target. Of the V2 there could be no doubt as to the category into which it came; it was a powered missile launched directly from a stationary platform. There is good reason to think that the German V2 represents the prototype of the future standard form of projectile discharger, just as the bomber is the standard long-range bombardment weapon of the first category.

Long-range bombardment weapons of the projector type, as used by Germany in World War II, produced no marked or lasting influence on the course of the war. There were two main reasons for this. First, at the stage of technical development attained, the range was not very

great — neither the V1 nor the V2 had a range of more than 400 miles (as contrasted with the bomber's radius of action of 1500) — and the accuracy very low. The efficacy of the new weapon was proved too late for its teething troubles to be overcome in time. Secondly, as in their earlier operations with aircraft and bombs the Germans had shown no true appreciation of the principles of long-range bombardment and counter long-range bombardment, or of support and counter-support, so now they failed to make any really intelligent or systematic attacks with their new weapon.

It was obvious that preparations for invasion were under way in various South Coast ports, and in view of the imminence of the threat the Germans might well have used their V1, if not their V2, in a support role against the impending surface action. The novelty of even so inaccurate a weapon and the possibility of an occasional hit would doubtless have caused serious misgivings in the mind of the Allied Command, especially during the first phase of the Normandy operation. Instead, during this phase the Germans turned the V-weapons exclusively against London (which in fact was the only target they could be fairly sure to hit repeatedly), and sought to justify their choice by citing civilian morale as the objective. No effect was therefore produced upon the course of the decisive operations in Europe. In any case, the renewed German long-range bombardment with projectiles came too late, at a time when Allied offensive air superiority gave full scope to active counter-measures against launching sites in the Low Countries and France.

It is instructive to turn back and follow in detail the

influences which determined the form taken by Allied long-range bombardment over the years between October 1940 and the spring of 1944.

The choice between alternative long-range bombardment target systems depends upon the degree to which the enemy's ability to wage war will be impaired by the effect which available weapons under existing conditions can produce (p. 34). In 1940 the highest priority was given by Britain to oil targets, because oil was believed to be the limiting factor in the Germany economy. After July 1941, however, upon a reassessment of Germany's oil position, transportation targets were given the preference.

The selection of these targets involved certain miscalculations. In the first place they were essentially precision targets, whereas the strength of German counter long-range bombardment weapons enforced operation at high altitudes and at night. Besides this, air navigation was so rudimentary that bombers had little chance of blind flying through cloud or of finding and identifying targets deep in enemy territory. These conditions, coupled with the inadequacy of our bombing aids, made precision bombing virtually impossible. Secondly, the damage inflicted by the relatively small bombs available was at first greatly over-estimated, and this over-estimate was only gradually corrected by a study of the effects of German bombing in Britain and of air photographs of the targets attacked. Finally, the structure and condition of Germany's economy was imperfectly understood. We were led to believe that, from the beginning of the war, the German economic machine was stretched almost to its limit, whereas in fact German

industry was far from fully harnessed to the war effort. Analysis of our early bombing efforts shows that German industry was very resilient under air attack and possessed considerable powers of recuperation. They had good stocks of capital equipment and machine tools; factory space was ample and modern; man-power was abundant and not yet fully mobilized; and raw materials, although limited to begin with, became plentiful after Germany's early conquests. In fact, years were to elapse before the German economy reached the point at which it must succumb to the combined strain of heavy precision bombing and of a full-scale continental war on several fronts.

Two results followed from our revised appreciation in 1942 of the true effect of our attacks. In the first place, production and research were concentrated upon removing the handicaps imposed by deficiency in weight, deficiency in precision and the enemy's counter-measures. In the second place, a new type of target, the area target, was adopted as more suitable and efficacious.

At the beginning of the war Bomber Command operational force consisted of 23 medium bombing squadrons with a total bomb lift of only 520 tons. By early 1943 the first-line strength had increased to over 900 aircraft, of which more than 600 were heavy bombers; and at the end of the war the first-line strength totalled 1790, mostly heavy bombers, including the Lancaster with a lift of 11,000 lb. at maximum range, as compared with the maximum bomb lift of 1000 lb. available early in the war. The improvement in bombs was equally striking. With a few exceptions the types of bomb in use at the beginning of the war were the same as

in 1918; by the end, we were producing, though still (for reasons which will appear) not in sufficient numbers, bombs as heavy as the 'Tallboy' (12,000 lb.) and the 'Grand Slam' (22,000 lb.). To increase precision, far-reaching technical developments in navigation and in bomb-aiming equipment were achieved, with the assistance, in particular, of electronic devices. Tactics were also improved and a path-finder force created.

At the same time attention was constantly given by the Allies to anti-counter-measures. From the beginning the United States developed a day-bomber force, which depended for its security on the mutual cross-fire of the guns of the bomber formation, on heavy armour and later on fighter escort.

There were a few occasions before the final development of the American long-range fighters when their bombers attacked targets unescorted beyond fighter range. In those attacks they usually suffered heavy casualties — on the last occasion, in October 1943, as high as 27 per cent; and it was for this reason that production of the long-range fighters was forced ahead. Henceforth the American bombers did not attempt to evade enemy fighters, but aimed at provoking attack and bringing on combat. Britain, on the contrary, until as late as the autumn of 1944, when German counter long-range bombardment was broken, and except for a few small day-bomber raids, usually heavily escorted by fighters, relied upon development of night bombing by aircraft flying singly or in a stream, despite the enemy night-fighter force which had increased from 120 in September 1940 to 250 by June 1942, and reached the figures of 620 twin-engine and 125 single-engine

aircraft in the spring of 1944, and over 1000 twin-engine aircraft in September 1944. To counteract the effect of the German anti-aircraft artillery upon accuracy of bombing, radar jamming devices such as 'window' were successfully developed from July 1943 onward. The night-fighter was to some extent combated by employing small forces on more than one target on the same night, by diversionary and feint attacks, or by dispatching two attacking forces against the same target on the same night and timing the second to catch the enemy fighters refuelling.

While these technical and tactical measures were being taken to remove the causes of failure of Allied long-range bombardment in 1940-42, that failure itself had in the meantime a fateful reaction upon long-range bombardment policy. When it was realized that stick-bombing with small bombs had been ineffective against the targets hitherto selected, long-range bombardment was directed against the only type of target upon which the available weapons would produce an effect, namely, against built-up areas; and it was affirmed (erroneously, as we were to learn) that destruction of centres of population would demoralize the enemy, and especially his industrial workers, to the point where further resistance would be impossible, and would also, by material damage, so disrupt German industry that its total collapse would result. On the basis of lessons learnt from German attacks upon Britain a combination of high explosive and incendiary bombs was adopted for the purpose.

The first cities to be attacked in pursuance of the area-bombing policy, initiated in February 1942, were Lübeck, Rostock, Cologne and Düsseldorf. The attack

on Cologne on the night of May 30th, 1942, is of interest because, for the first time, a force of over 1000 bombers was employed in one attack. The results of the raid proved that damage increased out of proportion to the numbers of aircraft involved and that the destruction of built-over areas by our bombing was a realizable aim. As our bomber forces gathered strength in the succeeding years, these area attacks were stepped up and reached their peak intensity in the period between March 1943 and March 1944. During this period the Battles of the Ruhr and Berlin were fought and the destruction of Hamburg took place. From intelligence of the results of area bombing up to the end of 1944 it was estimated that nearly 80 per cent of the 57 German towns with populations over 100,000 or more had been destroyed or heavily damaged and nearly half the total acreage attacked had been razed. In the course of area attacks, 45 per cent of the total bomb tonnage dropped by Bomber Command, more than 400,000 tons, was launched against German industrial cities.

Nevertheless, although these attacks were instrumental in gaining air superiority for the Allies, the ultimate desired results were not realized. Despite the terrific onslaught, the morale of the German civil population was not reduced to breaking-point and the devastation of acres of cities did not disrupt German industry to anything approaching the extent required for its total collapse. It has since become clear that the bulk of the German key industries were either not in the towns at all or else were in suburbs rather than the densely built-over central areas. Moreover the workers also were largely accommodated in the countryside so that the dislocation

of services in the town and city centres had little effect upon production.

Thus long-range bombardment of Germany before the spring of 1944 did not achieve all the results intended. The earlier attacks, in 1940-42, were based on a mis-appreciation of the effect of available weapons on the enemy's economy; the subsequent attacks, in 1942-44, were directed against targets through which the objects of long-range bombardment were not achievable. The root cause of the trouble lay in our very imperfect understanding of how German economy functioned and consequent inability to assess what its most vulnerable elements were. In the long process of seeking them by trial and error, great destruction of industrial and urban material was wrought, to our own impoverishment and Germany's. On the other hand, the continued long-range bombardment did force Germany to tie up in countermeasures substantial forces which would otherwise have been available for different purposes. The training of the German Air Force was also seriously hampered.

In the spring of 1944, forces were partially diverted from long-range bombardment of Germany for employment on preparatory support and anti-counter-support for the invasion of Europe. When they became available again in September 1944, evidence of the outstandingly successful support operations against transportation in France, Belgium and Western Germany amply confirmed how vulnerable was the German economy to long-range bombardment when directed against this type of target. Though theoretically 'top priority' was now given to oil, with transportation second and built-up areas third, yet, as it happened, conditions were often unsuitable for

attacks on oil targets. In actual fact, therefore, the greater weight of attack was directed against transportation, which had the additional advantage that accurate intelligence was less essential, and plans could be based with confidence upon the known facts of the system. The effect of this offensive against transportation, coupled with that against oil, was to deprive Germany of the effective use of her disposable forces against the advancing allied armies. In addition, such air forces as the enemy could put into the air were diverted from counter-support on the battle front to the almost hopeless task of defending the Ruhr, the 'heart' of Germany.

The fact that German industry was largely dispersed was a point in our favour when we started to attack transportation (p. 54). The disruption of transportation meant that German industry was cut off from its supplies of raw material. Building materials could not be supplied to repair damaged buildings. Further dispersal of industry was rendered impossible. Components manufactured by units already dispersed could not be married together to produce the finished article. Coming when German industry was at last working under severe strain, the offensive against the German transportation system, superimposed on that against oil supplies, was a principal factor in the final collapse.

It remains to follow the course of three-dimensional warfare in the role of support, counter-support and anti-counter-support from the autumn of 1940, when the *Luftwaffe* failed in these functions against Britain.

Germany's *blitzkrieg* technique which had succeeded against Poland and France was applied in April and May 1941 with equal success against Greece and followed up

into Crete by an airborne operation. Command of the northern shore of the Mediterranean was thus secured; and the struggle developed to gain immunity for communications with Africa, because if these could be operated at sufficient capacity to build up and maintain the Axis forces in Libya, the fate of Britain in the Middle East was sealed. In this battle for and against the reinforcement and maintenance of the Afrika Corps and its allies, the island of Malta played a crucial part, since it afforded to the Allies airfields from which, with those of Egypt or Cyrenaica to the East, and later of Algeria to the West, all the trans-Mediterranean routes could be covered.

In the Axis operations against Malta and again in those of the allies against Pantellaria, Sicily and Southern Italy, we witness the same pre-invasion phenomena as previously in the Battle of Britain and subsequently in Normandy. With modern defensive fire-power and devices, the success of an opposed landing, especially upon a small or heavily defended objective such as Malta and its sister islands, depends so largely upon the support of air forces, that unless this can be guaranteed the operation will not be undertaken. Despite the weight and intensity of the preparation against Malta in January to May 1942, and the ridiculously small numbers of aircraft operating in its defence, the point was never reached at which the Germans were sufficiently sure of the adequacy and immunity of their air support to consider invasion worth while in the light of their alternative projects in the Mediterranean. Thus Malta remained in British control, and it is no exaggeration to say that it was the possession of its airfields alone which tipped the

scale against Germany in the battle for the Mediterranean routes upon which the defence of Egypt and the Middle East in 1941-43 depended.

A marked feature of air operations in support of the North African campaigns was the high selectivity with which aircraft, working upon information derived from good intelligence and a deep and detailed study of Mediterranean transportation, were able to achieve in striking targets which would exercise the maximum effect upon the enemy's maintenance and reinforcement. This characteristic became still more prominent after the middle of 1942 when American heavy bombers operating in daylight with precision sights began to be used in replacement of the British night-bombers and torpedo aircraft.

In the war between Germany and Russia which opened in June 1941, air operations were virtually restricted to those connected with support to land forces. Like Germany in 1939, Russia had not designed her air force with a view to long-range bombardment; and while the results of the Battle of Britain should have focused Germany's attention on this role, the Russian air force, so far as we know, continued to be purely an instrument of support, reconnaissance, and transport. In no case do genuine long-range bombardment operations appear to have played a part in the Russo-German war. Similarly airborne operations played no part on either side, although Russia, like Germany, had for a decade given close attention to airborne technique and tactics. Presumably at no stage did either combatant feel confident of the rapid exploitation which can alone justify this type of operation.

In preparing for the Allied invasion of the Continent (the operation known as 'Overlord'), the Allied High Command found itself confronted with almost the same set of problems as that which had faced the *Luftwaffe* in the summer of 1940; and they were exposed to the danger of making the same error of confusing support operations with long-range bombardment, which had proved fatal to Germany and which might well have been equally fatal to the chances of 'Overlord'. The success of the invasion would clearly depend upon two factors: first, upon elimination of the enemy's power to interfere with the Allied landing, reinforcement and supply; and secondly, upon ability to ensure that the enemy forces attacking the bridgehead did not increase at a more rapid rate than the Allied Forces defending and extending it. Any available resources which were necessary to the attainment of these two objects, in which we recognize the familiar functions of counter-support and support respectively, had of necessity to be devoted to them, once invasion was decided upon. It was in the service of the former task, that of counter-support, that the Casablanca directive of April 1943, named 'Point blank', made the German Air Force and the aircraft industry which supported it the highest priority target of air operations from the United Kingdom. These operations and the general progress of the air war were so successful that by the spring of 1944 there was in fact little danger that the German Air Force could offer effective opposition to the invasion. It was upon the second function, that of preparatory support, that attention therefore centred as the date fixed for 'Overlord' approached.

While the Germans might be successfully deceived

as to the point of the invasion and could presumably be overpowered at the precise place and time, the potential rate of increase of their forces opposing the bridgehead was far greater than that of the invaders, because the capacity of the road and particularly rail communications towards the area of the bridgehead much exceeded the capacity of the Allied sea-routes and harbours. It was therefore essential that the capacity of the German reinforcement routes should be greatly reduced before invasion and thereafter kept at as low a level as possible until the success of the invasion was assured and the build-up rate of the invading forces exceeded that of their opponents. Accordingly, the Allied Expeditionary Air Force proposed to adopt what was called the 'Transportation Plan', which aimed at 'sealing off' the invasion area by devastating rail communications in Western Germany, France and Belgium. Since the physical destruction of the lines themselves would have involved an impracticably severe effort, the method chosen was to destroy some eighty nodal points and servicing centres.

Without the successful execution of this operation, 'Overlord' would have been deprived of the conditions on which successful defence and extension of the bridgehead depended. The German build-up must then have been in a ratio of roughly four to one against the Allied build-up; and it is not unreasonable to conclude that 'Overlord' would most probably have failed. In fact, the successful execution of the 'Transportation Plan', supplemented by attacks after D-day on rolling stock and road movements, made it possible for the rate of build-up of the Allied land forces in Normandy to be much greater than that of the German forces. During the first four weeks after

D-day the enemy was able to dispatch to the Normandy bridgehead an average of only four troop trains per day; and even of these the majority never reached their destination.

The 'Transportation Plan' was the major part of the preparatory support operations for 'Overlord'; but these operations also included the preliminary destruction of coastal batteries, radar and wireless stations, airfields and transport centres in the immediate vicinity of the point of attack. Concurrently with these support operations, the flexibility of air forces was successfully exploited in the execution of feints to deceive the enemy as to the intended point of landing. For every target attacked which was relevant to the intended operation, two of the same kind were attacked elsewhere throughout the period of preparation, so that the pattern of Allied attacks gave the enemy no indication of the area on which the assault itself would fall. During the night before D-day itself, the ten most deadly coastal batteries guarding the Normandy beaches, which for security reasons had not yet been singled out for concentrated attack, were blasted in bad weather by the whole weight of Bomber Command. All but one were silenced. Then the American 8th Air Force was launched in strength against the beach defences. These attacks facilitated the final approach of the great armadas of transports and landing craft. Transport and escort of the very successful large-scale airborne assault behind the Normandy beaches was another task undertaken by the air forces to assist the landing.

From D-day heavy bomber forces were called upon by the army to support attacking land forces. In fact there were nine occasions between the middle of June and the

middle of August 1944, when heavy bombers were employed to support advancing Allied land forces, and some 20,000 tons of bombs were dropped with telling effect on German concentrations on the battlefield. In subsequent operations, major support was afforded during the Scheldt operations and the crossing of the Rhine, and bomber forces played an important part in cracking the enemy strongholds which the land forces had by-passed at Le Havre, Brest, St. Malo, Boulogne, Calais and Cap Gris Nez.

Nothing has yet been said of maritime support operations. Throughout the war, in support of British anti-submarine forces, long-range aircraft were invaluable for convoy escort duties. The role of aircraft on convoy escort was to 'spot' U-boats and either attack them directly with bombs and depth charges or else guide escort vessels to the scene to undertake the attack. On convoy escort, aircraft, either alone or co-operating with surface forces, accounted for many of the U-boats sunk or damaged. Though merchant shipping losses were high, it is certain that they would have been very much higher if convoy escort had had to be undertaken by surface forces alone.

When the Germans overran France in 1940, they gained access to the French Atlantic ports from which they could better maintain their expanding U-boat offensive in the Atlantic. Operating from ports on the Bay of Biscay, U-boats increased their attacks on shipping on the main Atlantic routes, especially around the north-west approaches to Britain. By the end of 1940, the situation was becoming desperate; for between September and November 1940 merchant shipping

losses reached 350,000 gross tons per month. To counteract this U-boat offensive, it was decided to employ aircraft on offensive sweeps in the transit area in the Bay of Biscay through which it was known that U-boats must pass. These offensive sweeps forced the Germans to fit anti-aircraft armament to their U-boats and to introduce counter-support patrols over the Bay; but despite these counter-measures, U-boats remained vulnerable to attack, and although aircraft did not sink many U-boats, they forced the enemy further out into the Atlantic to escape attack.

By the end of 1941, shipping losses had dropped considerably. However, a comparatively large number of sinkings were still taking place in those middle areas of the Atlantic which could not be effectively covered by air from Britain or Canada. To cover the gap in mid-Atlantic, very-long-range aircraft were employed, and aircraft also began to operate from bases in Iceland. When America entered the war in December 1941, the centre of gravity of the U-boat offensive moved over to the Eastern seaboard of America, and heavy U-boat attacks in this area caused merchant shipping losses to increase tremendously during the first half of 1942, until in July nearly 700,000 gross tons of shipping were lost. During the later months of 1942, however, merchant shipping losses declined again owing to the increasing effectiveness of American counter-measures, to the employment of more very-long-range aircraft for escort, and to the extremely rough weather which made it difficult for U-boats to attack.

The first few months of 1943 saw U-boats operating in packs score a number of successful attacks on convoys, inflicting heavy losses. In the first three weeks of March

over 600,000 gross tons of shipping were sunk by U-boats. Nevertheless, the U-boat packs were vulnerable to very-long-range aircraft. A number of devastating air attacks were made upon packs operating on the surface, and by the autumn of 1943 U-boats rarely exposed themselves in daylight. Although during the invasion of Europe the U-boats were concentrated in the English Channel and equipped with a 'breathing' device which allowed them to remain submerged at all times, the vigilance and effectiveness of air support were such that out of the vast number involved, very few Allied vessels were sunk.

In addition to playing an important part in the struggle against the submarine, aircraft were active in attacks on surface vessels. British aircraft were responsible for sinking or damaging several German capital ships, including the *Scharnhorst*, *Gneisenau*, *Tirpitz* and *Scheer*, and the cruisers, *Köln*, *Hipper* and *Lützow*. Another capital ship, the *Bismarck*, was sunk by the Royal Navy as a direct result of air reconnaissance.

Yet it is in the Pacific campaign that naval support is most fully exemplified. The Japanese attack upon Pearl Harbour in December 1941, was itself a naval support operation, and in the following months the Japanese air force was used in support in the oceanic *blitzkrieg*, as the *Luftwaffe* had been used in support of the German army in the continental *blitzkrieg*. Another example of a fleet action fought and decided with only one fleet present (p. 39) was afforded by the Japanese when in December 1941, some sixty of their land-based aircraft, armed with torpedo and bomb and unaided by surface forces, attacked and sank the British battleship *Prince of Wales* and the battle cruiser *Repulse*.

In general, the Pacific war presents a strange kind of parallel to the European. In both, the Axis powers launched their offensives with air forces designed for the support role and gained their initial successes largely by that means. In both, the Allies gradually built up a position in which they were not only superior in support, but could bring increasing pressure to bear by long-range bombardment, to which Japan gave as little attention as Germany. The turning-points in the support battle in the Far East were the carrier operations known as the Battles of the Coral Sea (May 1942) and of Midway (June 1942). The long-range bombardment phase — more distinct in the Far East than in Europe — began in 1944[1] with operations from the Marianas and from China; it culminated in the atomic bomb raids of August 1945.

The principal air transport operations of the European war have already been mentioned. But here again, the war in the Far East provides in the Burma theatre the classic examples of air transportation on a major scale: the air maintenance of the second Wingate Expedition (1944), the reinforcement of threatened Imphal with two divisions from Arakan in June 1944, and the steady use of air supply thenceforward in the advance into Burma to supplement surface lines of communication which could only with very lengthy improvement have been rendered capable of supporting the forces deployed. Although the sole transport operation to a terminus in enemy hands — the airborne attack on Rangoon in April 1944 — proved to be unopposed, the Burma campaign as a whole merits close and special study from the point of view of the

[1] The Doolittle raid of 1942 was isolated and in its physical effects unimportant.

capabilities and methods of air transportation. Again, in the vast distances of the Pacific which separated the Allied forces from their main bases and from America and Australia, it was air transport which made possible the maintenance of the U.S. Air Forces, the U.S. Navy and the British Pacific Fleet.

It remains to draw attention to the extensive use in European waters, and along the Japanese shipping routes in the SE. Pacific and South China Sea, of that hybrid between naval support and transport, mine-laying from aircraft. The deterrent effect of this weapon proved at least as valuable as its direct results. In the Baltic alone, it has been estimated that, apart from actual sinkings, the fear of allied mine-fields, laid mostly from the air, was effective to the extent of partly paralysing German-Scandinavian trade.

CHAPTER VIII

THREE-DIMENSIONAL WARFARE IN THE FUTURE

THE characteristics of three-dimensional warfare have now been elicited and its evolution traced. Before attempting to apply the knowledge thus gained to the problems of Imperial defence, it is necessary to envisage the forms that three-dimensional warfare is likely to assume in the future. The lessons of one war have always in varying degrees been found inapplicable at the outbreak of the next. There is danger in basing preparations for the future upon the conditions of the present; yet so great is the number of unknowns that it is hardly possible to foresee all the directions in which development may take place or the points at which the earliest and greatest progress will be made. To base defence preparations on a fixed and unchanging view of future conditions is no less dangerous than to base them on the present or the past. The future circumstances which present preparations are designed to meet assume ever new aspects as time passes; and those in authority must possess the clarity and detachment of mind to take constant account of these new aspects by adjusting their forecasts and the preparations based upon them.

There are four general directions in which the character of third-dimensional warfare can change. The medium through which it is conducted may be further extended, the weapons used may be improved or replaced, the nature

and accessibility of targets may alter, and new destructive agents may be employed.

The third dimension is the only one in which the sphere of warfare is capable of extension. We must expect to see greater and greater heights of the atmosphere brought into use as a medium for the transit of projectiles and of human-controlled weapons. There is also likely to be a more vigorous and intensive use of the third dimension below the surface of the sea, and naval warfare may take on an increasingly submarine character. Even the possibilities of some form of subterranean warfare might conceivably be investigated, if it should prove possible to protect targets effectively from air or surface attack by burying them beneath the level of the ground. The principal factor limiting exploitation of the upper air and the stratosphere at present appears to be the difficulty of obtaining accuracy. Targets will still remain upon the earth's surface, and in operating a long-range bombardment force of any character a balance has to be struck between the advantages of immunity from interference and speed of transmission and the disadvantages of magnifying the causes of inaccuracy.[1] In submarine warfare an important limitation on the use of the third dimension lies in the density of the medium and the consequent steep increase of effort in relation to speed.

The efficiency of the weapons with which the destructive agent is applied in three-dimensional warfare is capable of improvement in two main respects — *range* and *accuracy*; for *speed* affects only the freedom from inter-

[1] An increase in the effective zone of the explosion correspondingly reduces the importance of accuracy. This possibility is largely bound up with the prospects of the atomic weapon, discussed later.

ference, not the efficiency, of the weapons. The two major categories of weapon, represented respectively by the bomber and the rocket projector, are both still capable of great extension of range, though the limiting factors in the two cases are different. For aircraft, they lie in the increase of weight due to fuel load, and the difficulties of take-off and landing thereby caused. These limiting factors would be greatly reduced if not eliminated by the discovery or development of a type of fuel which afforded the same power for much less weight and bulk. They may also be lessened by devices to reduce momentum in landing and increase acceleration in take-off. On the other hand, until television and remote control combined are successfully applied to non-guided weapons of the projector type, accuracy is likely to be the factor limiting extension in their range, for without such devices the chances of error, in contrast to aircraft, increase with the range.

The effect in general of any increase in range is to reduce the interdependence between long-range bombardment and surface operations, until theoretically a point can be reached at which all parts of the earth's surface are within range from all other parts and where consequently the extent of territory occupied or controlled by a belligerent has no necessary relevance to his long-range bombardment capabilities. Increase in range accelerates and emphasizes that shrinkage of the world which makes it likely that all future wars involving a major power will be world wars. This in turn implies replacement of the old 'balance of power' on a continental scale by 'balance of power' on a world scale.

For both aircraft and projector, development of accur-

acy is at least as important as development of range. With the methods of bombing in use during World War II, the effect varied inversely as the square of the error. Thus a given increase in effectiveness is attainable more economically by increase in accuracy than by increase in weight of attack. This result is of particular importance both in peace and war, since economy of means must always be a guiding principle. Hitherto aircraft, by virtue of visual aiming, have had the advantage over projectors in accuracy as well as in range. With the general increase in speeds and altitudes, however, accuracy in long-range bombardment by aircraft no less than by projector must come to depend increasingly upon mechanical devices. Advance here is likely to be achieved for fixed targets long before it becomes practicable for moving targets, because here observation must precede aiming. In attack upon merchant vessels, for instance, the target must be located before it can be attacked. Attack upon moving targets either by projector or by automatic aiming aircraft must therefore wait upon the evolution of remote observation at long ranges, which in turn implies success in combating the effect of the earth's curvature. We may safely conclude that weapons and methods are likely to retain their present forms longest in relation to moving or movable targets. The conclusion applies with greatest force to operations in support and especially in close support, where it is difficult to conceive how the direct agency of the human observer can be dispensed with.

The potentialities of warfare in the third dimension must obviously vary according to the relationship at any given time between the efficiency of the defence and the efficiency of the attack, or, in other words, between the im-

munity of the target and the impunity of the attacker. Here we have a relationship which is based upon the most delicate variables and liable to alter suddenly and unpredictably according to the order in which particular advances or innovations in technique happen to be made. Once again, the possibilities of such variation are least for moving targets and for targets directly connected with the operations of the surface forces, while they are greatest for the fixed targets which form the objectives of long-range bombardment.

It will not be difficult to agree that if counter long-range bombardment were to race ahead of anti-counter long-range bombardment and attain something approaching 100 per cent efficiency, long-range bombardment itself together with many of the typical features of three-dimensional warfare would, at least for the time being, be eliminated. The surface forces would then resume the exclusive role in warfare which they played before the third dimension was invaded. Indications are, however, that in the present phase, long-range bombardment and anti-counter long-range bombardment have a handsome start over counter long-range bombardment.

It seems most improbable that interceptor aircraft or artillery will ever afford the continuous coverage necessary to ensure 100 per cent interception either by preventing aircraft from reaching the area of their target or by destroying the bomb or projectile in flight. Continuous coverage could be provided either by a physical barrier (in the tradition of the balloon barrage) or by some kind of electronic barrier. The former device, however, is too encumbered with mechanical difficulties ever to prove practical against this form of attack, while the latter,

though eminently feasible, is unlikely to be realized for a long time to come. Furthermore, there is every likelihood that any electronic counter-measure has its corresponding anti-counter-measure and that consequently the period of 100 per cent efficiency for any particular electronic interceptor would be brief.

The passive measures of dispersion, duplication and protection could, if made efficient enough, render long-range bombardment wholly or largely ineffective. The experience gained in World War II is likely to stimulate adoption of these measures in peace-time, but in each case there are inherent limitations which forbid us to count upon any decisive or lasting reduction in the efficacy of long-range bombardment. Dispersion and multiplication beyond a certain point reduce efficiency and, as already noted (p. 54), increase a nation's dependence upon its transportation system and consequently its vulnerability through that system. Moreover, the dispersed or duplicated targets, though individually less valuable and more difficult to locate, remain accessible to accurate long-range bombardment directed by good intelligence.

Unless the penetrative power of long-range bombardment weapons can be greatly increased, the burying of potential targets may afford them complete immunity. But though the achievements of Germany in World War II should be a warning not to underestimate the extent to which installations can 'go to ground', there are certain insurmountable limitations. Some targets upon which the value of the others depends — such as ports and transportation systems — are, by their nature, virtually incapable of being located underground. Even if key personnel can be adequately protected, the bulk of the population

must continue to work and live on the surface. Finally, the cost involved in taking industry and housing underground on any comprehensive scale must prove prohibitive.

The relative vulnerability of different classes of long-range bombardment target, and possibly, though not necessarily, the vulnerability of such targets as a whole, may be altered by an alteration in the basis of a country's economy. For example, the development of a new source of power, independent of coal, oil or water, might not only facilitate dispersion and multiplication but result in the elimination of such targets as oil refineries and power stations without of necessity creating other targets of equal importance and vulnerability.

It may be concluded that, in long-range bombardment especially, the relative advantages of the offensive and the defensive are likely to vary within wide limits, and that their relation at any particular future time is peculiarly difficult to predict. There is, however, no good ground for supposing that upon the whole the efficacy of weapons using the third dimension will be less in a future war than in World War II. The struggle for command of the third dimension is likely to be decided, in the future as in the past, not by any single method of offence or defence but by the joint and cumulative effect of superior skill, forethought, weapons, resources and scientific knowledge, not to mention morale.

Consideration of the destructive agents used in war has been left till last. Stimulated by the use of atomic fission in the closing phase of World War II, it is round innovations of this kind that popular interest and imagination chiefly centre. Certainly a nation would be exposed to

peculiarly grave danger if its defence preparations failed to take account of any possible new destructive agents which might replace or supplement the high explosives used in previous wars. In addition to the 'traditional' high explosive, operating either by blast or by the missiles which it propels or scatters, three further possible destructive agencies are already known, namely 'war gases', atomic weapons and bacteria. All three have one general characteristic in common, they are non-selective. The single act of a belligerent in using any of them is capable of causing widespread destruction of the other belligerent's forces, population or material.

The extent of our experience in regard to each of these three agents differs widely. War gases, having been exploited fairly freely (though only at the battle front) by both belligerents in World War I, were prepared for World War II. But apart from a few trivial and isolated cases in the Far East, they were not used. Atomic weapons were applied at the end of World War II to a belligerent whose defeat was already certain. It is believed that the destructive capabilities of atomic fission demonstrated in Japan represent only a fraction of those within the range of possibility, and that destruction infinitely greater than at Hiroshima and Nagasaki is achievable. Finally, though preparations for bacteriological warfare had been made during World War II, this agent was never actually put to the test.

The atomic bomb differs to such an extent from any other kind of bomb, both in the nature and intensity of its effects and in the conditions of its production, that it must be regarded as essentially a new weapon. Its effects are characterized by the size of the area affected by a

single bomb and by the length of time during which the area affected remains dangerous. Existing conditions of its production are such that the number which even a great industrial power can make (and therefore, if they are not expended, can accumulate) in a given time is extremely low compared with orthodox weapons.

From these characteristics of the atomic bomb certain general conclusions regarding its use can at once be drawn. Targets appropriate for its application will, save in most exceptional circumstances, be both concentrated and of such a size as to occupy an area not very much less than the effective radius of one bomb. They must also be such that their contamination for a considerable length of time can be accepted. Given the relative scarcity of the weapon, the targets must further be of the utmost importance to their possessor's war-effort or war-will. These conditions are, upon the whole, fulfilled by great centres of industry or population, or by important ports, rather than by individual installations or by surface forces, whether land or maritime, which present relatively small targets dispersed over wide areas. The targets must not be objectives which the user of the bomb intends or needs to occupy or pass through for the purpose of prosecuting or winning the war or for his peacetime occasions immediately thereafter.

The vulnerability of a country to attack by atomic bombs depends, obviously, on the number and accessibility to an enemy of the targets belonging to it which fulfil these conditions. It is possible to exaggerate the differences between great powers in this respect. No country would be a great power or capable of warfare against other great powers if it did not comprise many

great concentrations of population or industrial centres. Some powers may, however, have such large or widely dispersed industrial resources, that more targets would need to be hit to produce a crippling effect than in the case of other powers. In the accessibility of these targets to an enemy, there may, it is true, be great differences; but these differences are not so great as they at first sight may appear. Even at present bomber ranges, there is practically no territory of a great power beyond atomic bombing range from territory possessed or commanded by others. The sole remaining difference turns on defence; and there is no inherent reason why a given number of atomic targets located in a comparatively small area (such as England and Wales) should not be as effectively defensible as the same number scattered over a much larger territory (such as the United States).

A corollary to the great size of the area affected by one atomic bomb is the great effect which one belligerent can produce upon another *in a very brief space of time.* A temporary failure of defences or the temporary loss of vantage ground to the enemy, which with earlier weapons might have been no more than inconvenient, may, with atomic weapons, be calamitous or even fatal. Normal confidence that superior force or superior resources will tell in the end is thus shaken or demolished. This is the rational basis of that horror which the destructive efficiency of the single atomic bomb produces upon the popular mind. It creates a moral factor in the use of the bomb, not to be overlooked or underestimated.

In considering the circumstances and manner in which use of the atomic bomb is foreseeable, the future has to be divided into two periods: the period before atomic bombs

and the means of delivering them efficiently are possessed by all the world's greatest powers and not (as is believed to be the present situation) by the United States only, and the period thereafter. The division between the two periods is, of course, not in the nature of a dramatic switch-over. The stocks of atomic bombs possessed by the United States will, presumably, continue to grow. The transition, which begins when the first bomb is produced by another great power, is complete only when stocks in the world, though still unequal, have reached such levels that even the lesser stock would be adequate to deal effectively with a potential enemy's atomic targets.

Even to say 'have reached such levels' is not strictly accurate. Certainly, if warfare with atomic weapons once begins, it is the existence and number of the bombs actually possessed by the belligerents which matters. But until that time, the action of the belligerents is influenced not by the facts, but by what they believe to be the facts, about their opponents or potential opponents. The two periods distinguished in the last paragraph must therefore be understood subjectively, as dependent upon the state of knowledge and belief of those called upon to make the relevant decisions in the respective countries. Thus, in the matter of atomic weapons, the importance of deception is out of all proportion great and a nation which possessed no atomic weapons or resources but could convince the world that it had them would, unless and until the bluff were called, not only be at no disadvantage but actually benefit to the extent of the resultant economy.

We have now to attempt some estimate of the factors which in these two periods of the future will influence the use or otherwise of the atomic bomb.

In the first period — the 'monopoly' period — the decision has to be taken, if war occurs, whether to seek quick and therefore cheap victory by the use of atomic bombs. The 'monopoly' period, however, must sooner or later draw to an end. Therefore, unless a potential enemy commits during that period an act which renders war unavoidable in any case, the further decision has to be taken, whether to profit by 'monopoly' conditions while they last. These decisions are essentially political, but there are certain military considerations which will, or should, affect them. Use of atomic bombs can only be decisive if a sufficient number of targets are effectively engaged in so short a space of time that the enemy has no power or opportunity of recovery. In any set of circumstances there is clearly a minimum stock of atomic bombs from which this result could be confidently expected, taking into account the number of targets, the proportion of atomic bombers expected to reach the targets, the degree of accuracy, and the presumed effectiveness of a hit. Only when the 'monopolist' attains stocks of these minimum dimensions and the ability to deliver them, could he consider the atomic bomb so decisive as to base his policy and his preparations upon mass use of it.

Even in this optimum situation for the employment of the atomic bomb, there are factors which may operate against making it the basis of national strategy. It should be the object of any nation not merely to disable its enemy from hostile acts or aggression in the foreseeable future, but to do so in such a way that the consequences to itself are as little damaging as possible. The consequences of prostrating one of the great powers by the mass destruction of its centres of population and of industry might well

be so serious for the rest of the world, including the victor nation or nations, as to form an appreciable counterbalance to the advantages anticipated from a 'preventive' war decided by atomic bombing or even to the use of that method to terminate aggression. In some conceivable circumstances, though not necessarily in all, victory would not be complete and its results could not be reaped without physical occupation of the whole or parts of the enemy's territory or of territory occupied by him which had contained essential atomic targets. This occupation might well, even after atomic destruction had ruled out large-scale organized resistance, represent a considerable military operation and involve widespread fighting. It would in any case be gravely hampered by the aftermath, direct and indirect, of massive atomic attack.

Two considerations above all others must operate strongly against giving atomic bombing a central position in national strategy, even during the 'monopoly' period. Reliance upon one weapon assumes the unconditional determination to use it, and to use it in whatever circumstances and manner are necessary to render its use decisive. It is doubtful whether any such assumption could safely be made regarding the government of a democratic country, dependent on and answerable to public opinion with its varying moods and gradualness of apprehension. Secondly, the 'monopoly' period, however long, is limited. The effective termination of 'monopoly' may cover years; on the other hand it may be the sudden result of unexpected intelligence or new scientific discovery. After termination of 'monopoly', atomic bombing will become subject to entirely new limitations and considerations, which must presently be examined, and

its decisive value to the former 'monopolist' could certainly not be assumed. It would be suicide to base the whole national strategy and defence preparations upon assumptions which, even if firm for the time being, are in their nature provisional and may suddenly be nullified.

If, then, the 'monopolist' does not take mass atomic attack as the basis of his whole strategy, the atomic bomb is relegated to the position which it occupied before stocks grew to such a size as to permit mass use: it becomes one weapon amongst others, an exceptionally powerful one it is true, but essentially a weapon of opportunity, as in World War II. The diplomatic effect of its possession, like the diplomatic effect of any other disparity of weapons or military force, is no greater than the practical possibilities; for the monopolist's potential victim follows the same train of thought as the 'monopolist' himself concerning the advantages and disadvantages for the latter of the alternative courses open — and it is unwise to assume that he comes to different conclusions.

Let us turn now to post-'monopoly' conditions. There is here one overriding factor — the fear of reprisals. When all great powers possess sufficient stocks of atomic bombs to create widespread havoc in the civil and industrial centres of others, there could be safety from reprisals only if the initial atomic offensive completely incapacitated the victim from retaliation. But in fact, the retaliatory forces would presumably be able to survive and operate whatever had been the fate of the atomic targets in their own country; indeed the possessor would presumably protect and insulate these forces as far as possible, with that very object. In any case, it is unlikely that attacks could reach and destroy all the possible bases of atomic

bombing operations at the disposal not only of the victim but also of his actual and potential allies.

The factors, therefore, affecting belligerents in post-'monopoly' conditions are likely to take the following form. An aggressor attacking a small power, when he could achieve his result by superiority of non-atomic force, would probably avoid employing a method which would reduce the value of his acquisition and impede his exploitation of it, apart from the fact that his behaviour would alarm other powers and put them on their guard. An aggressor attacking a great power, if he employed atomic attack, would court almost certain retaliation upon himself, so severe as to deprive victory of much of its value. On the other hand, if he himself refrained from atomic war and by the threat of retaliation induced his victim to refrain likewise, he might hope to secure his object with the superior military force which presumably in the first place prompted the aggression. Finally, the nation aggressed, as long as there was any prospect of successful defence, would have no object in beginning the atomic duel, for which the aggressor would probably be at least as well provided as itself; and when defeat and surrender was no longer avoidable, the balance of advantage in such a duel would be so decisively against the loser (by reason of loss of territory and bases, if not of air power), that to initiate it would be equivalent to suicide.

From this discussion of factors which condition the employment of atomic bombs in the 'monopoly' period and the post-'monopoly' period, while no reasonable person would scout the possibility of either an atomic decision in the former or an atomic duel in the latter, it is

clear at any rate that the atomic bomb is *not*, as there is a danger of its coming to be thought, a substitute for other forms of armament. Certainly provision of atomic bomb stocks and the means of applying them is now indispensable, if only to ensure the means of effective retaliation when the 'monopoly' terminates. Yet provision of these weapons is not an alternative; it is an additional burden, which all major powers must in future carry without, so far as can at present be foreseen, in any way reducing the necessity of adequate preparations for the traditional forms of war. Indeed, unless the use of the atomic bomb were beyond possibility of doubt the be-all and end-all of future warfare, and unless moreover its adoption at the appropriate moment were certain to be authorized by the government concerned, exclusive reliance could not be placed upon it, and all the same preparations would be necessary as if it had never been invented.

Research which is proceeding into the use of atomic power may eventually indicate means of reducing the atomic weapon's characteristics of non-selectivity and overhitting. There is obviously an immense range of intervening stages between present high explosives and the atomic weapon as we know it. The upper gradations in this scale coincide for practical purposes with the present atomic weapon, while in the foreseeable future there seems to be little prospect of producing atomic weapons in the lower gradations of the scale. Only when this problem has been solved will the considerations marshalled above cease to be valid, and only then can we expect general application of atomic weapons in warfare.

So far as gas and bacteria can be given a potency similar to that of the atomic weapon, similar considerations will

apply to their use. In the case, however, of bacteriological warfare there is the additional factor of the uncertainty which must attend the use of an untried weapon. Only in one respect do gas warfare and bacteriological warfare appear to hold out advantages over atomic warfare. The destruction which they bring about is destruction only of human life. They avoid that destruction of material, inseparable from the use of the atomic weapon, which has much the more serious economic consequences for the victor. Had, for example, the population of Germany been even more severely reduced during World War II, but without substantial material destruction, the economic damage to the Allies in victory would have been far less. In so far, therefore, as gas warfare and bacteriological warfare are more selective than atomic warfare, their use is attended by less disadvantage.

It is, however, pertinent to note that after twenty years of research in peace and six in war no belligerent in World War II considered resort to gas warfare justified by the dangers of retaliation. This form of warfare may be destined to remain a freak of World War I, and may in this way afford an instructive analogy to the atomic weapon.

Bacteriological warfare can take a large number of possible forms, according as the bacteria are designed to attack vegetation, animals or men, or are contagious or non-contagious, and so forth. It is likely to exercise its full effect only where the bacteria used disseminate themselves of their own accord; otherwise, the radius of action is not necessarily greater than, or even as great as, that attainable with high explosive or gas. Therefore in order to derive the full advantage from this weapon a belligerent would have to use it in the form which threatens the

greatest danger to himself as well as to his defeated opponent, namely, in the form of self-disseminating and virulent disease difficult to combat. It is observable, however, that objections on this ground to resort to bacteriological warfare are somewhat less strong against an insular target, where the effects might be sealed off by the sea.

The foregoing review of possible developments in three-dimensional warfare has led to the conclusion that an extension of the medium and an improvement, both as to range and accuracy, in the weapons of the third dimension is to be expected, and that the results of these changes will be greatest in the field of long-range bombardment and least in that of support. The relative efficacy of defence and offence is likely to be subject to sudden and unpredictable fluctuations. Conditions where the defence is so strong as to reduce use of the third dimension, particularly for long-range bombardment, to practical unimportance are not likely to obtain, or, if they do obtain, to be other than very short-lived. Finally, though all great powers must in future be more or less prepared to use the class of weapon designated as non-selective and over-hitting, the general form of three-dimensional warfare is likely to remain unaffected by this eventuality.

When we inquire into the future of the various forms of three-dimensional warfare, we find not only that allowance has to be made for the effect of the possible changes just recapitulated, but that the implications of developments already witnessed in World War II have yet to be fully worked out. In World War II long-range bombardment by aircraft was not exploited anything like fully until the closing stages. The projector type of weapon was hardly seen in use at all for true long-range bombardment.

Moreover the fact that the influence of long-range bombardment on warfare had not been fully appreciated earlier and that due intelligence and other preparations for it had not been made in peace, greatly reduced its effectiveness. In any future war, both belligerents must be assumed prepared from the start for long-range bombardment operations. These will therefore probably assume an importance quite out of proportion to that which they had in all but the very last phase of World War II.

The use of the air was exploited in World War II, and even World War I, much more thoroughly for support than for long-range bombardment. It seems likely that the potentialities of at any rate close support to land forces[1] have already been largely realized, and no drastic change on this account in the form of land warfare is foreseeable. The same cannot be said of maritime warfare, where the working out of the potentialities of weapons already known has yet to transform the character of surface forces and the manner in which they operate. Unless and until goods can be conveyed on a large scale and economically beneath the surface of the water, the aircraft is likely to be the principal weapon of offence against the merchant vessel and one of the principal weapons of its defence. Since, as we have seen (p. 14), the ultimate *raison d'être* of maritime forces is and always has been the destruction or protection of the merchant vessel (including the transport), it follows that the role of maritime surface forces is already greatly

[1] It will be understood that the terms 'land forces' and 'land warfare' both here and elsewhere in this book exclude weapons and operations ancillary to the use, or prevention of the use, of the third dimension. The crew of a rocket projector are no more 'land forces' than the crew of a bomber, nor is the firing of anti-aircraft guns or the raising of balloon barrages any more 'land warfare' than the manœuvring of interceptors or the detection of aircraft by radar. Considerations of 'Service' are here, as so often, a distraction.

restricted. Apart from their functions in defence against submarine attack, they now serve as little more than a 'long-stop', to provide a second line of defence or an alternative means of attack where or when aircraft cannot operate or other forms of interception have been eluded. As the accuracy of attack by aircraft is improved and their powers of search and observation are strengthened, the importance of this remaining function of maritime surface forces will progressively decline. The time is already in sight when (submarine attack still, for the moment, disregarded) a convoy attended only by counter-support aircraft carriers can sail from one side of the world to the other with as great or as little security as if it had been escorted by a battle fleet.

On the other hand, intensification and further development of submarine and counter-submarine warfare is to be envisaged as the efficacy of attack and defence of surface vessels from the air increases. Thus the battle for command of the sea is likely to be fought out by two categories of forces: on the one hand, support and counter-support, or long-range bombardment and counter long-range bombardment, according to the nature of the target (p. 55); and on the other hand, submarine and counter-submarine. Maritime warfare appears destined, accordingly, to be fought eventually by forces utilizing the third dimension above and below the surface, leaving upon the surface only the aircraft carrier.

There is one further function hitherto performed by naval forces, which is not strictly maritime and which may remain unaffected in the years to come. This is the function of a vessel as a floating platform for artillery to be used against shore targets — in fact, land artillery afloat.

Although a specialized type of vessel — the monitor — has been designed for this role, all other types, up to and including the battleship,[1] have been used in it; and situations in which this type of artillery support is necessary or desirable will occur in the future, as in the past, though not inconceivably this task also may come to be performed by vessels normally travelling submerged. It was from this use of the surface vessel that fleets have derived their value for demonstrations, especially against minor maritime or insular powers; and occasions for their 'diplomatic' employment in this role may still arise, although, provided that suitable bases are available, aircraft may more economically be employed for these purposes.

The least drastic change and development is to be anticipated in the use of the third dimension for transport. The restrictions which are imposed by the carriage of human beings, and the high ratio between effort and load which is involved in air transport, appear to limit fairly narrowly the use of the air for transport of goods and personnel, at least until exploitation of the stratosphere has proceeded much farther.

The land and the sea must therefore remain the predominant media of transport. Only if the relative capabilities of sea transport and air transport were more drastically reversed than at present appears possible would the importance of maritime communications and of the command of the sea be substantially reduced.

[1] E.g. the battleships of the Home Fleet in the landing in Normandy, June 1944.

CHAPTER IX

IMPERIAL DEFENCE IN A FUTURE WAR

THE remainder of this book is devoted to placing in a practical setting the conclusions already reached upon three-dimensional warfare and its future development. There are advantages in abstract study of the effect of technique and weapons upon strategy; but there are none whatever in applying the results of that study in abstraction. Military preparation is never for defence in the abstract; it is always for defence of a particular territory or territories against a particular enemy or enemies, though the latter fact tends to be masked by the difficulty or impossibility of foreseeing with certainty the actual circumstances or date.

If the enemies which a country will in fact encounter and the dates at which it will encounter them could be foreseen with complete certainty, it would be a matter of simple calculation to ensure that military preparations were neither deficient nor excessive, in other words, to eliminate both risk and waste. In practice, of course, the event is never precisely foreseeable, but must always remain a matter of 'appreciation' since it depends upon a vast number of causes, of which not all can be detected or, if detected, assessed at their true importance. Moreover, the constellation of causes is bound to change, through some coming into view or into greater prominence, while others lose importance or disappear altogether.

Appreciations have therefore to be reviewed and altered correspondingly. The duty of a government is to ensure that current defence preparations shall so correspond with current appreciation that there is a minimum both of risk and of waste.

The difficulties of making sound defence preparations within this definition of the term are greatly enhanced by the reaction of those preparations themselves upon the preparations and intentions of other nations. If it were possible to isolate the nation for which an appreciation was being made, and to regard the rest of the world as something entirely separate, with which relations began only at the outbreak of war, then at least the target aimed at would be a stationary one. As it is, both aimer and target are in political, economic, scientific and military motion, and their respective movements are in part related. From this reaction of the military preparations of one nation upon those of another arises the *deterrent* effect, the effect in preventing or delaying war, which those preparations either have or are supposed to have. It is common to hear reference made to expenditure upon defence as being in the nature of an insurance premium. The metaphor is misleading and contains a dangerous fallacy. The essence of insurance is that a loss which is bound to strike one out of every so many units insured is spread over the whole number, with the result that the incidence upon each (in the form of the premium paid) is very slight. This is a situation which bears no true resemblance to that of a nation either preparing to defend itself at a specific date against a specific enemy, or hoping by its preparations to reduce or defer a specific danger. Apart from the deterrent effect (where it really exists) and

apart also from certain non-belligerent uses of defence forces, it would be true to say that the resources in materials and labour devoted by a nation to military preparations which it does not in fact have to use in war against an enemy (or which are not indispensable to other preparations which it does so use) are pure waste.

In framing its defence policy a nation has thus to solve at the same time two problems. First it must assess what forces it would require at the outbreak and during the course of an assumed war or wars, and thence deduce the minimum peace-time preparations to assure the availability of the appropriate forces at each stage. Secondly, and concurrently, it must consider how far these preparations and others additional or even alternative thereto might actually prevent or defer the assumed war or wars.

The practical setting in which it is here proposed to place the conclusions reached on three-dimensional warfare is that of Imperial defence. The method will be a discussion of the form likely to be taken in the future by a major conflict which involves the Commonwealth and which is thus suitable to be used as a basis for defence preparations. It would not be possible or, if possible, desirable in a book of this kind to attempt to offer a detailed solution of the problem. This does not, however, preclude consideration of the military factors of which account must be taken, and there is little difficulty in sketching those features which are bound to be common to all detailed appreciations.

This discussion occupies the present chapter. The subsequent step of deducing the form of present defence preparations from the appreciation of a future conflict,

falls strictly outside our subject. For the principles involved are not essentially different for three-dimensional warfare from what they were for two-dimensional. So little, however, are these principles generally apprehended, that it has been thought worth while to add a last chapter by way of appendix to the main argument for the purpose of setting them out.

In considering Imperial defence in a future conflict, it is first necessary to be clear about what is to be defended. The answer to this question is essentially political.[1] Such a political decision always precedes and underlies military decisions. In the abstract probably the correct answer is that Imperial defence is the defence of the territories inhabited by the King's subjects. This definition does not necessarily exclude defence of the territories inhabited by British-protected persons or of the territories of permanent or temporary allies; but the ultimate reason why defence of these latter territories is at any time undertaken will be found to be the defence of His Majesty's dominions in the narrower sense of the term. Even defence agreements and undertakings which may be made under the auspices of an international body such as the United Nations are entered into because they are considered the best methods of ensuring the defence of the Commonwealth. Expressed another way, they would not be made if they appeared to conflict with any alternative method affording greater security.

[1] The term 'political' in this chapter and the next is used, without its ordinary associations of internal, or party, politics, to denote that sphere of action and decision which transcends and contains the military sphere and which is concerned with the aims and policies of nations as a whole both in peace and war. It is perhaps significant that no single unambiguous term to denote this sphere exists. The noun 'statesmanship' (though not the adjective 'statesmanlike') expresses the idea imperfectly and clumsily.

To say that Imperial defence is the defence of all the territories of the Commonwealth is not to say that it means the absolute denial to an enemy under any circumstances of all parts of those territories. Defence might be, and often has been, successful despite the abandonment of a certain amount of territory to an enemy, because the territory so abandoned was subsequently recovered in consequence of general victory. We have, therefore, to recognize that the term 'defence' as applied to different parts of the Commonwealth has different meanings and implies the use of different methods. These differences, which it is essential to establish before a sound defence policy can be formed, are not entirely inherent, but to some extent vary with the nature of the threat and with the political viewpoint. We have, therefore, after reviewing the composition and character of the Commonwealth, to define the respective degrees of security which it might be necessary to afford to the different parts in various circumstances.

The political and military future of all parts of the Commonwealth has been affected to a degree which at present it is impossible to foresee or closely define owing to the change in the status of India and Burma. Unfortunately, the difficulty of foreseeing the consequences of these events does not lessen their real importance, and any view of Imperial defence which made no attempt to take account of them would condemn itself at the outset. The dominating military facts are that the Indian sub-continent no longer forms part of the British military sphere, and that the indigenous forces previously raised and based in these territories, forces which were of great military value, are in consequence no longer auto-

matically available. The same qualification applies to any air and naval stations which may be at the disposal of United Kingdom and other Imperial forces in India, Pakistan and Burma, and to the means of providing for their supply and defence. Burma has ceased to be part of the Commonwealth and her future military relations with us are yet undefined. The future position of Ceylon, though politically similar to that of Pakistan and of India, is different to the extent that the insular and oceanic situation of the island reduces the effect of political changes upon its defensibility.

Reviewing the situation of the Commonwealth, less Pakistan and India, we are struck by two characteristics: the relative shortness of land frontiers and the immense distances separating the groups of territories which constitute the Commonwealth. In the western hemisphere, apart from small continental possessions in Central and South America, Commonwealth territory falls into two main groups: first the West Indies and Atlantic islands, and secondly the Dominion of Canada.

Still leaving the Indian sub-continent out of account, the Canadian frontier with America is the only significant land frontier in the Commonwealth, and it has for long been the only frontier with a great power. The United Kingdom, with the Republic of Ireland, forms a purely insular group of territories on the eastern side of the North Atlantic. Central and South Africa may be taken to represent, on a large view, a Commonwealth island, although considerable areas are held by European powers and others are autonomous; for it is separated from the rest of the world by the oceans and by the belt of desert which extends right across the northern half of the continent.

In the area between Africa and the major territorial groups in South-East Asia and Australasia are a number of islands or virtual islands, that is to say, Aden, Perim and Socotra, Ceylon and the islands of the Indian Ocean. The South-East Asian group, comprising Malaysia, British Borneo and Hong Kong, is separated by the Dutch and Portuguese East Indies from that comprising Australia, New Zealand and the territories in New Guinea and in the Pacific Islands farther east. In all these Asiatic and Australasian parts of the Commonwealth the only continental frontiers are those of Malaya with Siam, and of Hong Kong (Kowloon) with China.

Imperial defence being the defence of the territories just described, it follows that, despite their dispersion, they must be conceived, for the purposes of waging war, as constituting together a single entity. In what sense is the term 'defence' to be applied to the various parts of that entity?

For the defence of any territory to be successful, there must come a point in the hostilities at which equilibrium has been attained and after which the enemy's scale of the balance begins to descend. This point of equilibrium corresponds not only to a moment of time but also to a notional line on the map — the line of maximum permissible enemy penetration. It is possible for the 'line of maximum penetration' to lie in rear of the territory of a belligerent if that belligerent is making war in common with one or more allies. Thus, in World War II, the Belgian and Dutch Governments can be regarded as having ultimately succeeded in the defence of their respective territories; but the line of maximum penetration lay outside Belgium and Holland and in fact was only reached on the waters

separating the continent of Europe and the United Kingdom. It is unlikely that major wars in the future will, or even can, be fought between great powers singly rather than by groups of allied powers; nevertheless no nation can be regarded as a great power or pursue a free and independent foreign policy if its defence against any potential enemy is not designed to reach equilibrium either within its own territories or on the enemy side of them. It would, for example, be possible to conceive the ultimate defence of the Commonwealth being achieved even though all its territory passed under enemy control and was subsequently regained from allied bases (situated, for instance, in the western hemisphere). However, a defence policy which contemplated the line of maximum penetration being established in rear of the major Commonwealth territories would imply the virtual abandonment of its independence.

Where a nation will draw its line of maximum penetration is not entirely a matter of free choice. It is manifestly purposeless to fix upon a line on which absolute defence is not likely to be practicable in the circumstances foreseen. We do not know how Holland and Belgium drew their lines before 1940, but it would not in fact have been open to them on rational grounds to count upon absolute defence anywhere within their own frontiers. Practicability of defence is therefore the prime consideration. Political relationships are secondary, but still important. We have therefore to inquire for what portions of the Commonwealth it is politically necessary and at the same time practically possible to aim at absolute defence. In other words, we must define on these grounds the general line on or forward of which it is intended

that enemy penetration should be absolutely denied.

No large community possessing influence over an authority responsible for defence preparations is likely to acquiesce readily in plans which exclude the whole or the greater part of the territory it inhabits from the area of absolute defence. It is obvious that Commonwealth defence preparations must, so far as practicable, aim at the absolute defence of at least the major portion of any self-governing member of the Commonwealth whose collaboration is requisite. Subject, therefore, to practicability, the line of maximum penetration must embrace most or all of the United Kingdom and of each of the self-governing Dominions.

The extent to which integration of the defence policy of the states members of the Commonwealth is achieved will profoundly influence the drawing of the line of maximum penetration for the Commonwealth as a whole. We have seen that no autonomous state is likely to accept the drawing of this line in rear of its own territories. To the extent, however, that the constituent self-governing parts of the Commonwealth conceive themselves as together forming one single unit, it may be possible, if strategic considerations strongly indicate such a course as desirable, to draw that line from the point of view of the whole and thus deliberately to accept the possible temporary loss of all or part of one of the members.

Turning now from the political to the practical factors determining the line of maximum penetration, the United Kingdom and the Dominions other than Pakistan and India are, even collectively, far inferior in manpower to their potential enemies or combinations of enemies, and this inferiority is accentuated by their geo-

graphical dispersion. They can therefore secure equilibrium only in circumstances where the effect of superior military manpower can be reduced or eliminated.

The successful negotiation in force of water obstacles even as narrow as the English Channel or the straits between Sicily and Malta is no more practicable under conditions of three-dimensional warfare without command of the air than it was under conditions of two-dimensional warfare without command of the sea. As long as this remains true — and we have seen no reason to apprehend that developments in the foreseeable future will invalidate it — then, given the necessary command of the air, defence can be secured with great economy of force on, or immediately in rear of, the line of a water obstacle. In fact, the United Kingdom and the Dominions do enjoy the protection of continuous water obstacles, with the sole exception of Canada, which marches with the United States along a great land frontier; for the Union of South Africa enjoys the protection of the water obstacle which envelops the African continent.

There is, however, an essential further condition of successful resistance, even upon the most favourable water obstacle. The industrial and economic resources to sustain the war on the line of maximum penetration must be available and must be defended either against the enemy's surface forces or against his long-range bombardment, as the case may be.

If the resources which a nation requires to maintain the struggle on or forward of its chosen line of maximum penetration are not within its control, or if the means of transporting these resources to the places where they are required cannot be commanded, that nation is as little

capable of pursuing an independent policy as it would be if the line of maximum penetration itself lay outside its own territory. To take oil as an example, then, assuming it to be an essential material of war, and assuming it to be available for Commonwealth defence only from territories controlled by the United States, Commonwealth defence itself would be dependent upon the will of America and no independent policy likely to involve the danger or threat of a resort to force could be pursued by the Commonwealth independently. Similarly, if any great power were in a position to dominate the routes by which oil, though available in the Commonwealth or in territory controlled by it, was conveyed to the places of consumption, that other great power would hold a virtual veto over Commonwealth action.

It follows that the places where the essentials for defence are produced — whether food, raw materials or manufactured articles — and the routes connecting them with the places where they are required must be included within the area for which absolute defence is aimed at. Thus it comes about that territories outside the Commonwealth may be as much the object of Imperial defence as any part of the Commonwealth itself, if they either contain essential resources or dominate the transport routes. The degree of control which it is necessary to exercise over such territories varies from case to case: in some cases the neutrality of the producing country may be left entirely untouched, if the enemy can be denied the power of interference without measures involving breach of neutrality; at the other extreme, occupation during war or even in peace-time may be indispensable.

With changes in technique and weapons the list of

essential materials and their relative importance changes. In consequence the areas both inside and outside the Commonwealth which it is essential to defend also vary. It has been a consequence of the great extent, wide dispersion and immense variety of the Commonwealth that changes in technique have found it still controlling large supplies of the vital materials of war within its own confines. Great flexibility and freedom of mind is, however, necessary in reviewing the essentials of Imperial defence, since these can be rapidly changed out of all recognition by alterations in technique which affect the type of resources demanded. For example, as a result of the development of atomic power and the exploitation of new sources of atomic energy, the whereabouts of the world's sources of vital war material and consequently the location of the Commonwealth's line of maximum penetration may within the next decade or two change radically and more than once.

At present probably the location of oil supplies outside Commonwealth territory is the most important single consideration. Unless the Commonwealth is prepared to accept dependence upon the sources of petroleum in the western hemisphere which are directly or indirectly controlled by the United States then Commonwealth defence must be based upon supplies received from the major sources in the Persian Gulf and Red Sea and in the Dutch East Indies, access to the remaining major sources, Rumania and perhaps Burma, being even more difficult. The inclusion of the Dutch East Indies, lying as they do between the South-East Asian and the Australasian groups of Commonwealth territory and being purely insular in character, imposes no intolerable extra burden upon

Commonwealth defence. On the other hand, absolute defence of the oil-fields of the Persian Gulf and Red Sea would involve acceptance of long and ill-defined strategic land frontiers, and renunciation to that extent of the economy in manpower and resources which a water obstacle affords. Any measures, therefore, which reduce the importance of the Persian Gulf to Commonwealth defence by developing alternative sources of petroleum or superseding it as an indispensable war material would represent the most important contribution to the strength of the Commonwealth.

Apart from the approaches to the Persian Gulf and to the United Kingdom, the routes, both air and sea, which connect the main groups of the Commonwealth with one another and with the essential sources of supply are oceanic. Their protection devolves rather upon the maintenance of maritime power in its new form than upon the occupation or defence of commanding land masses. Great lengths of these routes are dominated by the African continent itself; but until effective radius of aircraft action is greatly increased, it will remain necessary to secure the use of the islands of the North Atlantic (Azores, Iceland, Greenland) and of those in at least the southern part of the Indian Ocean.

To include within the line of maximum penetration the industrial and economic resources essential for successful resistance and the territories which dominate the essential routes is, of course, not sufficient, unless those resources and routes can themselves be adequately secured against the long-range bombardment of an enemy. Successful counter long-range bombardment or, in other terms, the maintenance of adequate defensive air superiority in

respect of these potential targets, is no less a condition of successful resistance than that command of the air which enables the line of maximum penetration to be held if necessary against superior surface forces. The concentration of essential industrial resources in the United Kingdom and the consequent convergence upon the United Kingdom of essential routes gives to its defence against long-range bombardment a peculiar significance which can only be diminished by a far-reaching, and therefore probably very gradual, regrouping of population and industry within the Commonwealth.

We thus arrive at a line of maximum penetration embracing a core of self-governing territories and including such further areas, whether within or without the Commonwealth, as may from time to time contain the indispensable resources of defence or command the routes by which these are transported. The successful defence of the area enclosed by this line — that is, the ultimate success of Imperial defence itself — is conditional upon command of the third dimension in two major aspects: counter long-range bombardment, and support and counter-support on a water obstacle. Outside the area thus defined there will extend to varying depths a zone within which defence, though not absolute, may nevertheless be undertaken to some degree. The outer boundary of this zone will be that line, the passage of which by an enemy is treated as a *casus belli*. It will usually include all territory within the Commonwealth — unless a hypothetical case is envisaged in which the occupation by a foreign power of a part of the Commonwealth would not be regarded as a cause for war — but will also take in large areas which lie outside the Common-

wealth. The depth of this zone is fixed at any given time by a balance between military and political factors. Militarily, the deeper the zone, the greater the likelihood of successful defence on the line of maximum penetration (should that even be reached at all) and the less the resources required for that resistance. On the other hand, operations in defence of this 'zone of partial resistance' are unsound if they diminish rather than increase the prospects of successful ultimate defence.

However great the military advantage of deepening the zone of partial defence, there is a line beyond which public opinion will not recognize the advantage as worth securing and will therefore refuse to admit a *casus belli*. Ultimate defence of the United Kingdom against Germany would no doubt have been facilitated, or the necessity for it obviated, by a war in alliance with France to prevent the re-occupation by Germany of the Rhineland in 1936; but the consequences were not sufficiently clear or direct to permit the inclusion of the Rhineland within our zone of partial resistance at that time. The events of the second half of 1938 and the first half of 1939 represented a political decision to regard Poland in the spring of 1939 but not Czechoslovakia in the autumn of 1938 as forming part of the zone of partial resistance. Failure or unwillingness of public opinion to secure a military advantage is not to be confused with actual misappreciation of where military advantage lies which is sometimes represented as political error. The attempt to defend Greece in 1941 was not a political error, since the connection between the defence of Greece and Imperial defence was real and clear and there were no countervailing political considerations; it may have been a military

error, due to overestimating the delay and loss which such an operation would impose upon the enemy and underestimating the diminution of our strength which it would involve.

Generally speaking, the deeper the zone of partial resistance with which the line of maximum penetration is surrounded, the better. Misunderstanding of the use and character of this zone has led to much misplaced criticism of British strategy. The line separating the combatants when war is declared may indeed sometimes coincide in part with the line of absolute defence; but unless the part common to both lines is of exceptional strength and defensibility, such a situation would indicate that there had been bad strategy or bad statesmanship, or both. The British policy of maintaining the balance of power in Europe has, since the decline of France during the nineteenth century, been nothing more than an expression of the determination to place a zone of partial resistance in front of the line of maximum penetration represented by the North Sea and the English Channel.

Regarded in the light of a zone of partial resistance, the geographical extent of Commonwealth territory beyond the line of maximum penetration is thus seen to be of distinct military advantage, and the aspiration enshrined in the words 'Wider still and wider shall thy bounds be set' reveals itself as strategic good sense. From whatever direction threat may come, the greater the 'depth' of the Commonwealth on that side, the better is the chance of eventually holding the line of maximum penetration. In World War II the Japanese were able to penetrate thousands of miles within the circle of the Empire without reaching a really decisive spot. Anatomically speaking,

the Commonwealth's strategic vitals need to be covered with plenty of flesh and fat. It is indeed the extension and variety of the Commonwealth, no less than the water obstacle surrounding its heart, which have enabled it to ride clear of those vicissitudes in the character of warfare and in the distribution of world power by which former empires have been reduced to insignificance.

In resources of raw materials alone we have already seen the unpredictable advantages which a wide range of territory affords; but the advantage goes much farther, and in general it may be stated as a law that the greater the extent and variety of territory which a nation possesses or commands, the less its strength is liable to suffer by changes in warfare, technique or economy.

Having now ascertained the areas to which Imperial defence relates and interpreted the term 'defence' in its application to them, we may proceed to envisage the war aims of an enemy and the course which a war might in consequence take.

All wars in which the Commonwealth is engaged are bound to be defensive; in other words, the enemy will begin the war on the offensive and therefore with specific positive objects. Even if members of the Commonwealth had not undertaken under the United Nations Charter to refrain from the use of force in their international relations, it would not be necessary to consider the case of an offensive war from the Commonwealth side. In the first place the political relation between the major parts of the Commonwealth is such as to exclude the long and deliberate preparation for rapid, concerted action which successful offensive war requires; and in the second place neither the economy nor the political structure of the Commonwealth

affords the prospect of any advantage from forcible expansion or annexation. The idea of a preventive war is sometimes entertained, and at times in the last decade voices have deplored Britain's failure to anticipate her enemies. The possibility of an Imperial preventive war is no less a mirage than that of an Imperial war of aggression. Though the former may be defensive in ultimate intention, it is offensive in form, and would therefore demand for the attainment of its object the same initial superiority based upon long planning and preparation as a purely offensive war.

Assuming then, as we must, that the enemy is the aggressor, we can deduce what must in general terms be the form of the early phases of a war. Being an aggressor, the enemy presumably plans the annexation (under whatever form) of territory or the occupation of positions. *Ex hypothesi* these objectives will lie within the Commonwealth's zone of partial resistance; otherwise war will not occur. It is less likely that they will be within the Commonwealth itself, and almost certain that they would not be inside the actual line of maximum penetration. Before a potential enemy reached the point of being able to contemplate the direct conquest and annexation of vital parts of the Commonwealth, some previous act would almost certainly have resulted in war. For example, the invasion of Poland by Germany was made a *casus belli* in 1939, well in advance of any situation arising in which Germany could have directly invaded the United Kingdom.

Accordingly the aim of the aggressor will be to complete his operations as rapidly as possible, with a view to 'localizing' the war and preventing it from becoming a general world struggle. He thereby not only achieves the

maximum concentration of force upon his immediate object, but affords himself the best chance of a peace, if only temporary, which will leave him in possession of what he has gained. Conversely, he has no true interest in directing his earliest efforts against the centres of Commonwealth power. This may be illustrated by the case of Germany in 1939 and 1940. We have already seen (p. 70) that, for very natural reasons, Germany had not seriously addressed herself to long-range bombardment warfare. But even had she been fully equipped for it, the initiation of long-range bombardment warfare against Britain and France before Poland had been conquered, or against Britain before France had been conquered, would have been the gravest error of judgment. Any chance that existed of Britain and France acquiescing, or of Britain coming to terms, would have been thrown away, and at the same time effort would have been diverted at a crucial time from the speediest possible termination of the Polish and French campaigns. It may be argued perhaps that long-range bombardment might be resorted to in this phase by an enemy through error of judgment; but in appreciating an enemy's aims as a basis for our own defence, the assumption of right judgment on his part always gives the worst case for us, while any step which he takes in error can only have the effect of reducing the real threat.

In this initial phase the superiority of the enemy in surface forces must be assumed; for it is hardly conceivable that any but a great military power would be in the position to court a war with the Commonwealth. Unless the enemy could achieve a marked superiority, he would scarcely be prepared to take the offensive, especially as

choice of time lies with him. Even with the use of extensive mobility it is totally impracticable for the Commonwealth to contemplate maintaining, or raising before the outbreak of war, sufficiently large surface forces to approach equality with such an aggressor in any part of the zone of partial resistance. To challenge and if possible to gain the mastery of the air in the theatre of operations would therefore be of outstanding importance. The enemy, seeking to expedite the success of his surface forces by every means, may be expected to devote great attention to support and anti-counter-support; and the principal form of resistance which it is likely to be practicable for the Commonwealth to offer in the threatened area will be that of support and counter-support, by which indeed, if the attack fails directly upon a water obstacle, the issue itself may well be decided.[1]

Whether the first phase succeeds or fails from the enemy's point of view, he will be likely in the next phase, having presumably still a marked superiority in surface forces, to attempt to reach and break into the line of maximum penetration with their aid. This process will be pursued until eventually, unless the war is lost, a turning-point is reached through the reduction of the enemy's strength and the increase of our own.

Throughout this second phase (if it takes this form) support and counter-support will at least retain their importance; the fact that the enemy is able to continue and intensify his threat to reach and break through the line of

[1] The definition of 'support' in chapter IV (pp. 37ff) as covering all operations related to the progress and objects of the surface campaign must throughout be borne in mind. The term should on no account be confused with 'close support' (p. 38), which forms only a small part of 'support' in the full and correct sense.

maximum penetration implies that his surface forces enjoy continued superiority and that his support forces have not been rendered ineffective. The effort required to render our own support effective and frustrate the enemy's could not conceivably be withheld. To take two cases from the corresponding phase of World War II, if the Battle of Britain, which was a counter-support victory (see p. 72) had been lost, not even the most brilliantly successful long-range bombardment directed against Germany's war economy or civilian morale could have prevented the armies in Normandy and Brittany from reaching and occupying the United Kingdom; or again, when Rommel was driving forward to the capture of the Delta, the sinking of half a dozen supply ships bound for Tobruk was worth more to the survival of the Empire than the obliteration of the whole Ploesti oil-field.

Notwithstanding, the importance of long-range bombardment will in this phase be on the increase. The struggle must from now on absorb by stages the whole resources and energy of the belligerents, and long-range bombardment will increasingly be called into play to assist in lowering the level of resources below that of requirements. The less the enemy is enabled by circumstances to derive full effect from his superiority in surface forces, the more he is likely to resort to long-range bombardment; nor is it probable that a future aggressor will have neglected, as Germany and her allies had done in 1939-40, to secure the means of superiority in long-range bombardment, as well as in surface and support operations.

The employment of long-range bombardment and of counter long-range bombardment are really inseparable; but it is possible to deduce that counter

long-range bombardment would in most cases be of relatively greater importance to Imperial defence in the period before equilibrium is ultimately reached. Until that point, the Commonwealth is likely to be working upon the whole on a narrower margin than its enemies; and it would therefore be the application of long-range bombardment to the Commonwealth which would offer the quicker return. Accordingly, from the point of view of the Commonwealth, counteracting of the enemy's long-range bombardment must in these circumstances take priority over the development of her own long-range bombardment against the enemy, though it will be recalled that counter long-range bombardment includes among its weapons the long-range bombardment of those targets which most directly bear upon the enemy's own long-range bombardment operations (p. 51).

With the final attainment of equilibrium, which implies the prospect of acquiring and progressively increasing a superiority of force over the enemy, the roles in the third-dimensional war would be inverted: while pressure upon the enemy's surface forces increases, the Commonwealth's long-range bombardment must be so strengthened and intensified that the two processes in combination produce his collapse soonest and most economically.

In this third phase and, to a lesser degree, in the preceding one, strategic geography may be of decisive influence upon long-range bombardment. The projectile, whether fired from a stationary platform or conveyed to the vicinity of the target by an aircraft, travels by the shortest route, by the 'Great Circle'. For every centre-point selected, the Great Circle map of the world presents different features. The potentialities of long-

range bombardment against a territory can best be studied by constructing a Great Circle map centred upon the long-range bombardment targets which it contains, and noting the relation to them on that map of other territories available to an enemy. The two simple factors of range and location on a Great Circle map may be decisive for a country's power to resist long-range bombardment or to crush an enemy with its assistance. The desire to surround objectives with long-range bombardment bases at effective range may influence the course of a war (by prompting the occupation of positions for this purpose) or even the policy of a nation in peace (by bringing within the zone of partial resistance or even the line of maximum penetration positions which would otherwise lie outside them). The results of studying military geography in this light can be surprising; they reveal the global dispersion of the Commonwealth rather as a source of strength than of weakness.

CHAPTER X

IMPERIAL DEFENCE POLICY

WITH the illustration in the foregoing chapter of the general form of a future conflict involving the Commonwealth, the theme of the present work finds its logical conclusion. As already stated, however (p. 117), it appears worth while to append here a brief analysis of the principles, which cannot be too widely understood, upon which the size and composition of Imperial defence forces in peace-time ought to be inferred from the character, such as that outlined in general terms in the preceding pages, of the event for which they are maintained.

These deductions must be made for the Commonwealth's armed forces and war potential as a single, indivisible entity. Throughout our examination of three-dimensional warfare we have seen that the operations of the surface forces and of those which utilize the third dimension are inseparably interlocked: neither alone can be relied upon in any likely circumstances to secure the defeat of an enemy; the possibilities of effective action by one part of the armed forces are created by the other and *vice versa*. This interdependence of the various forms of surface and third-dimensional force transcends the mere notion of co-operation on the battlefield, with which World War II has made professional and non-professional opinion familiar. The relation between the forces is that between parts of a single war machine, so that the respective roles, the importance of each, and the

proportion of the national resources to be devoted in peace and war to the maintenance of each, can only rightly be deduced from the 'shape' of the anticipated war effort as a whole.

In the past, the strength and composition of the various forces has been arrived at by a very different process. Each service, considering separately the 'worst case' for itself in a future war, has endeavoured to secure an allocation of resources to meet that threat. Since the demands thus resulting were naturally in total, or even individually, out of all relation to the resources available for defence as a whole, the claims of the services have been 'boiled down' in a process of mutual bargaining, not to say recrimination. The resultant size and composition of each has thus had no necessary relation to the shape and character of any future war envisaged or to the part which each service might be expected to play in it.

From the fact that the object of Imperial defence is not restricted to the United Kingdom — that, in other words, the line of maximum penetration includes territories under governments other than that of the United Kingdom — it follows that decisions on Imperial defence must be taken for all the major components of the Commonwealth, regarded as one unit.

There is here a grave dilemma which it is neither honest nor safe to underestimate. On the one hand, the separate responsibility of the self-governing components of the Commonwealth for their foreign relations implies that they cannot commit themselves beforehand to a defence policy which, if it is to be realistic at all, must be based on one definite view of future relations with foreign powers and therefore, in the last resort, on a single Im-

perial foreign policy. On the other hand, as long as there exists the intention and desire to defend the Commonwealth substantially as a whole, Imperial defence policy cannot be other than a single one for the entire Commonwealth.

The solution of this dilemma is a political problem, not a military one; but the consequences, if it remains unsolved, must be militarily grave, and reference to it could not therefore be omitted. It is difficult to foresee a solution without the creation of some effective and fully responsible organ of common decision and execution in matters of common concern; yet the creation of precisely such an organ appears to be precluded by the present constitutional relationship between the fully self-governing member states of the Commonwealth.

In establishing defence policy the first steps are essentially political. They consist in laying down the line of maximum penetration and the limits of the zone of partial resistance, in the sense in which these two conceptions have been defined in the preceding chapter. It is also necessary to envisage the enemy or enemies against whom defence is planned, together with their objectives and the earliest date at which conflict is anticipated. Not one of these decisions, which of course require continual review and modification, can be made by the defence services themselves. They are based upon considerations lying largely outside the military sphere, although military intelligence about the capabilities and preparations of foreign powers may contribute to the appreciation, and although it will be a military task to translate the decisions into terms of resources and armed strength required.

Unless a directive including all these elements and

endowed with the authority of the government or governments concerned is forthcoming as a basis for the calculation of defence needs, the resultant military preparations will be perforce made blindly, with the inevitable results of both waste and risk. No foresight or efficiency on the part of military planners and thinkers can relieve any government from the necessity of supplying the basic assumptions or acquit it of responsibility if those assumptions are vague and erroneous.

Taking the political assumptions indicated above, the next stage is to decide the strength and resources which, given these assumptions, it is necessary to have in existence upon the outbreak of war and, so far as is foreseeable, in the successive phases subsequent to its outbreak, in order to guarantee the line of maximum penetration and to secure the best chances of success in the zone of partial resistance. The forces necessary for the former task constitute the irreducible minimum if the object of Imperial defence is to be secured at all; if correctly estimated, therefore, they are subject to no modification or reduction.

What further forces can or ought to be provided to cover the second purpose also is a question less simply decided. Their size varies between a minimum which would yield no defence forward of the line of maximum penetration and a maximum which would give full security on the outer edge of the zone of partial resistance. Practicability rather than necessity is here the guiding consideration, and the decision, which may involve redrawing the boundaries of that zone, is partially political, since it involves the allocation of resources as between defence and other national purposes.

Without needing or being able to offer a detailed estimate of the *strengths* at which such an assessment might arrive, the general shape of the forces likely to be demanded is indicated by the conclusions of the preceding chapter. In the first place, the assessment will assume a defensive war with inferiority in land forces and possibly in the other types of armed forces necessary to ensure the rapid success of aggression. Secondly, the geographical line of maximum penetration is likely to coincide for the most part with water obstacles; and it may be anticipated that purely land frontiers will be eliminated more and more from the line of maximum penetration as the policy of locating the essential resources of war in the most defensible parts of the Commonwealth is progressively implemented. Conversely the desire to secure a line of maximum penetration along a water obstacle may influence the selection of that line, a case in which an essentially political decision may properly be influenced by military factors. Thirdly, success or failure is likely to depend in the earlier phases of the war upon securing command of the air in relation to the surface threat or threats and upon maintaining defensive air superiority in relation to long-range bombardment targets within the line of maximum penetration. As the struggle proceeds, the emphasis may be expected to shift increasingly to the securing of offensive air superiority and the intensification of long-range bombardment. On the anticipated phasing of the war (which is a matter of appreciation for any given set of assumed circumstances), the phasing of preparations is likely also to be based.

In deducing, from the forces considered necessary at the outbreak of war and in its subsequent stages, the

strength and organization of the armed forces to be maintained in peace, the chief among the factors to be applied is the time factor. The political appreciation has already specified the minimum period likely to elapse before the outbreak of war. This period is, however, not the same as that in which it should be possible to bring the permanent peace-time forces to their war strength and composition; otherwise, it would be necessary to commence expansion from the date of the appreciation itself. Thus, if the appreciation 'no war for ten years' made at the beginning of year X were still true at the beginning of year X *plus* one, preparations made during year X for a war after nine years would prove to have been superfluous. In fact, in such circumstances, no preparations can be made at all. Rather must a further political decision be taken, fixing the minimum period (we will call it the 'warning period')[1] which can be allowed for expansion before the outbreak of war.

Knowing this period, and knowing the strength and composition which is to be reached at the outbreak and at later successive stages, it is possible, by taking account of the factors which influence rate of expansion, to arrive at the correct minimum size of the defence forces during the period which ends upon the receipt of warning. Length of warning period, rate of expansion and strength of peace-time forces are related variables; the more rapid the expansion which the relevant factors permit, the shorter need be the warning period for a given size of forces, or alternatively, the less need be the amount of

[1] On the analogy of an 'air raid warning' whereby, when enemy forces cross a certain line, pre-arranged measures are automatically taken throughout a given region.

national resources devoted in peace to the maintenance of the defence forces for a given length of warning period.

It must be noted that once a warning period has been laid down as a basis for military planning, the political authorities cannot without the utmost risk shorten it or bring the estimated date of likely war forward into the warning period, except after such notice as, together with the reduced period of warning, will at least equal the warning period previously in force.

The determination of the warning period is probably the chief source of difficulty for governments and their military authorities in determining the right size of peace-time defence forces. The natural reluctance to fix a definite warning period, and the doubt whether when the time comes it will be politically expedient to announce its commencement, tend to lead the military authorities to pitch high their estimate of the forces necessary for expansion at the planned rate during the assumed period of warning.

There is no complete remedy for this difficulty, but its severity can be reduced in more ways than one. The more the curve of expansion can be steepened, the shorter need be the warning period and consequently the more imminent and obvious will be the danger of war when warning has to be given. On the other hand, by extending the zone of partial resistance, the strength essential at the outbreak of war is usually reduced and the proportion of the planned expansion which can be left until after a state of war already exists is increased.[1]

[1] The quality of intelligence available has a direct bearing upon length of warning period and size of peace-time forces; the greater the reliance which can be placed upon accurate and timely information of the military preparations and capabilities of foreign powers, the shorter the warning period and the

The factors which determine the rate of expansion are themselves complex, and differ to some extent for the different arms and branches of the armed forces. The two major groups of factors are those relating to the training of personnel and to the production of material. The rate at which personnel are capable of being trained, though obviously there is an irreducible minimum for any given duty, varies widely with the education and aptitudes of the human material. The rate can clearly also be accelerated by so organizing the permanent forces that the number of actual or potential 'trainers' which they contain is as high as possible. Industrial mobilization similarly requires a certain period, but this can be kept very short in countries highly developed industrially whose industries are planned to take account of the needs of mobilization for war.

It will thus be seen that the security of the Commonwealth can be assured with the smallest permanent defence preparations if the general standard of education and skill of the populations within the Commonwealth and the degree of industrialization in the countries which compose it is raised to the maximum. In other words, to devote national resources to education, to technical training or to the encouragement of industry is, beyond a certain point, a more direct and economical contribution to Imperial defence than to expend them in the maintenance of armed forces.

There are other advantages which accrue to the nation which minimizes its permanent defence forces and its warning period. The shorter that period and the smaller

smaller the peace-time forces which can prudently be accepted. Under this aspect, outlay of resources upon intelligence may result in great net economies.

the forces maintained in peace, the more easy it is to utilize in war the latest advances in technique. The forces with which a country goes to war if it has maintained large defence forces in peace, will certainly be obsolescent compared with those of a nation which has expanded and trained them in the shortest possible time. The equipment of standing forces can never be precisely on a level with the latest capabilities of technique and invention. The larger these forces are, the greater is the expenditure involved in their constant modernization and the greater the tendency to take risks on obsolescence.

When an important change or improvement in military technique takes place, all nations, whatever the previous strengths of their forces, are in that respect reduced to a common level. Other things being equal, the advantage goes to the nation which can in peace devote the greatest resources and attention to improving the methods and technique of war while keeping its standing forces small until the latest possible moment. Here again we come to the same kind of conclusion as was reached in considering rates of expansion. We find that Imperial defence is best assured by the highest possible level of scientific and technical attainment rather than by specific military preparations beyond a certain irreducible minimum. The greatest advances in the weapons and technique of war are not obtained in isolation but spring from general scientific progress.

The shape of the peace-time forces, designed to be raised at the estimated rate of expansion to the size and composition required for war, will not necessarily bear any resemblance to that of the forces as mobilized. We must not think of the peace-time forces as miniatures of

the war-time, nor be deluded by a catchword into expecting them to be 'balanced'. Apart from additions and modifications to secure the fulfilment of purely peace-time tasks, which are dealt with below, the sole *raison d'être* of any part of the permanent armed forces is the function which it is to perform during the 'warning period' in producing the forces needed either at the outbreak of war or in successive subsequent phases.

The realization that the opening stages of any war in which the Commonwealth is likely to be engaged must find it on the defensive should dispose of the bogy of the 'striking force of all arms', which has bedevilled defence preparations for many decades. The idea that the defence forces of the Commonwealth should as a whole be ready to take the offensive against an opponent at the outbreak of war, rests upon certain confusions of thought. It represents in the first place an erroneous deduction from the fact that wars are rarely if ever won without the offensive being at some stage assumed, overlooking the second fact that the offensive only leads to victory in conditions of general and growing superiority which the Commonwealth cannot expect in the earlier phases. The fallacy has doubtless been encouraged by a confusion between the general offensive attitude of a nation's forces as a whole and offensive operations undertaken by the component parts of those forces. There is no inconsistency in individual forces, and especially air forces, acting offensively when the armed forces as a whole are on the defensive. Indeed, those forms of defence against support and long-range bombardment which consist in offensive action by our own forces in the third dimension may well be of great importance. What is least likely in the early

phases of war is a strategic offensive including vast land forces on the old model.

The most valuable preparations made by the Commonwealth for World War II were those essentially defensive, such as the building up of the air defence forces, the evolution of early warning radar in the years 1936-37 and the design and production of the eight-gun fighter. These are the obvious preparations for defence which tipped the scales in our favour and achieved equilibrium. Our bomber forces were no less an instrument of defence than were our fighters.

It is a mistake to assume that this defensive outlook, and an accentuation of the defensive aspect in the framing of war plans and the making of war preparations, need prejudice the inculcation of the fighting spirit in the armed forces themselves. Confidence that preparations are based upon sound appreciation of the nature and order of the tasks which will have to be fulfilled in war cannot but afford the best foundation for a healthy morale in the armed forces at every level.

The idea of a premature general offensive has undoubtedly been fostered by two considerations which relate rather to the functions of defence forces in peace than in war. These are the determent of potential enemies and the encouragement of potential allies. It is correct to regard these as peaceful functions, since they seek to achieve their object without resort to war and by using the defence forces, as it were, diplomatically. It has been believed that the ability of Britain to undertake a general offensive in the early stages of a war would have the effect of deterring potential aggressors and of encouraging resistance by potential allies.

The history of the great wars in which Britain has been engaged might be expected to demonstrate to any mind open to conviction at all that the one thing which a nation risking Britain's hostility had most to dread was a long struggle in which the gradual mobilization of the resources possessed or commanded by Britain and her allies must in the end prove overwhelming. A conviction of the Commonwealth's power to defend its line of maximum penetration successfully and thereby ensure the ultimate downfall of its opponents must afford the greatest pause to a potential enemy. Accordingly, the true deterrent to the Commonwealth's potential enemies must be the defensive strength which secures to it the power of protecting and of progressively bringing into play the industrial and economic resources at its disposal or within its reach. Were it at all practicable to reinforce this deterrent effect by the threat of an early and successful general offensive, there might be a case for such a thing. In fact, any potential enemy of the Commonwealth is bound to be a power or powers commanding such overwhelming resources of military manpower that no strength which could conceivably be supported in peace-time or mobilized in the early stages of war could enable the general offensive to be taken. To contemplate land 'expeditionary forces' of a corps or two when potential enemies count their armies in hundreds of divisions, is hard not to describe as infatuation.

Turning from the attitude of a potential enemy to examine the point of view of a potential ally, we find similar considerations applying. A continental power which knows the true strength of a potential enemy and the limitations of the Commonwealth's ability to produce

and maintain surface forces is not likely to be impressed or influenced by any small accession to these forces which might be made possible at the expense of the rest, or by further burdening the national economy. After the experience of World War II, if not of World War I, no nation is likely to fall into the error of disregarding 'the big battalions' in continental warfare. It was the big battalions of Germany which overthrew France in 1940; and without the big battalions of Russia it is difficult to conceive how the Allies could have achieved the invasion of Europe in 1944 and the unconditional surrender of Germany. It is not therefore likely that land forces, on any scale which it is reasonable to expect the Commonwealth could provide at the outbreak of war, would weigh with a potential ally in accepting the risk of war. There are fortunately other ways in which the Commonwealth can inspire confidence in its power to assist its allies as well as to defend itself.

We have seen that defensive air superiority, and command of the air in all threatened sectors, are the prime essentials for the ultimate defence of what is vital to the Commonwealth. In the early phases of a war for the zone of partial resistance, in which the Commonwealth's allies must bear the brunt, the identical needs will inevitably be felt. It follows that the strength and efficiency of those very forces upon which Imperial defence must above all concentrate carries within itself the best assurance of aid which the Commonwealth can afford to a potential ally. The knowledge that Britain has the means to meet any likely challenge to the command of the air, whether by support or long-range bombardment, and that its own long-range bombardment forces are strong and capable

of steady and rapid expansion, would afford to a potential ally more just cause for confidence than the promise of any surface forces which the Commonwealth could conceivably mobilize at an early stage.

In the years before 1939 the military alliance of France (if that was our object) could have been purchased more easily by the firm assurance that Britain was equipped for dealing effectively with the *Luftwaffe* than by any promise of an 'expeditionary force'. The prospect of British naval aid has in the past not unnaturally exerted little influence over potential allies of a continental character; the likelihood of effective help in the third dimension may be expected to make a very different impression.

The foregoing arguments are based upon real strengths and capabilities and assume accurate knowledge of them by both potential enemies and potential allies. There is, however, a wide margin of uncertainty which exists or can be created; and up to the limit of what the Commonwealth's known economic resources and industrial capacity indicate as possible, the existence of forces and preparations may be successfully simulated if the object is clear and the methods effective. For purposes both of determent and of encouragement a force or capability which is believed to exist is precisely equivalent to a force or capability which does exist; and provided that the resources of deception are employed to supplement, not to replace, the essential requirements of Imperial defence, they may represent a real accession of power. Used deliberately, therefore, upon a sound consistent plan, and in due relation to real preparations, there is as great a scope for deception in peace-time as there proved to be in war, though methods may require to be different, and though

peculiar difficulties have to be encountered and overcome in the publicity demanded by parliamentary forms of government.

The armed forces and defence preparations which can be arrived at by applying the factors indicated in the present chapter to an appreciation such as that attempted in chapter IX, will require to be supplemented if they are not in themselves able to discharge the purely peace-time tasks. The scope, however, of these peace-time tasks is customarily exaggerated by including in them functions that in reality relate to war. Garrisons, for example, though maintained in peace, are maintained purely for use against an enemy, that is, in war; they differ from the remainder of the forces required upon the outbreak of war only in that, owing to remoteness or other causes, it is considered worth while to maintain them permanently in their war-time stations, and that therefore they are not at all, or only partially, available as cadres for expansion.

When requirements of this kind are eliminated, there remain only the needs of law and order which, owing to the nature and extent of the Commonwealth, are more onerous than in the case of most great powers; yet the extent to which it proves necessary on this account to modify or increase forces already sufficient for affording the required strength in war can be reduced to within very narrow limits.

To work out in theory, and to realize in practice, Imperial defence preparations on the rational principles which it has been the aim of these chapters to indicate is a task which, in the nature of things, can never be finished. Neither the political nor the military directives can be drawn up once and for all and remain immutable canons

of defence. The political and the military settings in which the defence of a nation has to be viewed are alike in a state of constant, if not always perceptible flux; and that country whose defence preparations, however adequate and appropriate at one period, are not constantly modified accordingly, runs no less risk than if it had neglected its defences altogether.

Directions in which shifts and changes in political and military circumstances will influence Imperial defence have already been alluded to. Some of these changes within the framework of the Commonwealth itself call for encouragement. One is the growth of means whereby the political and strategic unity of the Commonwealth can find expression in a unified defence policy and unified defence preparations. Another is to reduce and eventually eliminate dependence upon resources to which access either cannot be guaranteed in all likely circumstances or can be guaranteed only by extending unduly the Commonwealth's zone of absolute defence and accepting an unsatisfactory line of maximum penetration. Finally, and partly as a corollary to the other two tendencies, an increasing proportion of the war potential of the Commonwealth — human, industrial and material — will come to be located outside the United Kingdom itself. This does not (as is often supposed) necessarily imply an absolute decline in the importance of the British Isles in those respects, but only a relative increase in that of the other parts of the Commonwealth. The consequence, provided intercommunication is guaranteed, must be a general reduction in vulnerability and growth in power of resistance.

Side by side with these tendencies within the Commonwealth there will be changes, both political and military,

in the world at large. The constantly shifting relations between the strength and policies of the powers will modify the political appreciations upon which defence preparations rest: the direction and character of the threats apprehended, and the duration of the period during which war is not expected. Simultaneously, scientific and technical changes in the anticipated form of warfare will alter not only the size and nature of the forces required to counter a given threat, but also the periods required to mobilize, train and equip those forces, and thus in turn the considerations which determine the length of the warning period.

The Commonwealth must not, however, be merely a passive spectator of changes in the technique of warfare; so far, at least, as they affect Imperial defence, it must be in the forefront. Two out of many possible directions in which changes in technique may be expected to revolutionize the familiar aspect of Imperial defence have already been hinted at in these pages: one is the exercise of sea-power, and the other the infliction or prevention of long-range bombardment. In either of these respects a technical 'start' over a potential enemy might well mean the difference between survival and destruction; indeed, the Commonwealth could not have been saved in World War II unless it had been able to maintain the technical initiative in both spheres.

Success or failure in the race for technical development in peace-time has much to do with the manner in which the defence forces are organized and administered. Emphasis has throughout this book been laid upon identity or similarity of *functions*, without regard to the *service* by which one function or another has hitherto

been discharged. This emphasis should not be confused with advocacy of one or two services in place of the existing three. The factors — training is perhaps the most important of all — upon which the division of the armed forces into services and the distribution of tasks among the services depend are quite distinct from the factors which should determine the grouping of tasks for administration, development and command. Unless all the tasks which contribute to the same function are brought together for these purposes, technical advance is certain to be delayed and distorted. To take a pair of intentionally simplified examples, the bomber and the rocket projector are two methods of long-range bombardment, while the interceptor and the electronic screen are two methods of counter long-range bombardment. The development of each pair ought clearly to proceed not in competition but in co-ordination, so that at any given moment the available resources can be directed into that combination of the two which yields the most effective long-range bombardment or counter to it, as the case may be. For this purpose it is not necessary — it may well not even be desirable — that both be manned by one service; but it is certainly necessary that the unity of each function should find recognition in a single authority responsible for its development.

We are thus led to the conception of a functional 'hierarchy' as well as a service 'hierarchy'. To examine organization for the administration and command of the armed forces in peace and war forms, however, no part of the present work; it was necessary here only to point out the bearing which it may have upon the success or failure of Imperial defence preparations themselves.

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